Analysis of Households' Water Access and Consumption in Differential Urban Neighbourhoods of Osogbo, Nigeria

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Abstract

The study focused on scrutinizing the sources and consumption patterns of domestic water supply in Osogbo, with an emphasis on households' socio-economic characteristics. Data were collected from three deliberately chosen residential neighborhoods representing low, medium, and high-density areas, with a cumulative population of 134,159 and an estimated 26,829 households. Employing a multistage sampling technique, 25% of streets in each neighborhood were randomly selected, and systematic sampling was utilized to distribute 268 structured questionnaires (1% of households) to gather information. Descriptive analyses, such as means and percentages, were employed to scrutinize socio-economic characteristics and water consumption patterns. The study also utilized inferential statistics, specifically Multiple Analysis of Variance (MANOVA), to assess the impact of residential densities and water sources on water consumption volume. Results highlighted hand-dug wells (46%), public taps (22.4%), and boreholes (15.7%) as the predominant water sources. MANOVA revealed a statistically significant influence of residential densities and water sources on water consumption volume ($p=0.049$). In low-density areas, households consumed an average of 960 liters per day, compared to 735 and 517.5 liters in medium- and high-density areas, respectively. Across Osogbo, the average household consumed 664.7 liters daily. Correlation analysis indicated a positive and statistically significant relationship between resident population and water consumption ($p<0.05$). The study concluded by emphasizing the pivotal roles of government, communities, NGOs, and individuals in addressing water provision challenges in the area.

Keywords: Households, water consumption, public health, water supply, residential density

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Introduction

Water is a basic necessity required for both improvement in the standard of living and production purposes. Provision of water in both urban and rural areas is crucial for development considering its importance for domestic use, livestock consumption, irrigation and industrial use. Apart from air, water is the next important resource to human beings (Utsev and Aho, 2012). Water has been described as a daily necessity and a key factor in human health and well being (Ibrahim *et al*., 2018). The survival and continued well being of human and animal lives depend on the supply of potable water of the right quality and quantity.

Water is essential for the day-to-day human activities and has a decisive influence on the population of any geographic space. The rational use of water constitutes the greatest challenge faced by water resource governing body and the government, mainly with regards to the efficient and adequate supply to urban households.

Man requires water for different uses such as drinking, cooking, general sanitation, agriculture, and manufacturing processes among others. It is universally accepted that an adequate water supply is required for personal hygiene, public health and the general well being of an environment (Adedotun & Fakayode, 2014). The quality of life in urban areas is obviously determined by the availability and functionality of utilities and services. The overriding objective of any settlement policy should be to make water available to those who need it in the quality and quantity it is needed.

The social-economic life of a man is not complete in the absence of water; as a result of this, man has been struggling to make sure water is never out of his reach (Ufoegbune *et al.*, 2011). It is obvious that the volume and quality of water available to a population will determine the health status of the inhabitants. Hence, public health officials often place a premium on efficient

and effective water supply in sufficient quantity and quality. Also, almost all productive activities require water at varying levels. Goal six of the sustainable development goals emphasise clean water and sanitation, which is at the very core of sustainable development and critical to the survival of humankind, especially in the face of the COVID-19 pandemic, which continues to ravage humanity.

Boretti and Rosa (2019) states that clean water scarcity is a major issue in today's world of 7.7 billion people. Access to water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to water and there is a clear correlation between access to water and gross domestic product per capita. However, some observers have estimated that by 2025, more than half of the world population will be facing water-based vulnerability and a report issued in November 2009 says that by 2030, water demand will exceed supply by 50% in some developing countries (WHO, 2010). The 2018 edition of the United Nations World Water Development Report reinforced the assertion by stating that by 2050, more than half of the global population (57%) will live in areas that suffer water scarcity at least one month each year and that the decline of water resources and water quality may be much harder to control due to population growth, economic development and changing consumption patterns (UNESCO World Water Assessment Programme, 2018).

The effort of the Nigerian government to make water available for her citizens dates back to the colonial period when the Public Works Department (PWD) and the native administration water schemes were responsible for water supply. Owing to the economic depression of the 1930s, planning and funding of water supply schemes were seriously affected. Hence, only cities with financial capability were considered in the provision of water supply schemes (Akpen, 2005). In the year 2000, the National Water Supply Policy (NWSP) was formulated to ensure the

provision of sufficient potable water to all Nigerians in an affordable and sustainable way. The agency was to achieve her aim through participatory investment by the three tiers of the government, the private sector and the beneficiary with the basic target of extending service coverage to 100% of the country's population by the year 2011. It was also meant to sustain 100% coverage for the expanding population beyond 2011.

FGN (2011) reported that by 2011, the supply coverage was assessed at 58%, representing 87 million people, while close to half of the population did not have adequate access to potable water supply. This implies that the policy fell short of its target. As the standard of living in a society improves, there will be an increase in demand for water (Unesco.org. 2021). Drakopoulos (2021) reports that Nigeria is making some progress in improving access to water, sanitation and hygiene (WASH) with 70 percent of Nigerians having access to basic drinking water services. The volume and quality of water for individual use is still lower than the required standard; the average amount of water each person receives in Nigeria is 9 litres per day according to the report. While water consumption varies from person to person and household-to-household, the minimum acceptable range is between 12 and 16 litres per person per day according to national standards. With the increasing population, there is need to increase the volume of water available to the urban populace especially with the incidence of COVID-19 pandemic which requires compulsory access to sufficient water to fulfil the sanitation requirements necessary to prevent infection.

On satisfaction with the quality of water supplied, Abebaw *et al*. (2010) stated that households that get their drinking water from an improved source have a higher probability of being satisfied with water quality than one that gets their water from an unimproved source. The study also reported that household's socioeconomic and location characteristics determine satisfaction;

for instance, households with educated heads are significantly less satisfied with the quality of water available for drinking than households with less literate heads.

The benefit of adequate accessibility to water supply cannot be disregarded because of the socio-economic impacts since water is used for a variety of productive uses and generating important sources of income (cash and non-cash) for households. Favourable access to water supply combined with better development of water sources may enable women to use saved time for other ventures, creating new sources of income for the household (Nwankwoala, 2006).

Studies have focussed on the factors affecting water supply and accessibility in human settlements, especially urban areas. These studies identified factors such as lack of knowledge about the finite nature of water, its scarcity and cost, the impact of deforestation and land degradation on the quantity and quality of water; inadequate capacity building, neglect of traditional knowledge bases, gender issues, fragmentation of water resources management, and weak institutional frameworks (Sharma *et al*. 1996). Other factors identified to affect the supply of water have to do with aging infrastructure and interrupted flows (Beukman, 2002) and inefficient organisation (WHO, 1994). Fan *et al.* (2013) reported that *per capita* domestic water consumption per day correlates significantly with water supply patterns and vegetable garden areas in rural households in the Wei River Basin, China. The study identified hygiene habits, use of water appliances, and preference for vegetable gardening as the dominant behaviours in the villages with access to improved water supply. The study recommended emphasis on user lifestyles and cultural backgrounds in formulating water management schemes. This view agrees with the submission of Akintola and Areola (2006) that wealth status should be an important factor to reckon with while estimating the required volume of water in human settlements. It is

obvious that increase in demand for water is also determined by the socio-economic status of people in the urban area.

Despite global efforts to identify the factors responsible for domestic water supply, those related to factors influencing access to water supply and volume of water consumption in urban centres were not thoroughly studied in the study area focussed on in this research work. The specific objectives of the study are: examine sources of households' domestic water supply; examine volume of households 'water consumption across different neighbourhoods of the city under study and elucidate on the availability of water demanded in the neighbourhoods.

Furthermore, two research hypotheses were raised to further establish the influence of residential neighbourhoods and sources of water on the volume of water consumption in the study areas. Those residential density neighbourhoods have no influence on the volume of water consumption for different domestic purposes. Also, population has no influence on the volume of domestic water consumption for different purposes.

The paper, therefore, analyses access and volume of water consumption in the study area in order to ensure availability and sustainable management of water and sanitation for the residents. This is with the view to offering policy suggestions for effective urban water supply and consumption.

Study Area

The study area is Osogbo, the capital city of Osun State in the South west of Nigeria. The city spread across three Local Government Areas (Osogbo, Olorunda and Egbedoore). It is located within latitude 7^0 46'N, longitude 4^0 34' east and latitude 7^0 767^1N and 4 $^o567^1$ east of the Greenwich meridian with 47 square kilometres area of land (Figure 1 and 2). It is located at

almost equal distance from Ile-Ife (48km), Ilesa (32km), Iwo (46km), Ila-Orangun (46km) and Ikire (48km). It is bounded in the East by Ilesa, in the West by Iwo and Ede, in the South by Ile-Ife and in the North by Ikirun and Iragbiji. The study area is about 88 kilometers by road Northeast of Ibadan, the defunct regional headquarters of southwestern Nigeria. It is situated on an extensive undulating plain that lies within the Yoruba upland regions. The landscape is dissected by many rivers principal of which are Osun, Okoko and Erinle (Adedotun, 2015).

The city had a population of about 287,156 people, based on the 2006 census with land area of about 47 square kilometres. Osogbo has been a major zonal centre in the western region of Nigeria since the colonial period. The city became a commercial centre with the arrival of railway in 1907, which brought the colonial government of then to the threshold of the town (Adedotun, 2015). The choice of Osogbo for this study is not unconnected with administrative, economic and educational functions the city performs. The city serves as the state capital (Osun) and the headquarters of two Local Governments. The city hosts a University (Osun State University) and many other institutions. These activities resulted in the unprecedented upsurge of the city population that has consequential effects on the demand for utilities, water in particular.

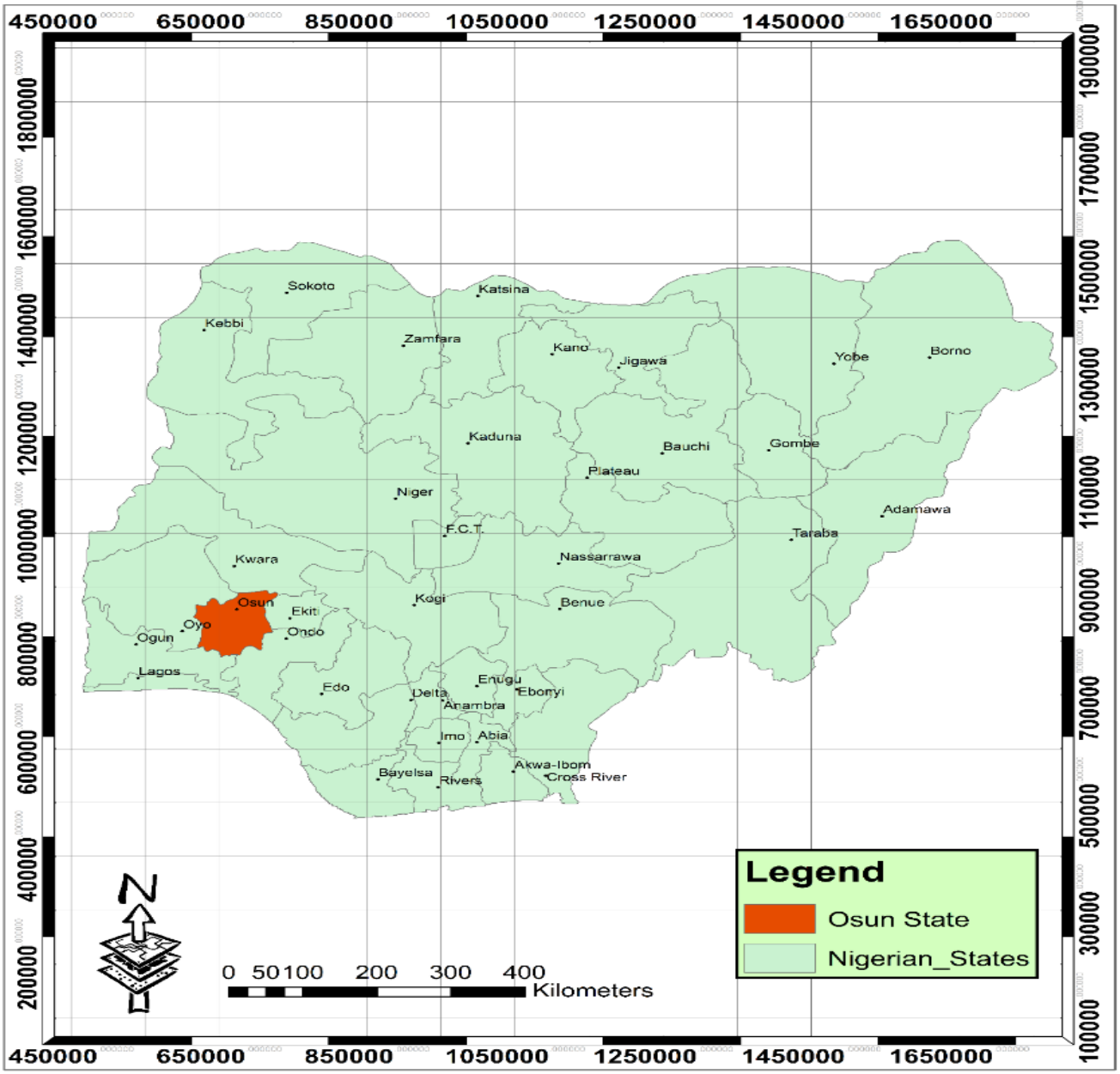

Figure 1: Osun State within Nigeria

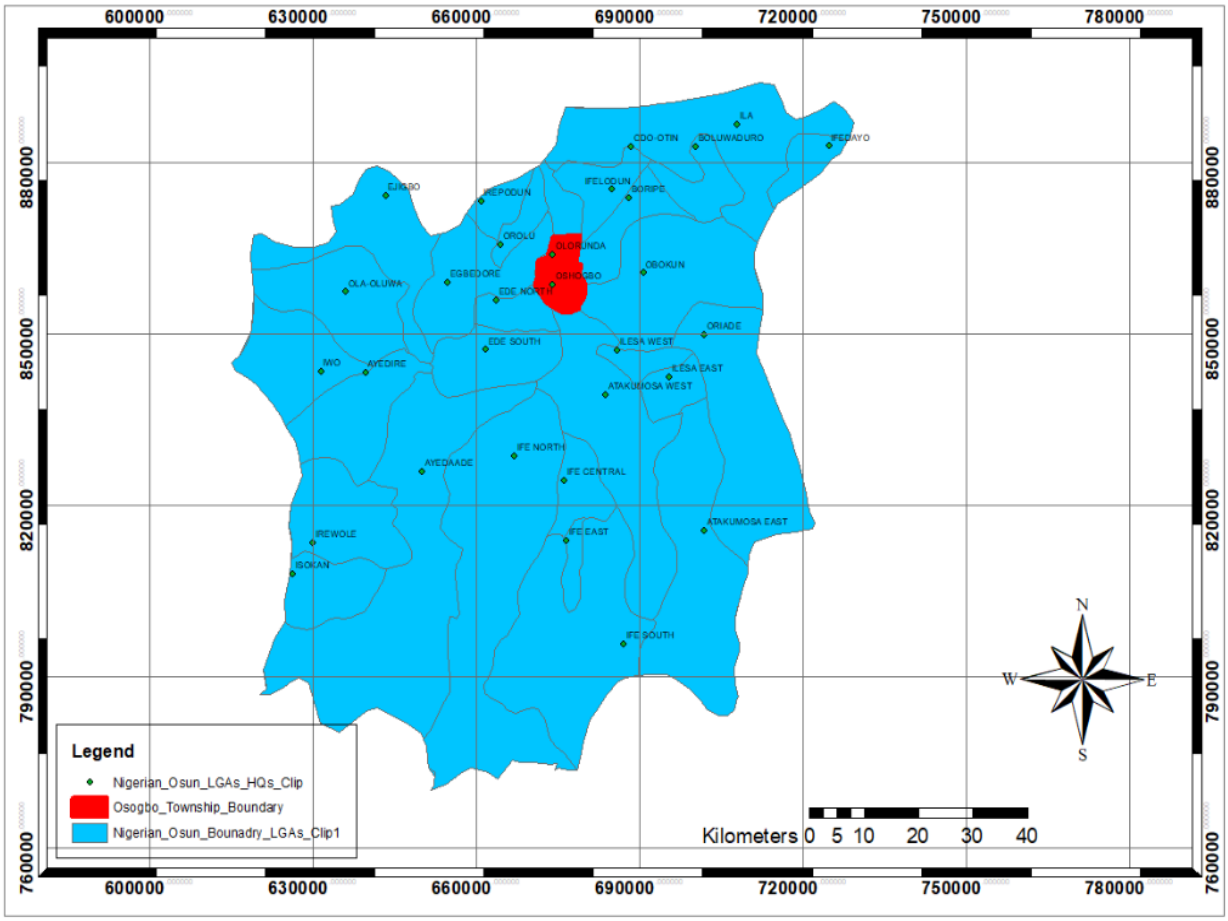

Figure 2: Osogbo within Osun State

Methodology

Households' socio-economic characteristics, sources of water supply and volume of water consumption were the data used in the study. There were two sources of data: primary and secondary sources. The primary source of data was the households across different neighbourhood density areas of Osogbo. Data on households' volume of water consumption and sources were elicited from the respondents using a structured questionnaire and focused group discussion. Respondents were asked to report their sources of water and volume of water consumption within the last one week to the date of the survey to ascertain their average volume

of water consumption per day in litres. The study was conducted within the month of July for a period of one week.

The estimated household population of the selected neighbourhoods was 26,829 based on the estimation that the average household size in the urban area was 5 as assumed by Adedotun, et al. (2017) and Solanke (2005). This serves as the sample frame for the study. However, considering the skilled research assistants needed, time factor and financial constraints, one percent (1%) of the households were surveyed in the study. This sample size is also based on the statistical belief that where a small sample is selected randomly from a large population, the result will always give a true representation of the area. Similarly, previous research (Adedotun *et al*. 2017; Aluko, 1996; Arimah and Adinnu, 1995) utilized 1% in their studies. While less than 1% was utilized by Olokesusi (1994) and Havlicek (1985). Table 1 shows the population characteristics of selected neighbourhoods and the sample size for the survey.

Random samples were taken from all the residential densities of the city: high (146), medium (62) and low (60). In all two hundred and sixty-eight households were surveyed which was one percent (1%) of the households in the selected neighbourhoods (Figure 3) across various residential densities in the study area (Table 1). Two hundred and sixty-eight (268) copies of questionnaires were administered across the three major residential density areas in the city-low, medium and high. The first part of the questionnaire sought information about the socio-economic characteristic of the respondents such as; age, gender, marital status, income, education, occupation, household size and other related variables while the second part acquired information about sources of water supply, volume of water consumption by households and quantity water demanded by the households in the study area. The quantity of water supplies and

consumed was determined using 20 litre buckets where the respondents did not have a water tank.

In each of the residential density areas surveyed, the numbers of streets were identified and a random selection made. On each of the streets, a systematic random sampling technique was employed to select one housing unit in every 10^{th} building. In each of the housing units selected, only one head of household was selected for questionnaire administration. On the other hand, women and children who are mostly engaged in search of water in the study area were involved in focus group discussions in each of the density areas. Independent variables of investigation in this study are sources of water supply (hand dug well, borehole, pipe born water, water vendor and rain harvest) and density areas (high, medium and low). The volume of water consumed by the households represents the dependent variables. The data generated were summarised using frequency distribution tables, percentages and means. Multiple Analyses of Variance (MANOVA) was used to investigate the influence of residential densities and sources of water on the volume of water consumed across different residential densities. Also, Pearson Product Moment Correlation was used to examine the influence of population on the volume of water consumed for various domestic purposes.

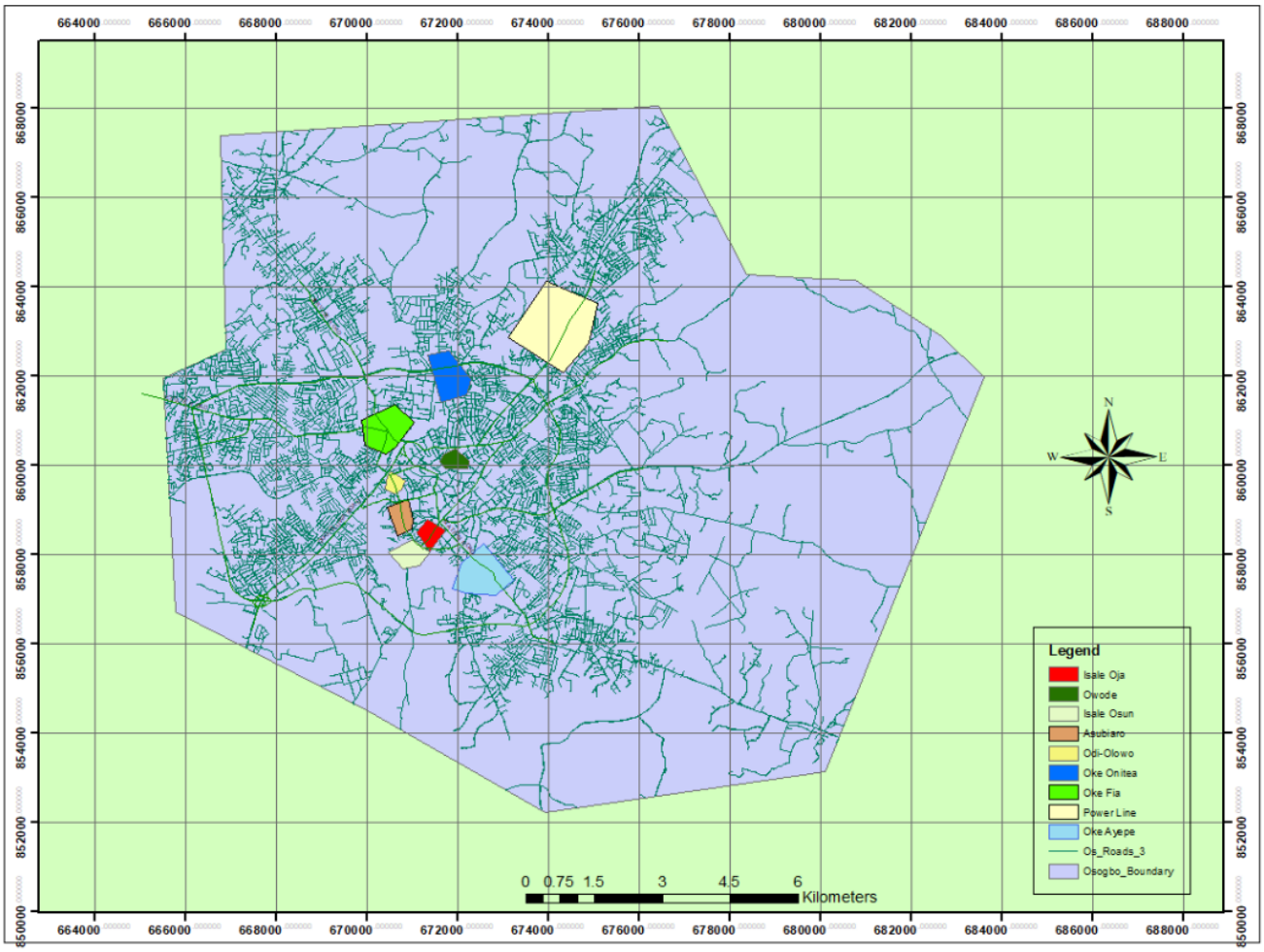

Figure 3: Selected neighbourhoods in the study area

Table 1: Population and Sample size of selected neighbourhoods

Low density	Neighbourhoods	1991 Population	Estimated 2018 Population	Estimated Households	Household Sample size
1	Power Line	2,871	6,721	1,344	13
2	Oke Ayepe	2,958	6,925	1,385	14
3	Oke Fia	7,001	16,389	3,277	32
	Total	12,830	30,035	6,006	60
Medium density					
4	Oke Onitea	4,633	10,846	2,169	22
5	Odi Olowo	3,547	8,304	1,660	17
6	Asubiaro	5,005	11,717	2,343	23
	Total	13,185	30,867	6,173	62
High density					
7	Isale Osun	17,336	38,763	7,752	77
8	Owode	4,010	9,387	1,877	19
9	Isale Oja	10,725	25,107	5,021	50
	Total	32,069	73,257	14,651	146
	Ground Total	58,084	134,159	26,829	268

Source: Fieldwork, 2018

Results and Discussion

Socio-economic attributes of respondents

Analysis of the data, as contained in Table 2, reveals that 52% of the respondents were females, while the remaining 48% were males. The higher percentage of female respondents is a reflection of women's involvement in the search for water and in the usage of water for domestic purposes. This conforms to the findings of Akoteyon (2019) on factors affecting household access to water supply in residential areas of Lagos metropolis, Nigeria. A good number of household heads also preferred that their women respond to the questionnaire since the research centred on water consumption, hence the variation in the gender of the respondents. Furthermore, 30.7% of the respondents were in the age bracket of 20-30 years, 28.1% were in

the age of 31-40 years and 22.1% and 19% of the respondents between the age of 41-50 years and above 50 years respectively. Persons within the age group of 20-30 years participate in household domestic activities, which involve the fetching of water and watching of household utensils, more than other age groups hence the information from them is reliable.

The study shows that 26.6% of the respondents were single, 54.8% were married while the remaining 9.6% are widow, separated or divorced. It is obvious that married persons require more water than single ones. An inquiry into the educational status of respondents shows that 12.5% of the respondents had primary education, 15.2% had secondary education, and 62.4% of the respondents had tertiary education while 9.9% of the respondents had no formal education. Occupationally, a significant number of the respondents were civil servants, 40.7% followed by traders with 19%. Osogbo, the study area is an administrative city being the state capital and seat of the headquarters of two local government councils, hence the justification for the high number of civil servants in the sample. Another socio-economic characteristic considered in this study is the monthly income of the respondents. The study shows that 53.6% of the respondents earned between N10,000 -50,000 per month, 36.2% earned N 51,000–100,000 per month while the remaining 10.2% earned above N 100,000 per month. The study shows that a significant proportion of the respondents are low-income earners, which is another socio-economic characteristic that may affect source and volume of water consumption (Table 2). The study also examined the household size of respondents in the study area, which also influences the volume of water consumption. The study revealed that 51% of the respondents have the household size of between 1 and 6 while the remaining 49% have the household size of 7 and above (Table 2).

Table 2: Socio-economic characteristics of respondents

Variables	Percentage (%)
Gender	
Male	48
Female	52
Age	
20-30 years	30.8
31-40 years	28.1
41-50 years	22.1
51years and above	19
Marital status	
Single	26.6
Married	54.8
Educational level	
Primary	12.5
Secondary	15.2
Tertiary	62.4
No formal education	9.9
Occupation	
Retirees	11
Artisans	5.3
Civil Servants	40.7
Trading	19
Farming	6.8
Students	17.1
Monthly Income	
₦10, 000-50,000	53.6
₦51, 000-100,000	36.2
> ₦100, 000	10.2
Household size	
1-3	08
4-6	43
7-9	31
Above 9	18

Source: Fieldwork, 2018

Sources of Households' Domestic Water Supply

This study investigates residential densities and analysis of sources of water supply in the study area for households' domestic use. The survey reveals different sources of water supply to the households across residential densities in Osogbo. Table 3 reveals that 46% of the respondents

depended on hand-dug well for their source of water unlike the study of Akoteyon (2019) in Lagos where pipped water was the main source of water supply. The Table also shows that 22.8%, 15.7%, 9% and 6.5% depend on the following sources of water; public tap water, borehole, rainwater and water vendors respectively. The analysis further reveals that respondents in the low-density areas i.e., the high-income earners mostly depended on borehole and public tap water (63.6%) as their main sources of water.

On the other hand, most of the people in the high-density areas that are also low-income earners depended on the hand-dug well for their source of water (61.3%). In the medium density area, 35% depended on hand-dug well while another 31.6% depended on public tap water. It is obvious from Table 3 that variation exists in the source of water across the households in different residential density areas of Osogbo.

Table 3 Residential densities and water sources

	Water Sources					
Density	Hand dug well	Bore Hole	Public Tap	Water Vendor	Rain Water	Total
Low Density	11	21	16	7	3	58
	19%	36%	27.6%	12.1%	5.2%	22.0%
Medium Density	21	9	19	5	6	60
	35%	15%	31.6%	8.3%	10%	22.8%
High Density	89	11	25	5	15	145
	61.3%	7.5%	17.2%	3.4%	10.3%	55.1%
Total	121	41	60	17	24	263
	46.0%	15.7%	22.8%	6.5%	9%	100

Source: Author's Field Work, 2018

Households' Volume of Water Consumption

Table 4 indicates volume of water used for various domestic purposes in the study area. Domestic use of water considered in this study is drinking, sanitation, cooking, bathing, and gardening. The essence is to establish which of the domestic uses of water take precedence over

others to guide policy makers in formulating water policy. The table reveals that 4.9% of the domestic water are used for drinking purpose across the study neighbourhoods, 36.78% for sanitation purpose, 28.13% for cooking, while 20.91 % and 9.21% are for bathing and gardening respectively.

Drinking: Study shows that a household across the neighbourhoods studied consume average of 33 litres of water for drinking per day. In the low-density residential area a household, drink 25 litres of water per day, in the medium density area household drink 30 litres of water per day while in the high-density area a household drink 37.5 litres of water per day. The variation in the volume of water consumed for drinking in the different neighbourhood density areas may not be unconnected with the household size that is relatively high in the high-density area couple with high concentration of population and activities.

Sanitation: The field survey shows that significant volume of water consumed (36.78%) is used for sanitation. This involves water used in toilet, watching of plates, clothes, and floors. The study further reveals that a household in the low-density area use an average of 350 litres of water for sanitation compared to medium and high-density areas where an household use 250 and 200 litres of water respectively for sanitation exercise. Respondents in the low-density area use more water for sanitation; this could be accounted for by the availability of regular supply of water from boreholes that dominate the area. Across the neighbourhoods, a household consumed an average of 244.5 litres of water for sanitation.

Cooking: The study also examined volume of water used for cooking in Osogbo. Table 4 shows that 28.13% of domestic water in the city was used for cooking. Furthermore, a household consumed an average of 187 litres of water for cooking across the neighbourhoods. A household in the low and medium density areas use above city average in water consumption for cooking.

Bathing: The study reveals that 20.91% of domestic water in Osogbo was used for bathing. As revealed in table 4, a household used an average of 139 litres of water for bathing in the city of Osogbo. High-income earners that dwell in the low-density area of the city used more water (225 litres) to bathe unlike the low-income earners occupying the high-density areas where a household used an average of 100 litres of domestic water for same purpose.

Gardening: The study also considered domestic water used in maintaining the garden in the respondents' compound. Table 4 shows that only 9.21% of the domestic water was used for gardening in the city. In addition, 61.22 litres of domestic water were used on gardening per day. The use of domestic water for gardening is dominant in the low-density area with an average of 125 litres per household per day. On the other hand, 75 and 30 litres of water were used for gardening purpose in the medium and high-density areas respectively.

The field survey reveals that households in the low-density area consumed more water for domestic purposes with a household using an average of 960 litres of water per day, while, a household in the medium and high-density areas utilised 735 and 517.5 litres per day respectively. Across the city of Osogbo, a household use up an average of 664.7 litres of water for various domestic purposes as indicated on table 4.

Table 4: Volume of water consumed for various purposes in litres per day

Domestic Use	Residential Density Areas			Total	%
	Low	Medium	High		
Drinking	1,450	1,800	5,437.5	8,687.5	4.97
Sanitation	20,300	15,000	29,000	64,300	36.78
Cooking	13,630	13,800	21,750	49,180	28.13
Bathing	13,050	9,000	14,500	36,550	20.91
Gardening	7,250	4,500	4,350	16,100	9.21
Total	55,680	44,100	75,037.5	174,817.5	100

Source: Field Survey, 2018

Influence of Residential Density and Water Sources on Volume of Water Consumption

In an attempt to know if the volume of water consumed is dependent on the sources and residential density, Multiple Analysis of Variance (MANOVA) was used to determine whether multiple levels of independent variables (residential density and water sources) on their own or in combination with one another have an effect on the dependent variables (volume of water consumption). The use of MANOVA in this analysis is apt because dependent variables conform to the parametric test assumptions. The results of MANOVA are presented in Table 5 and 6.

Table 5: Multiple Analyses of Variance (MANOVA) of Variations in the mean effects of Residential Density and Sources of water on Volume of water consumed.

Multivariate Tests						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.951	19.521	2.000	2.000	.049
	Wilks' Lambda	.049	19.521	2.000	2.000	.049
	Hotelling's Trace	19.521	19.521	2.000	2.000	.049
	Roy's Largest Root	19.521	19.521	2.000	2.000	.049

Table 5 shows that the overall interaction of the independent variables (X_1 and X_2 - residential density and sources of water) with the five dependent variables of water consumption is statistically significant at ($p<0.05$), $p = 0.049$. This implies that it is possible to generalize that residential density and sources of water could influence the volume of water consumed. However, the result of MANOVA as indicated on Table 6 shows the individual interaction of independent variables (residential density and sources of water) with the dependent variables of water consumption (drinking, sanitation, cooking, bathing and gardening).

Table 6: Multiple Analyses of Variance (MANOVA) of Interaction Between the Volume of Water consumed and Residential Density with Water Sources

Tests of Between-Subjects Effects						
Independent Variable	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Residential Density	Water for Drinking	182168994.890	1	182168994.890	31.258	.011
	Water for Sanitation	894007346.999	1	894007346.999	32.252	.011
	Water for Cooking	757639467.017	1	757639467.017	31.752	.011
	Water for Bathing	27241670.100	1	27241670.100	12.308	.039
	Water for Gardening	92736888.883	1	92736888.883	21.481	.019
Sources of Water	Water for Drinking	8167914.278	4	2041978.570	.350	.831
	Water for Sanitation	92458180.550	4	23114545.138	.834	.583
	Water for Cooking	37405100.553	4	9351275.138	.392	.806
	Water for Bathing	11714378.470	4	2928594.617	1.323	.426
	Water for Gardening	790222.222	4	197555.556	.046	.994

Source: Author's Computation, 2018

Table 6 shows that the influence of the residential density on the level of water consumption for all the five purposes of water is statistically significant at $p<0.05$). This implies that the volume of water consumed is dependent on the residential density. It is however curious to note that the influence of the sources of water on the level of water consumption for all the five purposes is not statistically significant at $p>0.05$). The implication of this is that the volume of water consumed is not dependent on the sources of water.

Influence of Population on Volume of Domestic Water Consumption

The study also examined the influence of population on the volume of domestic water consumption in residential densities of Osogbo. This is important with the outbreak of COVID-19 and its attendant increase in water demand for various domestic uses, which ranges from regular hand washing to other sanitation exercises. The results of Pearson Product Moment Correlation (PPMC) as indicated in table 7 reveals that there is very high positive significant correlation between the residents' population and level of water consumption for drinking (r = 1.000, p = 0.000), sanitation (r = 0.992, p = 0.000), cooking (r = 1.000, p = 0.000) and bathing (r = 0.876, p = 0.002). This implies that as the population increases, the volume of water consumption for drinking, sanitation, cooking and bathing also increases significantly. It can however be noted that there is negative correlation (r = -0.981, p = 0.000) between the residents' population and volume of water consumption for water gardening.

Table 7: Correlation Analyses of Residents population and Water Consumption Level

		Population
Water for Drinking	Pearson Correlation	1.000**
	Sig. (2-tailed)	0.000
	N	9
Water for Sanitation	Pearson Correlation	0.992**
	Sig. (2-tailed)	0.000
	N	9
Water for Cooking	Pearson Correlation	1.000**
	Sig. (2-tailed)	0.000
	N	9
Water for Bathing	Pearson Correlation	0.876**
	Sig. (2-tailed)	0.002
	N	9
Water for Gardening	Pearson Correlation	-0.981**
	Sig. (2-tailed)	0.000
	N	9

Correlation is significant at the 0.01 level (2-tailed)

Source: Author's Computation, 2018

Availability of Water demanded

The study also examined the relationship between water supply and water demand across the density areas. Table 8 shows that 33.8% of the respondents in the high-density areas reported that water supplied met their demand for domestic use, while 66.2% claimed that water supplied did not meet their daily needs.

In the medium density areas, 53% of the respondents claimed that water supplied to their households met their daily demand for domestic water consumption while 46.7% stated that water supplied did not meet their daily water demand. In the low-density areas 82.8% of the respondents stated that water supplied met their daily demand for domestic water need, while 17.2% reported that their need was not met.

The analysis shows that households in the medium and low densities were satisfied with water supply in their areas, unlike most of the households in the high-density areas who could not access required volume of water daily. Inadequacy of water supply in the high-density areas may not be unconnected with their low-income status and the available source of water in the area, which is predominantly hand-dug well, which is mostly seasonal in most areas.

The study shows in Table 8, that, 49% of the respondents in the study areas across different density areas claimed that, water supplied met their daily demand, while 51% of the respondents stated that water supplied did not meet their water demand for the day. This is an indication for urgent attention on the part of government, non-government organizations and the community-based associations to respond to the situation in order to prevent water-borne diseases in the city most especially in the high-density areas where the population clustered together.

Table 8: Availability of Water Demanded

Areas	Availability of water demanded		Total
	Yes	No	
High density	49 (33.8%)	96 (66.2%)	145
Medium density	32 (53.3%)	28 (46.7%)	60
Low Density	48 (82.8%)	10 (17.2%)	58
Total	129 (49%)	134 (51%)	263

Source Field Work, 2018.

Furthermore, focused group discussion reveals other information on the challenges of water accessibility in the neighbourhoods of Osogbo. The discussion was conducted across different interest groups that are mostly involved in the search of water in the city. Among these groups are the women and the children. The study reveals that most of the households have their water source within the radius of 500 meters. The result of findings also indicates that respondents in the high-density areas do travel long distance to fetch water (Plate 1 and 2) compared to low density areas where most households have their water source fixed within their premises such as borehole or electric powered well. Respondents in the high-density areas also maintained that they spent considerable precious time in search of portable water; an average of two hours in a day looking for portable water in the neighbouring houses. Plates 1 and 2 show people in search of water in the study area, some using motorcycle to fetch water. The study further that the water supply situation is more critical during the dry season when many of the hand-dug wells dry up due to aridity occasioned by changes in climate. Some of the respondents interacted with during focused group discussion also maintained that they spent an average of N300.00 per day on water procurement.

Further inquiry reveals that most of the people interacted with had suffered from one water related diseases or the other. The respondents especially from high-density areas reported cases of cholera, yellow fever, amoebiasis and ringworm usually related to poor sanitation and water

supply. The study further reveals that Community groups and Non-Governmental Organizations provide most of the water sources while Government also made little contributions to water supply in the city. The analysis had shown that only the high-income earners living in the low residential areas have access to portable water at affordable cost. Hence, it is imperative for government and relevant agencies of government to be adequately involved in the provision of water in order to improve the sanitation and hygiene status of the people and to prevent water-borne diseases and epidemic in the congested high–density areas of the cities. It must also be pointed out that adequate provision of water is crucial to the fulfilment of most of the seventeen sustainable development goals.

Summary of Findings and Conclusion

The study examines the socio-economic characteristics of households across the residential density areas in Osogbo, their sources of water for variety of uses, volume of water consumption and accessibility of water in the city. Data for the study were derived from structured questionnaire and focused group discussion with the stakeholders.

A slightly greater percentage of the respondents were women, who are mostly involved in search of water for household uses. Most of the respondents were within the age bracket of 20- 40 years and 54.8% were married. 62% had higher educational qualifications while about 41% were civil servants. The study shows that women in the study city consume more water than their men counterpart. Slight percentage variation in the volume of water consumed across age group was observed in the study area. The study further indicates that higher income earners consume more water than the low-income earners. The analysis also reveals that a large proportion of the domestic water is used for sanitary and cooking.

The survey also investigated sources of water across the residential density areas in the city. The result shows that a significant proportion of the households depend on hand-dug well for water supply across the density areas. Multiple Analyses of variance (MANOVA) however shows that sources of water across low, medium and high residential densities of Osogbo were not significantly different. It can however be inferred that hand-dug well was the dominant source of water and it is commonly found in all the three residential densities. Furthermore, the analysis reveals that households in low-density areas consumed much water than other density areas. This cannot be unconnected with the socio-economic characteristics of the households in the low residential density area. Most of the people (51%) across the residential density areas reported that water supplied did not meet their water demand which shows that, there is need for urgent attention towards provision of potable water in the affected areas in order to avoid water-borne diseases and improve the sanitation condition in the area. The study shows that women and children, the most vulnerable people of the society are mostly saddled with the task of searching for water. Households in the low-income group travelled longer distance looking for portable water and spent average of N300.00 on water procurement per day. Residents in this high-density area reported incidence of variety of water-borne diseases, which is an indication of the quality of water accessible to them.

In conclusion, the following recommendations are hereby made to enhance functional, clean and effective source of water, and to ensure adequate and sustainable water supply to households in the study area and Nigeria at large. Government should encourage cooperative arrangement among people in the same neighbourhood in sinking standard boreholes that will serve the community. This is better than the existing individual arrangement of hand-dug well. Water is also to be handled as a basic social service to be rendered by government in order to ensure a

healthy human population and hygienic environment. This implies that the government at different levels should complement the efforts of individuals, organisations and communities to make adequate water available to the population in a sustainable manner.

Plate1 Children in search of water

Source: Field Survey, 2018

Plate 2 People in search of water in Osogbo

Source: Field Survey, 2018

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