Urban Household Water Insecurity in Ibadan, Nigeria

Samson A. Adejumo (Ph.D)

Department of Urban and Regional Planning, Faculty of Environmental design and Management University of Ibadan

Abstract: **Urban water insecurity is a growing manifestation in Nigeria and some other parts of the world. This paper considered water availability, safety of the major source, accessibility (distance) and water per capita as water security indicators. A multi-stage sampling technique was used to sample 1,069 (5.0%) household heads from 21,391 residential buildings across all residential density areas in six selected Local Government Areas (LGAs) (Ibadan North, Ibadan North-West, Ibadan South-East, Ido, Egbeda and Ona-Ara) in Ibadan. Households' main sources of water were well (65.8%); borehole (20.1%), water vendor (11.6%) and public pipe-borne water (2.5%). Majority, (75.6%) of the wells available to respondents were sited at distance less than 25 metres (WHO minimum distance recommended) to soak-away pits facilities; 53.8% households usually experienced water shortage in their wells; 62% bought borehole water, 2.4% bought well water while 1.9% bought tap water to mitigate shortage. Also, 13.6% travelled more than 1,000 metres (WHO standard) to obtain potable water; 73.1% had access to less than 20 litres water per capita. Respondents in low (4.1%), medium (5%) and high (12.7%) residential districts assessed available sources of water as bad consequently 78.8% of respondents were not satisfied with the present situation of water, demanding for improved borehole and adequate pipe- bore water. Logistic regression model showed that education level (f=0.793, p<0.05) of the respondents has significant effect on the choice of both well water and water vendors as main source of water consumed. Pearson Chi-square result indicates a significant difference in the respondents' perception of the quality of main sources of water consumed (χ^2 = 546.59, p< 0.001). Household water security was poor in all residential densities. All residential neighborhoods in Ibadan therefore need to be considered in the planning of sustainable urban water supply.**

Keywords: **Water insecurity, Households, Groundwater pollution, water shortage, Ibadan**

I. INTRODUCTION

Water is essentially a crucial factor for the survival of all living beings and the economic development of a country (Akange, 2016; Sriyalatha, 2016). It is indispensable for all socio-economic development and for maintaining healthy ecosystems (Mancosu et al., 2015). It is not only essential in the world economy but is a precondition for human, animal and plant lives, as stability of health and well-being depends on safe and adequate water supply (Ohwu and Abotutu, 2014; Adejumo, 2018). The socio-economic life of man is incomplete without adequate water. Water is an important input to achieving desired outcomes, including health and income.

Water constitutes the largest part of most living matters. Man will survive longer without food than without water (UNESCO, 2017). Water is vital from the bathroom to the kitchen, to laundry, to car wash as well as from commercial agriculture to the factory, hydropower generation and sanitation (Sridhar and Oloruntoba, 2008). Water is at the center of human existence and plays a very important role in determining health and development. There is a direct association between potable water availability and economic development. The interdependence between water availability and development is shown by the link between water and poverty. Due to poverty, access to adequate potable water and sanitation is low in Africa (Gbadegesin and Olorunfemi, 2007; Adejumo, 2018). Safe drinking water and basic sanitation are crucial to preservation of human health, especially children (Sintondji et al., 2017).

Water demand already exceeds supply in many parts of the world and, as the world population continues to rise at an extraordinary rate, many more areas are expected to experience this imbalance in the near future (USCB, 2012). Globally, water supply in right quality and quantity is grossly inadequate and particularly uneven. The average American uses 378–666 litres of water at home each day, China is using 411 litres per day, Mexico use is up to 364 litres per day whereas the average African uses about 20 litres (Singh, 2017). Nigeria is among other countries in Africa that are facing water insecurity problem. The daily per capita consumption of water in Nigeria is between 10 and 27 litres, with an average of 16 litres, which is far below the internationally-recommended minimum requirement of 115 litres (Aper and Agbehi, 2011). This shortfall in water requirement is due to differences in availability and supply. The severity of water shortage has spatial dimension, ranging from cities to regions. Urban water insecurity is a growing problem in Nigeria and some other developing countries of the world, burn out of inadequacy of public pipe-borne water. Other factors responsible for water nsecurity are growing population, agricultural irrigation, increasing domestic demand due to rising standard of living, increasing industrial demand, escalating energy consumption, mining, climate change, urbanization, deforestation, and migration of people (Singh, 2017).In some developing countries, people resulted to indiscriminate digging of shallow and deep wells to supplement their daily water needs (Shittu, 2015). Most often, the shallow wells are located near sources of pollution, the quality is rather unsafe, and dry up in dry season consequently aggravated water crisis and insecurity.

Also, indiscriminate refuse disposal, and the use of septic tanks, soak-away pits and pit latrines are on the increase and are potential sources of groundwater pollution. The pollution rate is on the increase as a result of population pressure, lack

of proper coordination of the physical developments and low commitment of government to water supply. The groundwater, common source of household water has been vulnerable to pollution putting its quality into high risk and insecure. Consequently, the household water security is threatened, reducing accessibility and timely availability of adequate safe water to satisfy basic human needs (Asare, 2004). The scarcity of water in Ibadan Region has cost some residents a lot of time and money (Adejumo, 2018). In view of the above the study examined the degree of effects of water shortage on residents, perception of people about the available quality of water and coping mechanism by residents.

II. LITERATURE REVIEW

Water insecurity is measured or determined by the amount of water available to a person within a time spent to source water which consequently has immense impact on economic productive time of such person, while the excessive distance covered could as well inflict serious pain on the health of people (Adeleye, 2014). Reasonable access to water supply is the availability of at least 20 litres per person per day from a source within one kilometre distance to the user's dwelling (WHO, 2006; Odafivwotu and Abel, 2014). There is no universal water requirement per person per day because of differences in region, body physiology, water requirement for different food preparation and seasonal factor. The average American uses 378 to 666 litres of water at home each day, whereas the average African uses about 20 litres besides drinking, water is needed for cooking, washing, bathing, sanitation, cooling and heating, water consumption varies widely from country to country and from city to city. In general, the higher the standard of living, the greater the water uses. Kuwait has the highest per capita water consumption: it had 200 litres of water consumption per person per day in the 1980s but it has gone up to 500 litres per person per day (lpd) (Singh, 2017).

Brooks and Peters (1988) estimated that water use for food preparation in wealthy regions ranges from 10 to 50 litres per person per day, with a mean of 30 litres per person per day. In a study carried out on water provided for 1.2 million people in northern California, an average of 11.5 litres per person per day was used for cooking, with an additional 15 litres used for dishwashing (Inocencio et al.,). Ohwo and Abotutu (2014) discovered in Yenagoa metropolis that the quantity of water supply was inadequate in spite of the proliferation of wells and boreholes, and the short distances to sources of major water supply; and that 29.28% of sampled respondents used below 20 litres of water per capita per day.

Efforts at enhancing effective water supply are incomplete until every citizen or inhabitant of a particular place has unrestricted access to potable and safe water (Amori and Makinde, 2012). The ease in getting to a place or obtaining a resource, good or service is critical to social well-being. This is often determined either by the distance travelled to get to a place or point to obtain a good or service and the time taken. The task of obtaining water falls largely on women and children and their journey to accomplish the task could be long, tiring and hazardous (Lee Geere et al., 2018). The effect of water scarcity could infringe on their social life, education and well-being of female children where there is severe water shortage. Some society have deprived female children right to formal education because of unmeasurable time that have to be spent on sourcing water. Ifabiyi et al., (2010) investigated the productive time spent on water supply by women in Ijumu Local Government Area of Kogi State. Most of the respondents sourced water at an average distance of 100 metres from hand-dug wells, and spent between 30 minutes and one hour before getting water. Water supply situation in the community affects the productive time of women. Alouka (2006) noted that providing physically-accessible clean water is essential for enabling women and girls to devote more time to the pursuit of education, income generation and even the construction and management of water and sanitation facilities.

UNPF (2001) reported that women in developing countries walk an average of six kilometres per day to get drinking water. The statistics vary according to countries. In Cameroun, women spend an average of six hours per day (NISC, 2004). It is about four hours in the dry season in Kenya and two hours in the wet season. Averages of 4 to 6 hours have been reported in Burkina Faso, Botswana and Ivory Coast. About 17 hours a week has been estimated for Senegal (Sriyalatha, 2016). On the impact of water fetching on the health of women in Ghana, Buor (2004) observed that quality of water, and hours spent in getting water are some of the factors influencing women's health in Kumasi, Ghana.

Rapid urbanisation is making it more challenging for governments to provide adequate piped water services (Satterwaite, 2017), particularly to the poorer communities and slum areas in urban cities. In most countries, population growth in urban centres outpaces the growth of utilities such as water supply. In the absence of piped water systems, communities in these areas meet their water needs through a combination of different sources and methods. They either access water freely from public or private protected or unprotected sources and/or purchase water from formal or informal vendors, depending on the quantity and quality of water available (Pangare and Pangare, 2008).

Whittington (1991) observed that people in Onitsha, Nigeria, obtain their water from an elaborate and well-organised water-vending system run by the private sector. About 275 tanker trucks obtained water from private boreholes and sell to households and businesses equipped with water storage facilities. Many of these households and businesses resell water by the bucket to individuals who cannot afford large storage tanks or who cannot be reached by tankers.

Olajuyigbe et al., (2012) studied water vending in FESTAC Town in Lagos State and discovered various sources of water supply by vendors, assessed their level of patronage among

households and identified the problems associated with their operations. The result showed that there are two main categories of water vending, namely formal and informal vendors. All formal vendors obtain their supplies from improved sources while most informal vendors obtain theirs from unimproved sources. Majority of the households consider vended water as a coping strategy since they are aware of the safety implications. Ishaku et al., (2010) studied water vending in three informal settlements in Yola North in Adamawa State of Nigeria. Field survey was conducted in the area with 100 observations of households in each of the three informal settlements. Findings revealed that about 92% of respondents in Sabongari-University village, 66% in Vinikilang and 87% in Wurojabbe depend on vended water from borehole, hand-dug well as well as surface water sources delivered by hand-pushed trucks.

III. STUDY AREA

Ibadan is located between Longitude $7^{0}20^{1}$E and $7^{0}40^{1}$E and Latitude $3^{0}35^{1}$N and $4^{0}10^{0}$N of western Nigeria. It measures about 145 km distance from Lagos and about 345 km southwest of Abuja, the Federal Capital of Nigeria. It is an inland city built on a ridge with latitude ranging from 150 – 275 meters (Adeniji and Ogundijo, 2009). Ibadan region is made up of eleven Local Government Areas (LGAs). Its population was estimated to be about 2,550,593 according to 2006 estimates by the National Population Commission (OYSG, 2011). It is a fast growing city, sprawling in all directions of the settlement. The human population is growing and this has resulted in continuous increase in demand for some basic infrastructures such as water, electricity, road, health care centers among others. More importantly, the demand for water has outgrown the supply resulting to persistent water shortage in the city and its environs.

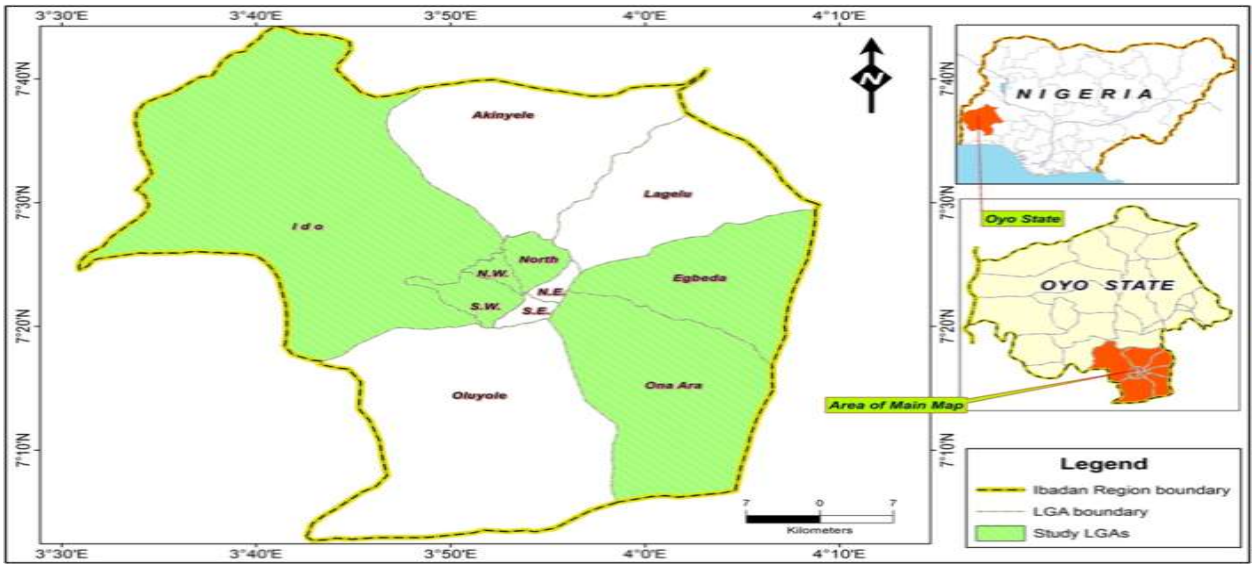

Figure 1: Map of Ibadan Region

IV. MATERIALS AND METHODS

Survey research design was adopted to collect data used for this study. Multi-stage sampling technique was employed to randomly select six Local Government Areas (LGAs) (Ibadan North, Ibadan North-West, Ibadan South-East, Ido, Egbeda and Ona-Ara) and three residential districts each (low, medium and high) from the selected LGAs. The study randomly sampled 1069 households as respondents. Structured questionnaire which consist of information on sources of water, time cost to source water, distance travelled to fetch water, quantity of water available to a household among others was administered to head of households in the selected localities. Both descriptive and inferential statistics were used to analyse the data on residential district basis.

V. RESULTS AND DISCUSSION

1) Main sources of water consumed by household

The study revealed that every household had a main source of water for domestic usages. The investigation identified four main sources (well, borehole, vendors and public piped water) of water supply to households in the study area. Majority (65.8%) of the respondents sourced water from wells. This finding validates the discoveries of earlier scholars, Sridhar et al., (2011) that majority (67.5%) of Ibadan residents depended on well water. Boreholes (public and private) provided water to 20.1% of the respondents, 11.6% depended on water vendors while the public piped water either from Eleyele or Asejire waterworks, served as the source of water to only 2.5% of the residents.

Well water has been observed as the major source of water

supply in Ibadan Region. This observation is prevalent because well water is the cheapest and most commonly available potable water to all residents. In low-density residential areas, about half of the respondents (48.6%) used well water, 74% have well as main source of water in medium-density areas while 67.1% in high-density areas solely rely on well as source of water. Furthermore, 97.8 % of the wells used by respondents were shallow wells while 2.2% were machine-dug. The machine-dug wells were mostly built by government, community associations and few individuals among the rich. About 75.6% of the wells available to respondents were sited at distance less than 25 metres (WHO minimum distance recommended) to soak-away pits which put the groundwater to pollution and contamination risk. The analysis on residential densities revealed that 69.5%, 80.3% and 72.6% of the buildings in low, medium and high density zones respectively had their wells located at distance less than 25 metres to their soak-away pits. In addition, 47.8% of wells were located down- hill to soak-away pits are grossly susceptible to pollution. Likewise the study revealed that 90.4% of the wells were ringed and covered, 5.7% were built without ring but covered while 3.9% were ringed without cover and highly susceptible to pollution.

Borehole was the next common source of water used in the study areas. This source is available in all residential districts. The identified boreholes were built by either by public or private efforts. The public boreholes are community-based water projects sponsored by either government or community associations. In low density-residential zones, 40.8% among the dwellers mainly used borehole as main source of water. Similarly, 12.1% relied on borehole in medium-density areas while 15.3% of the respondents have borehole as main source of water (Table 1). In high-density residential zone, the study discovered that majority of the respondents pay for borehole water or fetched it free from community-based borehole.

Next to borehole is water vendor as a major source of water supply in the study areas. 7.2% of the respondents in low-density residential zone regularly buy water from community-based vendors, 12.9% and 13.3% in medium and high density areas respectively bought water from vendors. Residents bought different kind of water for consumption. The study revealed that 2.4% of the respondents bought well water, 1.9% bought tap water while 62% bought borehole water. The respondents that purchased bottled water, water from tanker and sachet water were 1.9%, 3.4% and 28.3% respectively. This revelation revealed the relevance of borehole as an important source of drinking water to residents of Ibadan. The finding showed that 28.9% of the respondents in low-density residential areas rated the performance of vendors as good, 7.9% considered the service to be very good, while 28.9% rated the performance as fair.

In addition, 34.3% of residents in low-density areas assessed the activities of the water vendors as poor. In medium density areas, 50.7%, 4.0%, 29.3% and 13.3% of the respondents assessed the vendors' performance as good, very good, fair and poor respectively. In high-density areas, proportion of respondents that assessed vendors' performance as good, very good and fair were 55.6%, 10.9% and 34.8% respectively. The study revealed that largest proportion of the residents of high-density areas cherished the services of the vendors more than residents of other residential zones. This is because high-density areas suffer most from pollution and degradation, with low access roads, consequently deprives them of enjoying provision of borehole.

The public piped water serves as a main source of water to only 3.4%, 1.0% and 4.3% of respondents in low, medium and high density areas respectively. This finding revealed that the government has not given the right attention to the public piped water supply as a social need of the citizen. The alternative sources devised by residents which were meant to augment the shortfall of the public water supply have become the major sources of water to the city.

Table 1: Main sources of water

	Residential density			
Main Sources	Low 265 (%)	Medium 497 (%)	High 307 (%)	Total 1069 (%)
Well water	129(48.6)	368(74.0)	206(67.1)	703 (65.8)
Borehole	108(40.8)	60 (12.1)	47 (15.3)	215 (20.1)
Water vendor	19 (7.2)	64(12.9)	41 (13.3)	124 (11.6)
Tap water	9 (3.4)	5 (1.0)	13 (4.3)	27 (2.5)
Total	265 (100)	497 (100)	307(100)	1069(100)

Source: Field work (2018)

2) Distance Travelled From Dwelling to Main Source of Water by Respondents

Time and energy spent to fetch water by households is a function of distance covered. The study revealed that majority (61.3%) moved to a distance less than 50 metres to fetch water. As high as 15% went between 51 and 150 metres, 10.1% travelled between 151 and 1,000 metres while 13.6% travelled above 1,000 metres. These distances were within the respondents' neighbourhood and outside their neighbourhood. About 6.5% of the respondents could not determine the distance travelled to fetch water. Of all distances covered, those who travelled more than 1,000 meters from their residence to obtain water have exceeded WHO (2006) recommended distance consequently experiencing water insecurity. Going by this yardstick, the study could conclude that some households (85.4%) in Ibadan have reasonable access to water supply because the distance of households to the main source of water is below one kilometre. However, this access does not translate into effective demand because of the cost of water purchased in relation to households' disposable income. The reason for the short distances travelled is not far from indiscriminate sinking of boreholes and wells by some water merchants in the metropolis.

3) Seasonal well water shortage

The major challenges of groundwater are pollution and drought. The availability of water varies with seasons. In dry season, a greater proportion of household wells lack adequate water especially during prolonged drought**.** The study revealed that 53.8% of the respondents usually experienced water shortage in their wells while 46.2% did not have shortage of water. The latter may be enjoying location advantage. More often than not, when the location of a well is very close to a stream, the well has perennial water yield. In low-density residential areas, 44.4% experienced drought while 50.9% and 64.5% experienced same in medium and high density residential areas respectively. This indicates that there is no section of the study areas that is free from water crisis especially in dry season hence there is seasonal well water insecurity in Ibadan. This discovery is synonymous with the finding of Chia et al., (2014) in Makurdi, Nigeria where a large proportion of residents disclosed that they experienced water shortage in dry season. Respondents sourced water from elsewhere when there was water shortage during dry season. Among these were 67.7% residents who sourced water from wells in the neighbourhoods, 23.9% bought water from vendors, 5.2% fetched water from boreholes within the neighbourhoods, 1.5% used commercial water tankers while 1.7% fetched from streams. This is a clear manifestation of water shortage and insecurity in the study areas. Residents spent uncomfortable amount of time and energy to source water from alternative sources.

4) Water per capita per person per day

There is no common understanding of the minimum per capita fresh water requirement for human health as well as economic and social development. The World Health Organisation (WHO), in its guidelines for drinking-water quality, assumes an adult requires approximately two litres of drinking water per day, although it acknowledges that water intake per person can vary significantly (UNDP, 2006). The per capita water per day varies with season, region, age, occupation and social status. Type of toilet facility determines the amount of water required for sanitation. The study revealed that 96%, 61% and 48.2% individual person in a household in high, medium and low residential areas respectively had access to less than 20 litres of water per day. Similarly, 2.6%, 31.9% and 47.2% individuals had access to quantity of water between 20 and 49 litres in high, medium and low residential areas respectively. Also, 0.8%, 6.9% and 4.6% individual persons in a household in high, medium and low density residential areas respectively used between 50 and 100 litres per day. The study revealed that residents in high-density areas had access to the least quantity of water while the residents in low-density areas had access to highest quantity of water. This revelation showed inequality and spatial variation in the amount of water available to residents in the study areas.

From the entire study area, majority (73.1%) of the respondents had access to less than 20 litres of water per day. While 23.4% had access to quantity of water between 20 and 49 litres, only 3.5% had access to between 50 and 100 litres. This discovery showed a shortfall from WHO recommended water per capita per person. The water supply situation in Ibadan showed that majority of the residents have access below the recommendation of Gleick (1996) that basic water requirement of 25 litres per person per day of clean water for drinking and sanitation should be provided by water agencies or governments. This discovery revealed that there is water insecurity in the study areas.

Table 2: Quantity of water available to a person per day

Quantity	Residential density			
	Low (%)	Medium (%)	High (%)	Total (%)
<20 litres	145(48.2)	85(61.3)	450(96.6)	789(73.1)
20-49 litres	142(47.2)	96(31.8)	12(2.6)	250(23.4)
50-100 litres	14(4.6)	21 (6.9)	4(0.8)	37(3.5)
Total	301(100)	302(100)	466(100)	1069(100)

Source: Field work (2018)

5) Respondent's perception of the quality of the main source of water used by household

The research obtained the respondent's perception on the quality of main source of water available to the households. Essentially, the respondents were requested to assess the physical characteristics of the main source of water used for cooking or drinking. The assessment was based on the colour, taste and odour of the water. Respondents therefore rated water as good or bad based on the physical attributes such as smell, taste, and colour. When the water had smell, taste and colour, such water was regarded as bad. Where those physical attributes were considered favourable, the water was rated good.

It is noteworthy that some sampled respondents (7%) assessed main source of water available to their households as bad while majority (77%), appraised the main water available as good (Table 3). This revelation is synonymous to the finding of Egbinola and Amanambu (2014) in a study carried out in Ibadan to determine the groundwater quality where only 11% of the respondents felt that their water was polluted. A total 15.2% of the respondents failed to assess the available water probably because it was difficult for them to identify the physical attributes of the water.

Furthermore, the analysis of the respondents' assessment of the main source of water available to the household on residential densities showed that 61.5%, 88% and 75.2% of the respondents who appraised the main source of water were living in low, medium and high residential districts respectively, and they assessed the water as good. On the other hand, 4.1%, 5% and 12.7% of the respondents sampled in low, medium and high residential districts respectively assessed the main sources of water available as bad.

Table 3: Respondents' perception of the quality of water

Variables	Residential density			
	Low (%)	Medium (%)	High (%)	Total (%)
No response	91(34.4)	35(7.0)	37(12.1)	163(15.2)
Bad	11(4.1)	25(5.0)	39(12.7)	75(7.0)
Good	163(61.5)	437(88)	231(75.2)	831(77.7)
Total	265(100)	497(100)	307 (100)	1069 (100)

Source: Field work (2018)

6) Coping Mechanism by Residents

Some of the residents were conscious of need to drink safe water. This is evident in the findings of the study as 34.8% of the respondents purified their drinking water. The purification was required because some households depended solely on either rain or well water. Some of them had to purify the water before consumption.

Table 4: Water Purification by Households

Variables	Residential density			
	Low (%)	Medium (%)	High (%)	Total (%)
Yes	73(27.5)	176(35.4)	123(40.1)	372(34.8)
No	192(72.5)	321(64.6)	184(59.9)	697(65.2)
Total	265(100)	497(100)	307(100)	1069(100)

Source: Field work (2018)

The finding revealed different methods used by respondents to purify water. As high as 39.0% of the respondents used water-guard and salt to purify and preserve rain water. Similarly, 30.4% added alum to clean drinking water while 20.7% added chlorine to their water before drinking. Other respondents used some other methods such as straining (2.4%), filtering (8.3%) and boiling (13.4%). The residential analysis of the water purification device by residents revealed (Table 2) that 42.3% and 24.4% of residents in high-density areas add alum and water guard/salt respectively to their water. In medium-density areas, 31.8% and 40.3% used alum and water-guard/salt respectively to purify water. In low-density zones, 35%, 26.0% and 15.6% of the residents used chlorine, water guard/salt and filtering methods respectively to clean their water. These discoveries revealed that water available to residents was not secure and respondents in all residential areas were aware that poor quality water is harmful to their health. Therefore, they made personal efforts to keep their drinking water clean since the public water was not available in most of the areas in Ibadan. In addition, the quality assurance of available water was not guaranteed despite that individual household made extra efforts to purify the water to make it fit for consumption.

Table 4: Means of purification of water

Variables	Residential density			
	Low (%)	Medium (%)	High (%)	Total (%)
Straining	3(4.1)	3(1.7)	3(2.4)	9(2.4)
Filtering	11(15.1)	11(6.3)	9(7.3)	31(8.3)
Adding Alum	5 (6.8)	56(31.8)	52(42.3)	113(30.4)
Boiling	9(12.3)	26(14.8)	15(12.2)	50(13.4)
Water guard /salt	19(26.0)	71(40.3)	30(24.4)	120(32.3)
Chlorine	26(35.7)	9(5.1)	14(11.4)	49(13.2)
Total	73(100)	176(100)	123(100)	372(100)

Source: Field work (2018)

Chi-square test on respondents' perception of water quality

The study investigates whether perception of respondents of the quality of the main sources of water differed significantly with the main source of water available. Chi-square test was applied on the responses. The Pearson Chi-square result indicates a significant difference in the respondents' perception of the quality of main sources of water consumed ($\chi^{2} = 546.59$, $p < 0.001$).

Table 5: Chi-square Test on Respondents' Perception of Water Quality

Quality of water	Main source of water consumed in the household				Chi-square (χ^2)
	Well water n=703 (%)	Borehole n=215 (%)	Vendors n=124 (%)	Tap n=27 (%)	
Bad	52(7.4)	16(7.4)	6(4.8)	1(3.7)	546.586[a]
Good	638(90.8)	71(33.1)	118(95.2)	4(14.8)	df = 6
No response	13(1.8)	128(59.5)	0(0.0)	22(81.5)	p > 0.000*

** Significant at 0.05*

7) Respondent's preference for alternative sources of water supply

The study discovered that the available sources of water were not satisfactory to some respondents. Majority, 78.8% of respondents were not satisfied with the present sources of water. This revelation showed that largest proportion of Ibadan residents was not satisfied with the water supply situation. Many of the respondents preferred alternative sources of water. Above half (57.0%) of the respondents wanted borehole water powered with solar energy, 34.1% demanded adequate provision of public pipe water, while 6.3% were comfortable with regular supply of rain water The revelation in this section implies that water available to the respondents is not secure both in quality and quantity. This in adequacy has precipitated the quest for alternative sources of water.

VI. CONCLUSION AND RECOMMENDATION

Water insecurity is endemic in Nigerian cities with its uncalculated impacts on human, social and economic development of the nation. The time spent to search for portable water in urban centers consequently has immense impact on economic time of such person, commonly women and female children while the excessive distance cover as well inflict serious pain on the health of people. The provision of the public water by government has grossly failed to meet the daily water needs of people in Nigerian rural and urban centres. The situation has degenerated so much that individual has devised several alternatives sources of water to meet their daily water requirement.

Several alternative sources of water have been identified by this study without quality assurance. The alternative sources to the public pipe- borne water include well, rain, borehole and water vendor supply of which most of them are not reliable especially in dry season. Past and present studies have identified well water has the most commonly used source of water in Ibadan. A significant proportion of respondents (13.6%) travelled above 1,000 metres (WHO minimum standard) making water accessibility difficult. More than half of the wells suffer water shortage in dry season while over 60% are located in high density areas. During dry season, about 68% of the victims sourced well water from wells within their neighbourhoods while others resulted to purchase water from commercial vendors. Majority (73.1%) of the total respondents had access to less than 20 litres (WHO minimum standard) of water per day. The per capita water per day varies with season, region, age, occupation and social status. There was variation in the water per capita per day in the study areas. The study revealed that 96%, 61% and 48.2% individual person in a household in high, medium and low residential areas respectively had access to less than 20 litres of water per day.

The quality of water available to residents is of importance to the social well-being of the people. Respondents therefore rated water as good or bad based on the physical attributes such as smell, taste, and colour of available water. Some of the respondents rated their water as poor and insecure. The findings revealed that about 35% of the respondents purified the available water for consumption. Some of the respondents used water-guard, salt to purify and preserve rain water, added alum and chlorine to their water before drinking. These discoveries reliably revealed that water available to residents was not secure and respondents in all residential areas were aware that poor quality water is harmful to their health. Majority, 78.8% of respondents were not satisfied with the present sources and quality of water. This revelation showed that largest proportion of Ibadan residents was not satisfied with the water supply situation.

The study therefore encourage the government agency responsible for water supply to be sincerely discharge their responsibility to enhance water security in major urban areas. This requires management of water resources that are available, which include surface and groundwater resources, management of water supply, demand and water use for sustainable development.

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