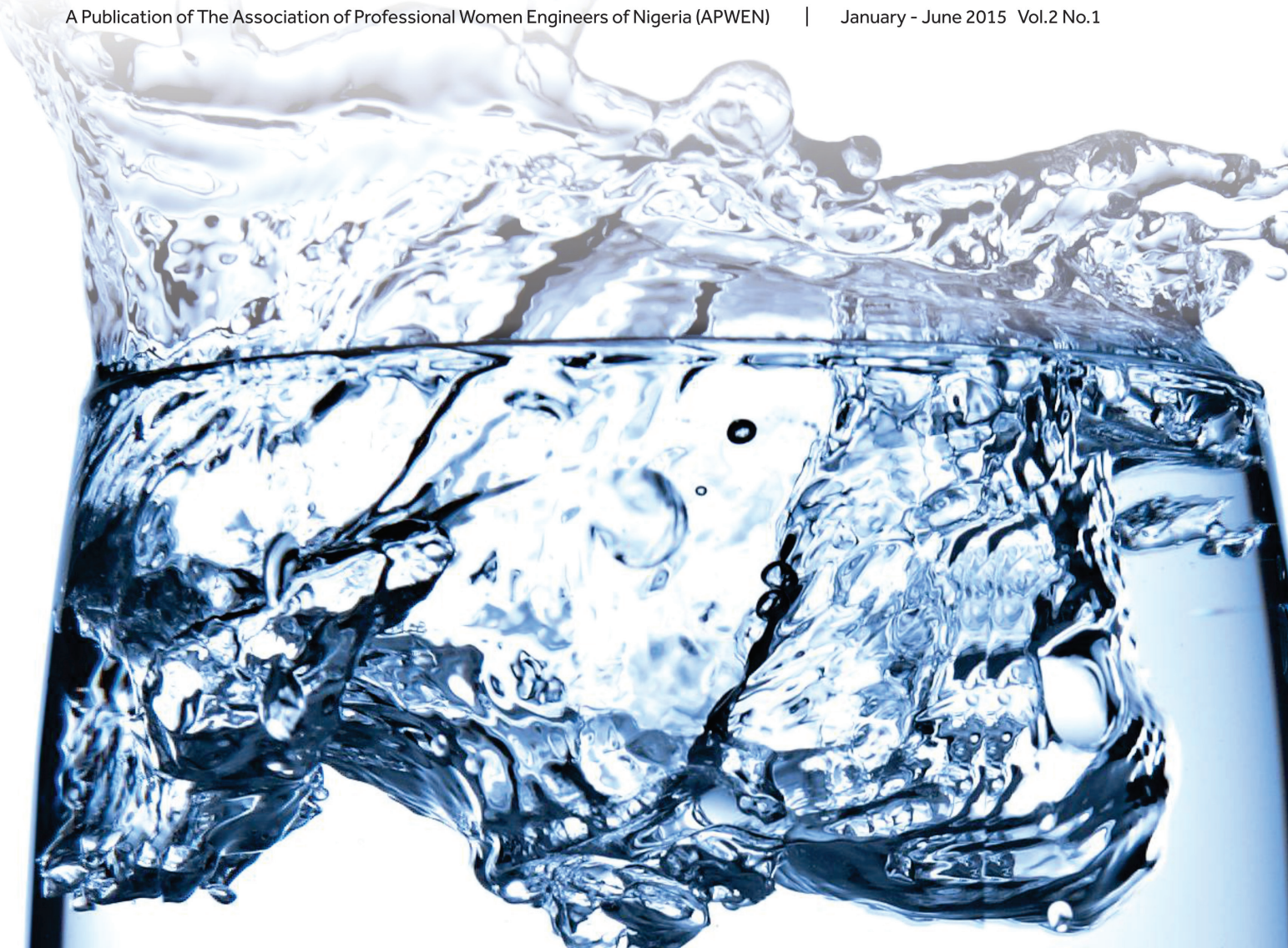


# JOURNAL OF ENGINEERING, SCIENCE AND TECHNOLOGY

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# Foreword

APWEN's 2015 focus on Power and Water Engineering has stimulated extensive intellectual discourse and has evolved a number of project proposals to create positive change and progress for the economic development of Nigeria. In the final year for the achievement of the Millennium Development Goals (MDGs), engineers, scientists and technologists are challenged to live up to their calling and create products, services and process that will improve the quality of life for all.

This edition of **APWEN Journal of Engineering, Science and Technology** features three papers written and presented by women engineers of high repute. Authors are:

**Engr. Busari Ayobami MNSE**, a Lecturer at the Covenant University Canaan Land, Ota and Civil Engineer. She is an APWEN member, COREN registered engineer and in a Ph.D. programme at Covenant University. Her paper titled, **'Water Withdrawal Trends, Cost and Uses in Ota, Ogun State, Nigeria'**, assessed the water resource availability, access, water withdrawal trends, and presents the outcome of a survey of water use pattern in a semi-urban settlement.

**Engr. Uchenwa Nebiem Ujam FNSE**, a Principal Lecturer, Electrical/Electronic Engineering Department, Institute of Management And Technology (IMT), Enugu. Engr. Ujam is a seasoned practitioner and a Fellow of the Nigerian Society of Engineers (NSE). She has held several elective positions in APWEN & NSE and has to her credit a number of published articles and books. Her paper titled **'Digital Television Broadcasting; A Must New Technology for Nigeria'**, brings to the fore the deadline set by the International Telecommunication Union, ITU for the all broadcasting stations in the world to go digital. The paper further elucidates actions Nigeria must take to achieve cutover by the 2017 deadline.

APWEN President **Engr. Nnoli Akpedeye FNSE** & National Technical Secretary **Engr. Dr. Christy Ijagbemi MNSE** co-authored a flagship paper – **'APWEN in Society: Driving Socio-Economic Development in Power and Water Engineering'**. This paper written by two sought-after orators and doyens of the engineering profession highlights the roles and importance of women in the power and water supply sectors.

**APWEN Journal of Engineering, Science and Technology**, a bi-annual publication designed to showcase engineering solutions to the myriad of technological challenges confronting the nation. It is the contribution of Female Engineers to the on-going discussion to change in the Nigeria project.

The Association's yearly conference holds from 16th to 18th September in Warri, Delta State, with the theme **Appropriate Technologies For Provision Of Potable Water And Reliable Power Systems In Nigeria**. Attendees are expected from Nigeria, Ghana, South Africa, United Kingdom, USA and Cameroon to provide worldwide discussions, knowledge sharing and networking. Visit [ww.apwen.org](http://ww.apwen.org) and follow us on twitter - @apwennational - for details.

The Editorial Team



# Water Withdrawal Trends, Cost and Uses in Ota, Ogun State, Nigeria



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## Abstract

Water is an essential component of life. Globally, there is a drawback in its availability and this is increasing and duplicating itself thereby intensifying the struggle for scarce water resources. This study assessed the water resource availability, access, water withdrawal trends, and presents the outcome of a survey of water use pattern in a semi-urban settlement in Southwest Nigeria. The study employed the use of a detailed questionnaire and oral interview for the collection of data. The water use pattern extends to various water consumers such as residential, institutional, commercial and industrial. The collected data were analyzed using descriptive statistics. The results showed that 70% of the settlement depend on groundwater alone, while 30% on surface water. The findings in the study revealed that the rate of patronizing commercial water seller is very high compared to the government approved tariff rate of 66.7% price margin, and there is an increasing demand on water from the various settlements considered. The outcome will enable better investment and management decisions in water withdrawal and usage in the near future as this must be based on estimates of future needs and the available resource potentials.

**Keywords:** Water demand, Water resources, Cost of water, Water withdrawal, Water usage.

## Introduction

In Nigeria, water management is a big challenge and effective solution has not been developed. UN-Water Thematic Initiatives, 2006 states that water use has been growing at more than twice the rate of population increase in the last century. Although there is no global water scarcity as such, however, an increasing number of regions are chronically short of water. The same research showed that by 2025, 1.8 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions. The situation will be exacerbated as rapidly growing urban areas place heavy pressure on neighboring water resources. Recently, it was noticed that the supply for this scarce water resources in many places is intense and there is an incomplete picture of the water resources of the country. It was stated by UNESCO in 2006, that the world is not "running out of water," but it is not always available when and where people need it. Fewer than 10 countries possess 60% of the world's available fresh water supply. Nigeria has about 200 dams of various capacities holding more than 12 billion cubic meters of water for regulated use in water supply, irrigation and hydro-power generation where applicable (Maduabuchi, 2004). About 85% of the large-scale dam projects are concentrated in the Northern and Central areas of the country that are prone to periodic drought (Maduabuchi, 2004). It was observed that since independence, many water supply schemes have been and are still being commissioned to satisfy political promises and aspirations without resources maintenance consideration (Olukanni and Ugwu, 2013; Ajibade, 2004).

Viessman and Hammer (2005), claim that in Mining operations water use includes water for the extraction of naturally occurring minerals; solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. The same author also assessed the amount of water used in the production of electricity. The principal use of water in electricity generating facilities is for cooling and to dissipate rejected heat. The amount of cooling water withdrawn depends on the plant size, generator thermal efficiency, and cooling heat transfer efficiency. Parker et al. (2008) analyzed the different factors which influence the rate of demand for water viz: Climatic condition, cost of water, presence of industries, policy of metering and charging, and quality of water use.

As a measure to reduce the daily shortage of water especially in most of our urban centers, attention has been shifted to open dug wells for groundwater resources (Olukanni and Ugwu, 2013). For centuries, aquifers have thought to be one of the veritable and sometimes the major reliable source of potable water resources in many nations of the world but this is not always true in all cases. The deeper the aquifer, the better its water quality is expected to be. Besides, maintenance of groundwater resources is a must to every home that consumes water (Gbadebo and Akinhanmi, 2010). This study assessed the water withdrawal trends and uses in a semi urban settlement in Southwest Nigeria in order to investigate the trend in public water supply system by determining the source of water, investigate the major purposes for which water is put to use and determining the cost of getting water.

## MATERIALS AND METHOD

### Description of Study Area

This study was done in Ota, Ogun State, Southwest Nigeria. The municipality covers an area of 885 square kilometers with an average density of 372 persons per square kilometer and lies between latitude 6° 58' N and longitude 6° 42' E. Figure 1 shows the map of Ota and the selected locations for data capture. The Ado-Odo/Ota Local

Government Area is one of the 20 Local Government Areas (LGAs) of the State. It has an estimated population number of 527,242 with 261,523 males and 265,719 females. The municipality shares neighborhood with the commercial city of Lagos State thus hosting majority of the population spill over from the densely populated commercial city of Lagos. The LGA is the second largest in Ogun State and having about four hundred and fifty (450) towns, villages and settlements.

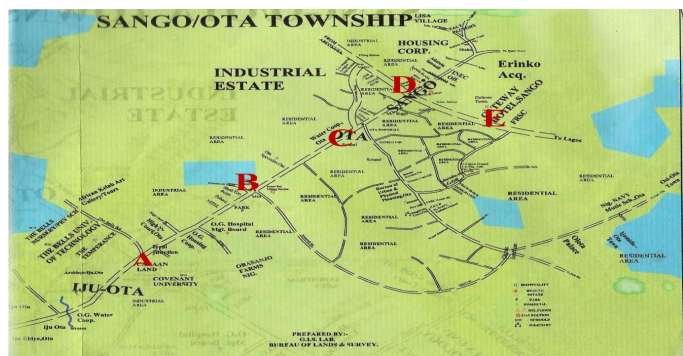


Figure 1: shows the map of Ota and the selected locations for data capture.

Source: Olukanni et al., 2014.

## Nature and Sources of Data

The study made use of structured questionnaires in addition to in-depth interviews and on-site observations in capturing the information on water withdrawal, water demand and usage of the respondents in the study area. The study is both quantitative and descriptive with field works that assessed social cultural and economic factors influencing semi-urban dwellers in Southwest-Nigeria. The responses of this study were transformed to quantitative measurable variables. It takes into account housing typology which comprises parameters such as average household's income, size of households, water rate and usage pattern and number of subscribers to drinking water system. The secondary data on the other hand, was made of official statistics, data on water withdrawal trends and uses from Ogun State Water Corporation.

## Design Approach/Sampling Procedure

The questionnaires were administered to randomly selected respondents spread across five strategic zones of the city in an attempt to assess their most common source of drinking water. The questionnaires were administered using the face-to-face method and the analysis was based on persons aged 18 years and older. These persons were considered to undertake decisions relatively independently. The information gathered include the following: Demand for water, Withdrawal methods, Cost of water and so on.

## Method of Data Analysis

The data and responses in the forms were collated after which it was analyzed and expressed in percentages. Statistical tables were used to analyze the data.

## Results and Discussion

### Sources of Water

The result of the data obtained from the questionnaire showed the sources of water. The following locations as represented on the map of Ota in Figure 1 are respectively listed below:

- Location A (Iyesi Junction)
- Location B (Oju-ore Junction)
- Location C (Water Corporation)
- Location D (Sango)

### e. Location E (Gateway Hotel)

The study reveals that more people rely on groundwater sources for their water needs. The highest percentage of the respondents that depend on ground water is from the Sango, Oju-ore and Water cooperation axis. This is because it is readily available commercially either from water tanker sellers or stand post water sellers (Figure 2).

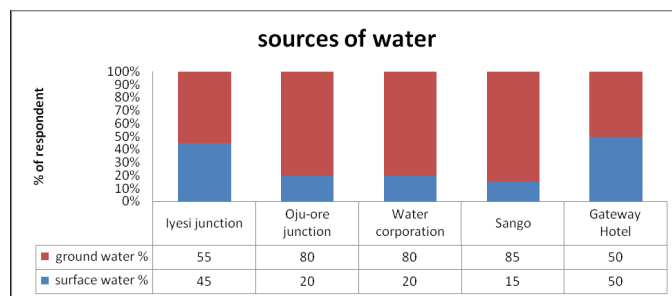


Figure 2: Sources of water in Ota

## Water Withdrawal Methods

The methods of water withdrawal are the house connection, stand post, and direct withdrawal from well. The house connection is used for borehole and water produced by water corporation. It is an example of an improved water supply system where pipes are fitted in certain places in the house such as the kitchen, bathroom etc. it is the most convenient method of water withdrawal because water withdrawn is not transported over a long distance. The stand post is used by those that sell water in the neighborhood and it is usually stationed outside a house which allows other people to get water from the water supply system (Plate 1). The distribution of these water withdrawal methods in the various zones are shown in Figure 3. Direct withdrawal from the well has the lowest percentage compared to some few decades ago when it was the most adopted withdrawal method. Most respondents avoid this distribution method because it is slow, not hygienic and energetic. Due to civilization, majority of the households now adopts the other withdrawal method. Stand post method is highly patronized at Sango (70%) while the house connection method is widely used in Gateway Hotel zone.

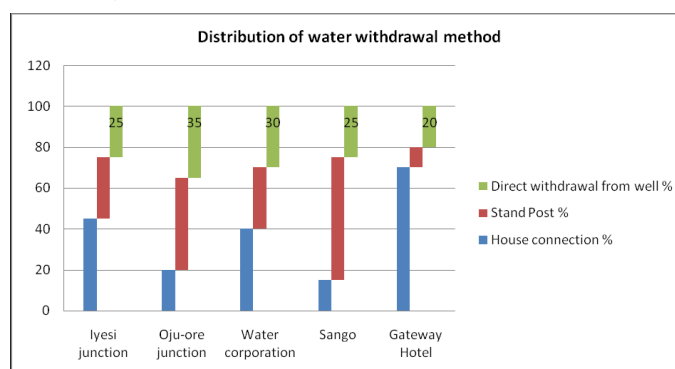


Figure 3: Distribution of water withdrawal method



Plate 1: Shows a stand post at Ota  
Source: Olukanni et al. (2014).

## Usage of Water in the Different Zones

The use of water in this geographical region ranges from the use of water for domestic uses such as water used for bathing, washing, cooking etc. Commercial uses of water in this area are water used in car wash, block molding industries, restaurants etc. Industrial uses such as water used in manufacturing, cooling of plants etc. and the use of water for firefighting. Figure 4 shows the distribution of these uses in the zones. Generally, the use of water for domestic uses rank as the highest from these data. In all zones considered, domestic water uses is high because of the first need of man which is the physiological need. The highest percentage of industrial water use is noticed in the industrialized zone of Ota.

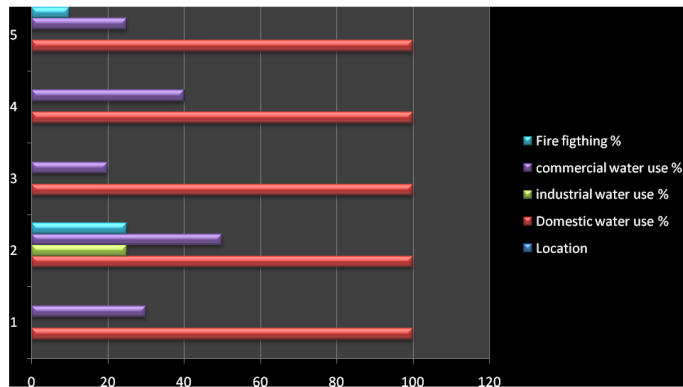


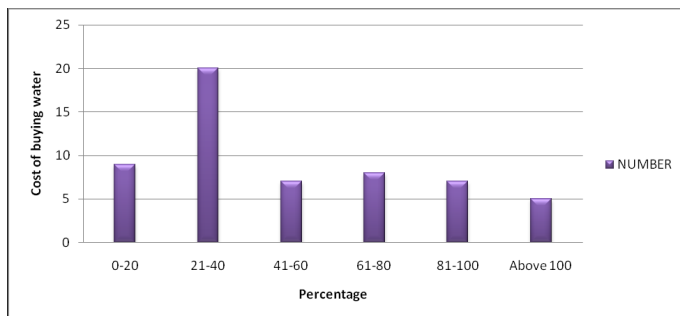
Figure 4: Uses of water in Ota.

## Cost of Water in Ota.

The amount individuals are willing to pay for water supply from individual sources. Result reveals that only 8.93% of the sample size pays above N100 per day for water. It was gathered that in Ota, 25litres container is sold for N10 that is a liter of water is sold for:

$$\frac{N10}{25 \text{ litres}} = N0.40 / \text{litre} \quad \text{----- (1)}$$

Figure 5: Cost of buying water



As shown in Figure 5, it has been established that most of the respondent buy water from individual majorly for their domestic activities. Gateway axis has the highest percentage of respondent that buy water from individual while water corporation zone has the lowest. This can be explained with the fact that the availability of Public (government) water supply reduces the demand for commercial water. It can be buttressed with the fact that 20% of the respondent in that axis patronize commercial water seller's compared to lyesi and other zones where public water supply are

not available. Those that withdraw water from stand post are those that buy water from selected areas on the street.

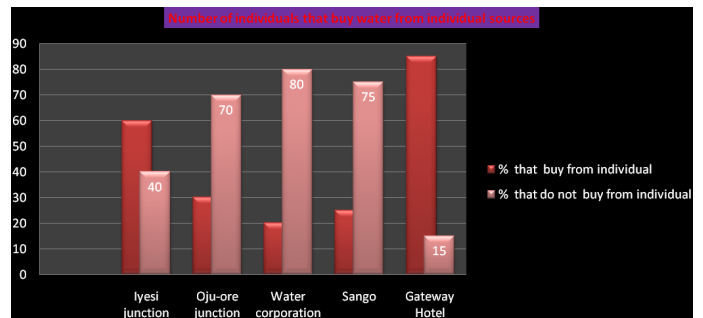


Figure 6: Percentage distribution of water purchase

Figure 6 shows the percentage of respondents that buy water as well as those that do not buy water in relation to their location. At Iyesi, 60% do not buy water while 40% buy water, at Oju-ore, 30% do not buy water while 70% buy water, at Water Corporation, 20% do not buy water while 80% buy water. At Sango, 25% do not buy water while 75% buy water and at Gateway Hotel, 85% do not buy water while 15 % buy water. It is revealed that the percentage that buys water is more than those that do not buy water. The cost of water based on the government tariff varies from type of settlement to the uses of water.

## Comparative Assessment of Commercial Water Rate and Water Corporation Approved Tariff.

From this study, most domestic water users patronize private commercial sellers. The comparative assessment of the approved tariff rate of government Water Corporation and private commercial seller show that the rate at which private commercial water seller sells water to both domestic and industrial user is very high. According to World Health Organization (WHO) and World Bank, most Nigerians live on a dollar per day and considering the exorbitant amount spent on water especially for industrial use is alarming. As a developing nation, there is a need for the populace to have access to portable water because it is one of nature's abundant resources which is inevitable for living. Most respondent patronize this water sellers because of proximity and availability which the government water supply lacks. Table 1 shows the water tariff rate for the last decade and the commercial rate.

Also, due to the poor maintenance culture of the country, most of the government water pipes, tanks and stands are faulty. There is a need for the government to invest in this sector so as to make living more comfortable because water is part of daily life since it is the next to air in ranking. From Table 2, the minimum water usage for commercial activities is hairdressing which is 6000 liters per month while the highest commercial usage of water is for recycling and installation. This commercial activity involves a very large volume of water as can be seen in Table 1. Most firms either dig borehole or patronize commercial (water tankers) which is at a rate of N15, 000 per tanker. This cost includes the cost of transportation. Hence, there is a need for the government to put in place an effective and efficient water supply scheme to meet up with this high water demand.

Table 1: Comparative Assessment of Government Water Tariff Rate, Commercial Water Seller Rate and the minimum water usage

Type of customers	1999	2004	2010	Commercial rate	Fixed Rate	Minimum
INDUSTRIAL CUSTOMERS	Price per 1000 ltr (N)	Price per 1000 ltr (N)	Price per 1000 ltr (N)	1000 ltr (N)	(MONTHLY) (N)	Usage (Monthly) In Liters
Large/Heavy industry	100	25	100	15,000	61200	600,000LT
Medium Industry	100	100	15,000	30750	300,000LT	
Low industry	100	3000	1000	15,000	8000	75,000LT
Block industry	25	3600	15,000	4800	36,000LT	
COMMERCIAL CUSTOMERS	15,000					
Highly commercial	100	25	100	15,000	61200	600,000LT
Recycling and installation	80,000	100	1200	15,000	101,200	1,000,000 LT
Petrol station	1000	3000	1500	15,000	2250	51,000LT
Car Wash	3000	4000	15,000	4750	42,000LT	
Pure Water	2000	350	100	15,000	21200	21,000LT

Note: Figures in Italics depicts the monthly Government tariff rate

For domestic purpose, the average rate of N1000 naira per month is being charged to the residents. Residents living in mansion have the highest rate due to the more facilities in the buildings. The minimum water usage for domestic activities is 1200 Liters (Table 2) which is at a rate of N150 using the government tariff. The percentage difference for 1200 Litres is

$$\frac{\text{Government rate}}{\text{Commercial rate (water tanker seller)}} \times 100$$

----- equation 2

$$\frac{120}{18,000} \times 100$$

----- equation 3

= 66.7%

### Commercial Stand Post/Water Seller

This was calculated using the minimum water usage rate from Ogun State Water Corporation for domestic purpose. This is placed at 1200 liters. The respondent revealed that they purchase water at the rate of 40k per litre.

$$\frac{\text{Government rate}}{\text{Commercial rate (standpost tanker seller)}} \times 100$$

----- equation 4

$$\frac{120}{40 \times 1200} \times 100$$

----- equation 5

= 25%

It is expected that government should be able to meet up with the expected water demand of the nation in abid to reduce the unnecessary dependence on commercial source of water thereby alleviating poverty.

Table 2: Domestic Customers

Type of customers	1999	2004	2010	commercial rate per 1000ltr (N)	Stand post seller (N)	Fixed rate (N)	Minimum usage
Building with self-contain	400	120	1000	15000	4000	250	1200
Face to face	100	700	1800	15000	4000	250	1200
Flats	600	600	600	15000	4000	600	1200
Estates	1000	1000	15000	4000			1200
Mansion	3000	3000	3500	15000	250	1200	

Table 3 shows the minimum water usage for recreational activities. The result shows that the minimum water required monthly for recreational purpose is 9000 liters. Stadium accounts for the highest water used for recreational purpose. This cost much when purchased from commercial sellers.

Table 3: Recreational Facilities

Type of customers	1999	2004	2010	commercial rate per 1000 (N)	Fixed Rate (N)	Minimum usage
Private Fountain	1000	6000	1500	15000	1,750	15000LT
Swimming Pool	5000	25000	7500	15000	7750	30000LT
Religious Centre	500	900	500	15000	1400	9000LT
Public toilet	2000	1000	900	15000	2500	21000LT
Horticulture	10000	2000	15000	1200	24000LT	
Stadium	25000	25000	15000	1200	180000LT	

### Time Required in Getting to the Source of Water.

The time spent in getting water from the stand post in relation to the number of respondents that spend the specified time is as shown in Figure 7. The time required to access commercial water post is lesser compared to government water post which is always far due to the zoning culture adopted. There is a need for the government to bring government water post close to residents.

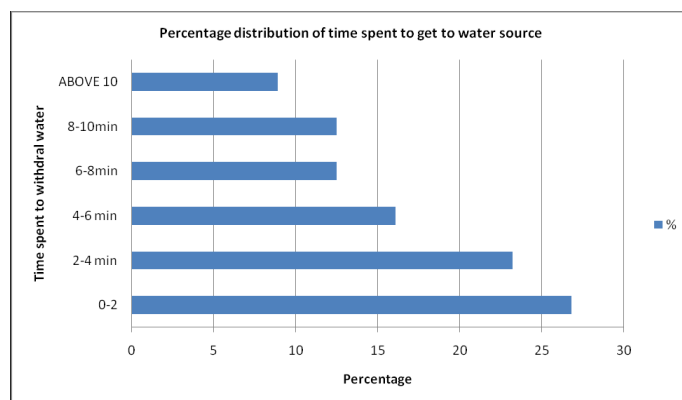


Figure 7: Percentage distribution of time spent to get to water source



## Conclusion

Generally, the use of water for domestic purpose ranked the highest from this study. It has been established that most of the respondent buy water from individual sellers, majorly for their domestic activities. The average daily cost of buying water commercially is between N21 to N 40 per day which is high for the poor or low income earners. Most respondent patronize this commercial water sellers because of proximity and availability which the government water supply could not provide. The water business has therefore grown in the urban areas of Ogun State due to the population growth and inadequate public water supply to cater for the growth in population. The percentage difference between government water tariff rate and commercial (tanker water seller) is 66.6% while stand post is 25% higher than the government tariff. Stand post and house connection accounts for the most predominant water withdrawal method.

## Recommendation

There is a drawback in water availability and an increase in its demand from the various settlements considered; hence Government should put in place an effective and adequate water supply scheme and structure to meet up with the minimum water demand. This will reduce the over dependence on commercial water seller. There is a need for the government to bring government water post close to residents. Also, constant maintenance work on the structures should be taken as priority and these structures should be redesign when it does not meet the expected water demand of the community.

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