



# **Gombe Journal of Geography and Environmental Studies (GOJGES)**

**Vol. 1 N0.1 Dec. 2019**

**e-ISSN: 2714-321X**

**p-ISSN: 2714-3201**

**<http://www.gojgesjournal.com>**



## HOUSEHOLD CHARACTERISTICS: IMPLICATION FOR WATER SUPPLY IN BAUCHI METROPOLIS, NIGERIA.

Istifanus, Victor \*\* Bwala, Haruna Baba

\*Department of Environmental Management Technology, \*\*Department of Urban and  
Regional Planning, Faculty of Environmental Technology,  
Abubakar Tafawa Balewa University Bauchi

### Abstract

The demand for domestic water is a collective outcome. Thus, a number of factors determine the quantity of water used for domestic activities. This study investigates household characteristics in Bauchi metropolis and its implication for water supply. Nine selected household characteristics were analyzed. A stratified systematic random sampling technique was used for the study. 381 households were sampled in 3 residential density areas covering twelve wards of Bauchi metropolis. The study found out that 64 % of households in Bauchi have relatively large sizes of above 6 persons. 81 % of households are Muslims, 18 % are Christians while 1 % are traditional worshippers. 68 % have tertiary education and 3 % have primary education. 68 % of households are low income earners, 58 % are civil servants, 43 % live in compounds, 39% in flats and 3 % live in single rooms. 49 % obtain water from wells, 26 % from public boreholes and 5 % from streams. 83 % of households are married while 17 % are not married and so on. The distribution of households in the various densities along religious lines has serious implications for water supply. In the high and low density areas 93 % and 96 % of households are Muslims while in the medium density areas 42 % are Christians. This implies that more water is required in the high and low density areas than the medium density areas as every Muslim need additional 7 litres of water for prayers apart from normal domestic use. Gender also has water supply implication as females use 15 litres more than males. Only 39% of households are connected to the public water supply scheme.

---

**Key words:** household, water, supply, characteristics, implication.

*Istifanus and Bwala*

<http://www.goigesjournal.com>

## 1. Introduction

Water is a vital resource for the survival of all living things. Without water, life on planet Earth would not exist (Abrashinsky, 2004). Water is a basic resource, which supports economic growth and maintains daily life.

The earth's hydrosphere has about 1.36 billion km<sup>3</sup> water and 75% of the earth surface is covered with water containing 97% salt and 3% fresh. Only 1% of the water is available for human consumption (Ali & Tarfa, 2012).

Nigeria's fresh water resources cover only 3.4% of its total land area of 94,185,000 hectares to meet the demands of 170million people. Therefore, Nigeria needs to be able to use water in a sustainable way and this present the country will be a big challenge (FAO, 2006). Water is used for different purposes including residential, commercial, industrial and agricultural water uses. WHO, (2003) define domestic water as water used for all usual domestic purposes including consumption, bathing, and food preparation. Household water use is usually the most important part of municipal water use because it accounts for more than half of the total municipal water use in many developing countries (Lu 2007). The increase in demand for water because of increase in population and changes in lifestyle and economic activities has put pressure on water supply systems, which is considered as leading to shortages in Nigeria's urban centres.

Other reasons have been adduced to this problem ranging from inability of water boards to abstract water from sources leakages in the distribution system, outright breakdown of machineries, unreliable estimates of urban water demand, the pattern of water use and lack of proper understanding of household characteristics

Water shortages are a common feature in most of Nigerian urban centres (Ayanshola, *et. al.*, 2010). Some urban centres have prolonged shortages lasting for about six month to one year while others may have shortages lasting for weeks or days.

In Bauchi, the state government allocated and invested a total of 5,108,540,629 naira from 2005-2010 for the provision of potable water in the metropolis. Despite these huge investments, there is ample evidence to show that there is acute water shortage in Bauchi metropolis. The daily water supply to Bauchi metropolis was given as 13,388,535 litres per day while the demand in the metropolis was 66,700,000 litres a day, leaving a shortage of 53,311,415 litres of water (Bauchi State Water Board, 2015). A large number of children and women can be seen going to places in search for water. In addition, numerous water hawkers and water tankers can also be seen complementing the water supply (Plates 1-2)

### Images of Water Scarcity in Bauchi



**Plate1: People Siphoning Water from Water Main near Gudun in Bauchi**

*Source:* Field work, 2019



**Plate 2: Water Hawker along Wunti Market**

*Source:* Field work, 2019

In a rapid assessment of Bauchi State Water Board facilities, it was reported that both the Gubi treatment plant and the network of boreholes supplying water are in need of repairs, additional power sources and expansion (Sustainable Water and Sanitation in Africa (SUWASA) (2012)).

One of the problems facing Bauchi metropolis therefore is the provision of adequate amounts of water for the smooth operation of its various sectors. Reliable Figures for water actually used are hard to come by.

To explain the urban water supply problem, several studies have been undertaken since the classic Howe and Linaweaver study of 1967. For example, Schnleich & Hillenbrand (2007) studied the determinants of domestic water demand in Germany and found out that differences in price and income alone explain the largest part of the gap in domestic water use. However, household size had a negative impact on water demand while higher age appears to be associated with higher water use.

Cochran & Cotton (1985) studied municipal water demand for Oklahoma City and Tulsa Oklahoma, indicated that price and per capita City water demand while only per capita income was found to be a predictor for water consumption in Tulsa.

Mimi & Smith (2000) & Khadam (1984) in their water demand studies for Ramallah and Khartoum respectively found water price, and size of household to be significant factors that determine water use. Similarly, Ali & Terfa (2012) studied state water supply in urban areas at household level in Nekemate town Ethiopia and found that household size income levels, education and availability of tap water are the major determinants of water use.

Ayanshola & Salami, (2010) studied water demand at household level in Ilorin Nigeria and found that income, education level and gender are the major determinants of water use. Okeola & Sule (2010) studied long term

## **2. Sources of Water Supply and Accessibility in some selected Nigerian cities.**

In most Nigeria, urban centres the main source of water supply are rivers, boreholes, wells and springs. In Lagos water supply comes mainly from the Ogun and Iju River, which supply 210 million litres of water while the demand is 600 million litres. In Makurdi a crumbling network serves only about 25 – 30 % of the inhabitants and inhabitants fetch raw water from the polluted river Benue. Other sources are wells and streams. In Owo, 72.06 % of water is obtained from wells, 7.2 % from streams, 97 % from boreholes 1.62 % from rainfall and 7.3% from pipes borne. In Osiele, 78.8 % of the households' fetched water from hand operated wells and 21.2 % from boreholes

income were the predictive variables for Oklahoma

water demand for Offa Kwara State in Nigeria and found out income education level and proximity to water sources are the main drivers of water use.

These studies focused mainly on conventional or “traditional” determinants of water use covering economic and physical characteristics and overlooked household characteristics and its implications for water supply. For any meaningful water supply and management or conservation policy to be achieved it is important to understand household characteristics of the study area. Nonetheless, little quantitative information exist on household characteristics' Bauchi metropolis and its implication for water supply. This study investigates household characteristics in Bauchi metropolis and its implication for water supply.

and motorised wells (Oluyigbe & Fasakin, 2010; Amori & Makinde, 2012; Ezenwaji, *et al*, 2014 & Ojo, 2014).

In Abuja the Federal Capital Territory water supply and sanitation is not encouraging. The main sources of water are the lower Usman dam etc. According to the Abuja Capital Territory Baseline Survey 2010 43 % of households, obtained water from rivers and streams, 27 % from boreholes and only 7 % had access to tap water (NMDGR, 2013). Enugu Uzoamaka (2010) noted that the major source of public water supply was the Ajali water scheme commissioned in 1985 to provide water to about 3.3 million inhabitants of Enugu urban. According to her, for the five years (2002 – 2007) the inhabitants experienced acute water shortage. The



situation she said has not improved. Most Nigerian urban centres water supply connections are not metered. The metering ratio varies from 7 % in Katsina to 16 % in Kaduna and 26 % in Lagos in 2007. In Bauchi water supply is not metered. In Lagos metropolitan domestic water supply is 210 million litres per day while the demand for domestic water is 540 million litres per day giving a deficit of 330 million litres per day. Lagos State water Board (LSWB) (2015). Similarly, in Zaria public water supply to the town is 35,000 m<sup>3</sup> (35 million litres) per day while the demand for domestic water stands at 85,000 m<sup>3</sup> (85 million litres). This gives a shortage of 50,000 m<sup>3</sup> (50 million litres of water a day. (Kaduna State Water Board KSWB, 2010). In Kano metropolis the total demand for water is 550 million litres per day while the supply is 200 million litres per day, with a deficit of 350 million litres per day, thus satisfying only 36 % of domestic need Kano State Water Board (KNSWB) (2011).

In Owerri city Nigeria, Onyenechere & Osuji (2012) reported that River Otamiri water facility that is supposed to supply 66 million litres of water currently supplies 12 million litres of water a day, leaving a deficit of 54 million litres a day. They stated that households in Azuri I, Azuri II, G.R.A and Owerri II wards depend on water peddlers for their water supplies. In Yenagoa 29.28 % of the people, use 20 litres of water per capita per day. This water shortage is attributed to the high cost of water of (4, 500.00) four thousand five hundred naira per month in a country where minimum wage is (18, 000.00) eighteen thousand naira. (Ohwo & Obotutu, 2014). In Ibadan city, only 30 % of residences are connected to the public water system.

In Bauchi main sources of water supply are the Gubi water scheme at Gubi Dam, a network of boreholes and private wells. The

supply to Bauchi is 13,388,535 litres while the demand is 66,700,000 litres. Thus, only 20 % coverage was achieved in 2014 (Bauchi State Water Board, 2015)

### **3. Nigeria National Water Policy (NWP) 2004**

The Nigeria National water policy on water supply and sanitation sets consumption standards: 30 litres/capita/day within 250 metres for rural areas; 60 litres/capita/day with pipeline reticulation, with limited or full house connections and 120 litres/capita/day served with full reticulation and consumer premises connections for urban areas. Despite these the policy sets a target of 120 litres per day for urban centres.

Water demand in urban and small town areas is increasing at a rate, which is not proportional to the rate of expansion of water supply and sewerage services. This is due to the increase in urban population, increase of industrial activities and significant unaccounted-for-water that includes leakage, wastage and illegal connections. Water demand management measures will replace the up to now existing supply management in order to conserve and use the available water efficiently and equitably and to protect the poor. (National Water Policy, (NWP) 2004)

#### ***Objective of NWP***

The main objective in water supply and sanitation is:

To increase service coverage for water supply and sanitation nationwide to meet the level of socio-economic demand of the nation in the sector through:

- i. new projects designed carefully to meet the real demand of the population avoiding over sizing
- ii. combating leakages and losses
- iii. reducing unaccounted for water

This led the Federal Ministry of Water Resources (FMWR) to develop the Nigerian National Water Supply and Sanitation Policy (WWSSP) in 2000. The Nigerian National Water Supply Sanitation Policy (NSUSSPS) targets of water supply were as follows:-

- i. Initiative target is to meet the national economic target of improving service coverage from 40 % to 60 % of the year 2013
- ii. Extension of service coverage to 80 % by 2007
- iii. Extension of service coverage to 100 % by 2011
- iv. Sustain 100 % full coverage 2015 and beyond

#### ***Agencies for Water Supply in Nigeria***

The following agencies are responsible for water supply in Nigeria.

- i. Federal Ministry of Water Resources
- ii. Abuja Municipal Water Supply Agency
- iii. Ministry of Water Resources in all the 36 State of Nigeria
- iv. State Water Board, Bauchi State Water Board.

#### ***International Agencies***

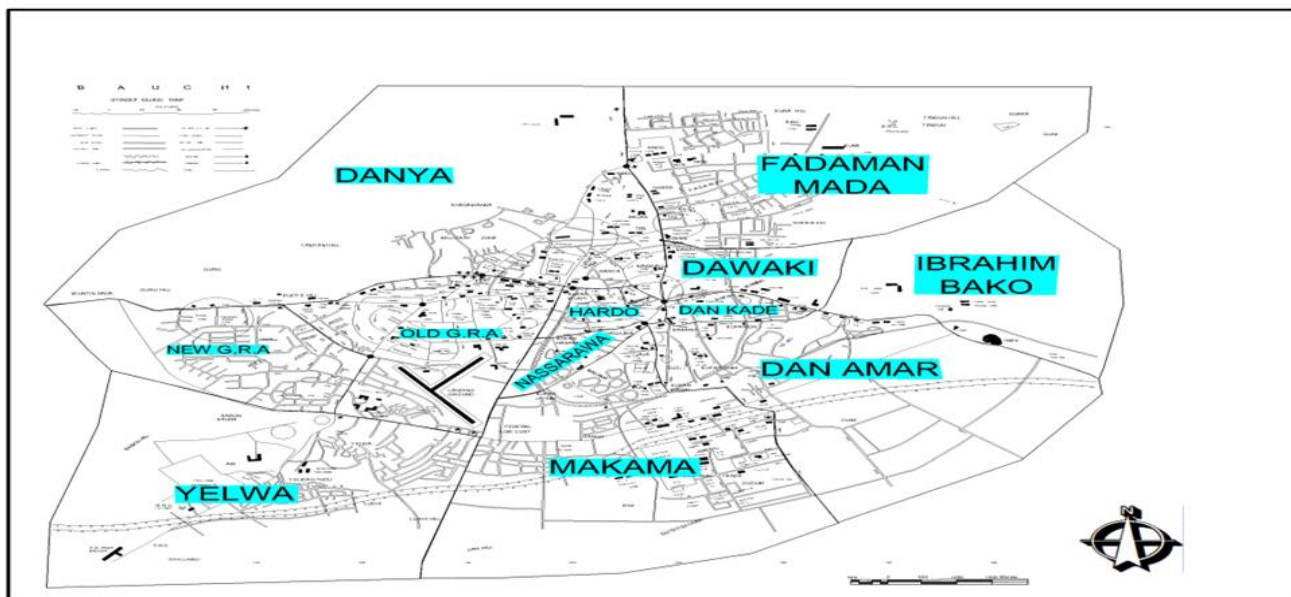
- i. Water Aid
- ii. European Environmental Agency
- iii. Japanese International Agency (JICA)
- iv. UNICEF
- v. Sustainable Water and Sanitation in Africa (SUWASA)

However, this ambitious target set by the National Water Policy (NWP) (2004) has not been achieved by the end of the year 2015. Most Nigerian towns have per capita water use to less than 120lpcd.

#### ***Study Area***

##### ***Location***

Bauchi metropolis, headquarter of Bauchi State is located between latitude 9°00 and 9°30 north of the Equator and longitude 10°25 and 11°20<sup>0</sup> east of the Greenwich meridian. It occupies total land areas of 3,604.0 hectares. It is about 128 kilometers northeast of Jos and 154 kilometers west of Gombe town. Figure 1.



**Figure 1:** Administrative Wards of Bauchi metropolis  
*Source:* Fieldwork, 2019.

### **Population**

Bauchi has a population of 417 917 living in 52, 239 households in 12 domestic wards. The main tribes in the metropolis are Hausa, Fulani, Ibo Angas, Jarawa, Sayawa and so on

### **Climate**

There are two main seasons experienced in Bauchi metropolis, the cold dry season and hot wet season. The long dry season lasts from October to April and the wet season from May to September. For most part of the year, the metropolis is apparently hot. The hottest months are March- May with highest temperature record of 40<sup>0</sup> -50<sup>0</sup>c while the coldest months are December and January (harmatan) with a minimum temperature record of as low as 6.11° C and 7.22° C respectively.

The rainy season lasts for seven months from April to October. The total annual rainfall average stands at 1091. 4 mm with a peak in August. The maximum daily humidity

decreases slightly about the middle of the rainy season but drops drastically from about 94 % in August to less than 10 % during the harmatan.

### **4. Bauchi Water Supply Scheme**

The daily supply of water in Bauchi metropolis was 13,388,535 litres while the demand was 66,700,000 litres given coverage of 20 %. The supply of water to urban Bauchi is dependent mainly on Gubi Dam and its two treatment plants but the supply is augmented by new and existing smaller boreholes based schemes in and around the city. The schemes are operated and maintained entirely by the Bauchi State Water Board (BSWB, 2015).

The main treatment plant at Gubi Dam draws raw water from the dam and treats it by using conventional techniques of Flocculation, sedimentation, filtration, chlorination and transmission through steel pipe mains to an



elevated reservoir at Wuranje hill through a distance of about 25 kilometers. The production capacity of the plant is designed for at 10 million cubic meters a day at its optimum, although due to power shortages much less than this is realized from the daily operations Sustainable Water and Sanitation in Africa (SUWASA, 2012). The package treatment plant supplements the supply from Gubi Dam by drawing raw water from the same source and treating it using six package plant units delivering clear water into a surface steel tank before pumping through the steel pipe main to Buzaye hill reservoir. Other borehole schemes are:

**Barkumbo scheme:-** this was the first centralized water supply system for Bauchi town before Gubi plants came on stream but was abandoned soon after. This has just been reactivated by drilling new boreholes, constructing a surface steel tank and booster station for pumping water through the pipe mains to an elevated Braithwaite tank at the junction of Tudun Salmanu. The scheme has 12 boreholes, spread out in the field but centrally controlled in the pumping station, a ground steel tank with capacity for 400,000 litres.

**Gudum Scheme:-** This depends on 6 boreholes, a surface steel tank water from this location is pumped first to Zhango and then

Dutsen Tanshi along with the supply from Zhango. **Zhango Scheme:-** is located behind the industrial training school. It has 5 new and 5 old boreholes that supply water into a steel surface tank (320,000 litres). **Rafin Zurfi:-** has a scheme which depends on 4 boreholes, 80,000 litres overhead tank, a 108,000 litres surface steel tank. **Yelwa Kagadama – Tsakani – Lushi scheme:-** This system has one overhead tank 108,000 litres at Yelwa Kagadama, another similar capacity at Tsakani and a pumping station at Lushi. It also has a 220,000 litres surface steel tank and an overhead tank in Lushi now incorporated in the scheme.

**Yelwa- in Yelwa** is a scheme based on 4 boreholes, a 108,000 litres surface steel tank and an elevated steel tank with capacity of 80,000 litres to serve the areas.

Other boreholes schemes, part of the very old system of water supply before Gubi dam, are 15 boreholes scattered around Bauchi town and reported as still in use. But details of how they work and who is in charge are not quite clear (SUWASA, 2012).

Other sources of water supply are:

private boreholes, wells and streams. Rain harvesting as a source of water is limited to few households and is mainly during the short rainy season/days.

## 5. Methodology

A Survey of households was conducted using questionnaires. The questionnaires were administered to household heads or their representatives on domestic activities involving use of water. Information relating to household characteristics assumed to determine water supply were asked. A total of 54 questions were asked in the questionnaire and 381 questionnaires were

administered. Trained research assistants were used in administering and retrieving the questionnaire

## Data Collection Procedure

Since water supply to Bauchi metropolis is not metered the questionnaire method is used. The data collection was carried out over a period of three weeks (3) with the help of six (6) trained research assistants. The data was collected through structured questionnaires

for the households. The head of households were the target respondents.

### **Sampling and Sampling Technique.**

Bauchi has a population of 417 917 . This is made up of 52,239 households. In this research, sampling is determined in three perspectives, sampling frame, sampling size and sampling techniques.

- i. **Sampling frame:** this denotes the body of the unit from which the target respondents are selected. In this case, the study areas are divided into three domestic density i.e low, medium and high domestic density and a total of 12 wards. In each domestic density, there are wards (Gunduma or administrative units). There are three (3) wards in low residential density, four (4) wards in medium residential density and five (5) wards in high residential density areas which form the sample frame. From each ward in a density area a proportionate unit of households was selected for the purpose of administering questionnaires and interviews.
- ii. **Sample size:** Krejcie & Morgan (1970) table suggested that for a target population of forty thousand (40,000) a sample size of three hundred and eighty (380) should be taken and for a population of fifty thousand (50,000) a sample size of three hundred and eighty one (381) should be taken. Since there are fifty two thousand two hundred and thirty-nine (52, 239) households in the study areas, a sample size of three

hundred and eighty one (381) was taken for this research (Table 1).

iii. **Sampling techniques.** There are various sampling techniques and each has some assumed pre- conditions suitable for its application. For a heterogeneous environment like Bauchi metropolis where population density, income level and probably occupation, which largely may determine water, use, stratified systematic random sampling technique was adopted. For the selection of the samples. This technique is most suitable for social research because they are scientific and easy to apply. (Gravetter & Wallnau, 2014).

The samples were selected in order to have a fair representation of all the wards and residential densities. The 381 samples are distributed among the twelve (12) wards with 54 households in low, 130 households in medium and 197 households in high-density areas of the metropolis respectively (Table 1). medium density and 52 % in high density areas (Table 2). The average household size in Bauchi metropolis is 8 persons (Table 1).

**Table 1: Population and number of households in Bauchi metropolis**

| Ward         | Population | Hh Size | No Hh | Frequency | Density |
|--------------|------------|---------|-------|-----------|---------|
| Old GRA      | 20427      |         | 2553  | 19        | Low     |
| New GRA      | 11776      |         | 1472  | 11        | Low     |
| Fadaman Mada | 26515      |         | 3314  | 24        | Low     |
| Yelwa        | 66362      |         | 8295  | 60        | Medium  |

|              |                |            |               |            |        |
|--------------|----------------|------------|---------------|------------|--------|
| Daniya       | 38022          |            | 4753          | 35         | Medium |
| Makama       | 15926          |            | 1991          | 15         | Medium |
| Ibrahim Bako | 27690          |            | 2836          | 20         | Medium |
| Nassarawa    | 46544          |            | 5818          | 42         | High   |
| Dan Kade     | 41709          |            | 5214          | 38         | High   |
| Dawaki       | 55359          |            | 6922          | 51         | High   |
| Dan Amar     | 51854          |            | 6482          | 47         | High   |
| Hardo        | 20658          |            | 2582          | 19         | High   |
| <b>Total</b> | <b>417,917</b> | <b>8.0</b> | <b>52,239</b> | <b>381</b> |        |

Source: NPC, 2006 Projected.

**Table 2: Total Population and Households in Bauchi Metropolis**

| Density          | Low    | %  | Medium  | %  | High    | %  | Total   |
|------------------|--------|----|---------|----|---------|----|---------|
| Total household  | 7313   | 14 | 17761   | 34 | 27164   | 52 | 52,239  |
| Total population | 58,700 | 14 | 143,076 | 34 | 216,141 | 52 | 417,917 |

Source: Author's 2019

## Method of Data Analysis

The data analyzed for this study were characteristics of households, quantities of water use, relationship between household characteristics and quantity of water use. This is because the quantity of water use will inform the quantity of water to be supplied.

Both qualitative and quantitative techniques were used in data analysis. These include descriptive and inferential statistical tools such as tables, graphs, charts and pictures, averages, percentages. Microsoft Excel was used for the data analysis.

## 6. Results and Discussion

### *Household Characteristics*

The study found that Bauchi has an estimated total population of 417,917 people living in 52,239 households. Of this 14 % of households are in low density areas, 34 % in

medium density and 52 % in high density areas (Table 2). The average household size in Bauchi metropolis is 8 persons (Table 1).

**Table 2: Total Population and Households in Bauchi Metropolis**

| Density          | Low    | %  | Medium  | %  | High    | %  | Total   |
|------------------|--------|----|---------|----|---------|----|---------|
| Total household  | 7313   | 14 | 17761   | 34 | 27164   | 52 | 52,239  |
| Total population | 58,700 | 14 | 143,076 | 34 | 216,141 | 52 | 417,917 |

Source: Author's 2019

The study found households having 1-3 people constitute 18 %, 4-6 people 32 %, 7-9 people 23 %, 10-12 people 22 % and above 12 people 5 % of the total household in Bauchi metropolis. Households' size between 7-12 persons constitutes 48 % of the total households. This relatively large number of people in households directly influences domestic water use. Between the densities household size varies with 1-3 people constituting 22 % in low density but only 15 % in high density. Similarly, households with 10-12 people constitute 11 % low density while in high density it constitutes 30 % (Table 3).

The study found 68 % of all households in Bauchi have tertiary education. Household with primary education 3 %, informal education constitutes 6 %, figure 8. There are variations within the densities. For example, while households with secondary education accounts for 26 % in the medium density; only 7 % of the households in low density have secondary education. These educational structures have influence on domestic water use (Table 4).

Income level also plays a vital role in domestic water use. In Nigeria where the minimum wage is N18, 000 Naira civil servants from grade level 1-5 are referred to as low-income earners. Therefore, people earning less than 300,000 naira a year are

low-income earners. The study found that 32 % of the household surveyed earned above 301,000 naira a year while 68 % earned below 300,000 naira a year. Within the densities, only 4 % earned less than 30,000 naira in the low density while 17 % in the high density earned less than 30,000 naira (Table 5).

**Table 3: Distribution of Households size in Bauchi Metropolis**

| Number of people in household | Number of households |    |                |    |              |    |       |    |
|-------------------------------|----------------------|----|----------------|----|--------------|----|-------|----|
|                               | Low density          | %  | Medium density | %  | High density | %  | Total | %  |
| 1-3                           | 12                   | 22 | 25             | 19 | 30           | 15 | 67    | 18 |
| 4-6                           | 17                   | 32 | 53             | 41 | 52           | 26 | 122   | 32 |
| 7-9                           | 5                    | 9  | 34             | 26 | 48           | 24 | 87    | 23 |

|              |           |           |            |           |            |           |            |            |
|--------------|-----------|-----------|------------|-----------|------------|-----------|------------|------------|
| 10-12        | 11        | 20        | 14         | 11        | 58         | 30        | 83         | 22         |
| Above 12     | 9         | 17        | 4          | 3         | 9          | 5         | 22         | 5          |
| <b>Total</b> | <b>54</b> | <b>14</b> | <b>130</b> | <b>34</b> | <b>197</b> | <b>52</b> | <b>381</b> | <b>100</b> |

Source: Author's 2019

**Table 4: Educational Level of Head of Households in Bauchi Metropolis**

|              | <b>Low Density</b> | <b>%</b>  | <b>Medium Density</b> | <b>%</b>  | <b>High Density</b> | <b>%</b>  | <b>Total</b> | <b>%</b>   |
|--------------|--------------------|-----------|-----------------------|-----------|---------------------|-----------|--------------|------------|
| Primary      | 0                  | 0         | 1                     | 0.01      | 11                  | 5.6       | 12           | 3          |
| Secondary    | 4                  | 7         | 34                    | 26.2      | 48                  | 24.4      | 86           | 23         |
| Tertiary     | 49                 | 91        | 90                    | 69.2      | 121                 | 61.4      | 260          | 68         |
| Informal     | 1                  | 2         | 5                     | 1.5       | 17                  | 8.6       | 23           | 6          |
| <b>Total</b> | <b>54</b>          | <b>14</b> | <b>130</b>            | <b>34</b> | <b>197</b>          | <b>52</b> | <b>381</b>   | <b>100</b> |

Source: Author's 2019

**Table 5: Income Level of Head of Households in Bauchi Metropolis**

|                 | <b>Low Density</b> | <b>%</b>  | <b>Medium Density</b> | <b>%</b>  | <b>High Density</b> | <b>%</b>  | <b>Total</b> | <b>%</b>   |
|-----------------|--------------------|-----------|-----------------------|-----------|---------------------|-----------|--------------|------------|
| <5000-30,000    | 2                  | 4         | 4                     | 3         | 33                  | 17        | 39           | 10         |
| 31,000-60,000   | 7                  | 13        | 13                    | 10        | 29                  | 15        | 49           | 13         |
| 61,000-100,000  | 7                  | 13        | 20                    | 15        | 43                  | 22        | 70           | 18         |
| 101,000-300,000 | 7                  | 13        | 40                    | 31        | 54                  | 27        | 101          | 27         |
| Above 301,000   | 31                 | 58        | 53                    | 41        | 38                  | 19        | 122          | 32         |
| <b>Total</b>    | <b>54</b>          | <b>14</b> | <b>130</b>            | <b>34</b> | <b>197</b>          | <b>52</b> | <b>381</b>   | <b>100</b> |

Source: Author's 2019

The type of house has influence on domestic water use. The study found out that 43 % of residents live in compounds, 39 % in flats, 15 % in rooms and parlour while only 3 % live in single rooms. Within densities, 70 % live in flats in low-density areas and only 31 % live in flats in high-density areas. Similarly, 9% live in compounds in low density areas, 25 % in medium density and 59 % live in compound houses in high-density areas (Table 6). The study found out that 49 % of households obtained water from wells, 26 % from public tap 13 % from private boreholes and vendors

only 5 % source water from streams Figure 4. Within the densities 54 %, 53 % and 22 % households obtain water from wells in the high of, medium and low-density areas. Similarly, 46 %, 19 % and 25 % obtain water from public taps in the low, medium and high-density areas respectively (Table 7). The study found out that 83 % of respondents are married while 17 % are unmarried. This explains why the household sizes are relatively large. However, in the low-density areas 85 % are married and 15 % unmarried (Table 8).

**Table 6: Types of Houses and Households in Bauchi Metropolis**

|                | <b>Low Density</b> | <b>%</b> | <b>Medium Density</b> | <b>%</b> | <b>High Density</b> | <b>%</b> | <b>Total</b> | <b>%</b> |
|----------------|--------------------|----------|-----------------------|----------|---------------------|----------|--------------|----------|
| Single Room    | 3                  | 6        | 5                     | 4        | 4                   | 2        | 12           | 3        |
| Room & Parlour | 4                  | 7        | 18                    | 14       | 35                  | 18       | 57           | 15       |



|              |           |           |            |           |            |           |            |            |
|--------------|-----------|-----------|------------|-----------|------------|-----------|------------|------------|
| Compound     | 9         | 17        | 33         | 25        | 117        | 59        | 159        | 43         |
| Flat         | 38        | 70        | 74         | 57        | 41         | 31        | 150        | 39         |
| <b>Total</b> | <b>54</b> | <b>40</b> | <b>130</b> | <b>34</b> | <b>197</b> | <b>52</b> | <b>381</b> | <b>100</b> |

Source: Author's 2019

**Table 7: Sources of Water in Households in Bauchi Metropolis**

|                 | Low Density | %  | Medium Density | %  | High Density | %  | Total | %  |
|-----------------|-------------|----|----------------|----|--------------|----|-------|----|
| Well            | 12          | 22 | 69             | 53 | 107          | 54 | 188   | 49 |
| Stream          | 0           | 0  | 9              | 7  | 8            | 4  | 17    | 5  |
| Public borehole | 1           | 2  | 11             | 9  | 15           | 8  | 27    | 7  |
| Public tap      | 25          | 46 | 25             | 19 | 50           | 25 | 100   | 26 |

Source: Author's 2019

**Table 8: Marital Status of Head of Households in Bauchi Metropolis**

|              | Low Density | %         | Medium Density | %         | High Density | %         | Total      | %          |
|--------------|-------------|-----------|----------------|-----------|--------------|-----------|------------|------------|
| Yes          | 46          | 85        | 110            | 85        | 161          | 82        | 317        | 83         |
| No           | 8           | 15        | 20             | 15        | 36           | 18        | 64         | 17         |
| <b>Total</b> | <b>54</b>   | <b>14</b> | <b>130</b>     | <b>34</b> | <b>197</b>   | <b>52</b> | <b>381</b> | <b>100</b> |

Source: Author's 2019

**Table 9: Religion of Head of Households in Bauchi Metropolis**

|              | Low Density | %         | Medium Density | %         | High Density | %         | Total      | %          |
|--------------|-------------|-----------|----------------|-----------|--------------|-----------|------------|------------|
| Muslim       | 52          | 96        | 74             | 57        | 183          | 93        | 309        | 81         |
| Christian    | 2           | 4         | 55             | 42        | 13           | 7         | 70         | 18         |
| Traditional  | 0           | 0         | 1              | 1         | 1            | 1         | 2          | 1          |
| <b>Total</b> | <b>54</b>   | <b>14</b> | <b>130</b>     | <b>34</b> | <b>197</b>   | <b>52</b> | <b>381</b> | <b>100</b> |

Source: Author's 2019.

The study found out that 81 % of households are Muslims while 18 % are Christians and 1 % traditional worshipers. Within the densities 96 % of households are Muslims, 4 % are Christians in low density areas while in the medium 57 % are Muslims, and 42 % are Christians. In the high density, 92 % are Muslims, 7 % Christians and 1 % traditional

worshipper (Table 9). In addition, the study found out that 46 % of residents are males while 54 % are females. In the low density, 44 % are males and 56 % are females. In the high density, 47 % are males while 53 % are females. The gender composition may have influence on domestic water use (Table 10).

**Table 10: Gender Distribution in Sampled Household in Bauchi Metropolis**

|              | Low        | %          | Medium     | %          | High        | %          | Total       | %   |
|--------------|------------|------------|------------|------------|-------------|------------|-------------|-----|
| Male         | 204        | 44         | 366        | 45         | 758         | 47         | 1328        | 46  |
| Female       | 259        | 56         | 443        | 55         | 834         | 53         | 1536        | 54  |
| <b>Total</b> | <b>463</b> | <b>100</b> | <b>809</b> | <b>100</b> | <b>1592</b> | <b>100</b> | <b>2864</b> | 100 |

**Source:** Author's 2019.

In Bauchi metropolis, only 39 % of Households are connected to the municipal water supply network, while 61 % are unconnected. In the medium density areas, only 28 % are connected while 72 % of households are unconnected. This may

explain why 47 % of the total domestic water source in medium density is from wells. In the low-density areas, 85 % are connected while 15 % are unconnected. Similarly in the high-density areas 37 % are connected and 63 % unconnected (Table 11).

**Table 11: House Connection to Pipe Borne Water Network in Sampled Households in Bauchi Metropolis**

| Connection   | Low       |    | Medium     |    | High       |    | Total      | %  |
|--------------|-----------|----|------------|----|------------|----|------------|----|
| Yes          | 46        | 85 | 36         | 28 | 72         | 37 | 149        | 39 |
| No           | 8         | 15 | 99         | 72 | 125        | 63 | 232        | 61 |
| <b>Total</b> | <b>54</b> |    | <b>130</b> |    | <b>197</b> |    | <b>381</b> |    |

**Source:** Author's 2019

## 7. Household Characteristics Implication for water supply in Bauchi metropolis

The household characteristics in Bauchi metropolis have implications for water supply. In a study of the analysis of the quantity of domestic water use in Bauchi metropolis, Istifanus (2017) found out that average household water use varies from one density area to the other. The average household water use is 878 l/p/d, 439 l/p/d and 458 l/p/d in the low medium and high density areas respectively. This means that water supply to the density areas must also vary with 5,994,132 litres, 10,157,615 litres and 12,323,742 litres to be supplied in the low, medium and high density areas

respectively. While the number of households in the low density area constituted only 14% of households in Bauchi, their water demand was 21% of total water for the metropolis. This is an important guide for water supply in Bauchi metropolis.

In Bauchi Metropolis, 64% of households have relatively large sizes of above six persons (table 3). In a Correlation study of the relationship of domestic water use and socio-cultural factors Istifanus et al (2019) isolated the influence of socio-cultural factors on quantity of domestic water use and found that household size, income, educational and marital status are positively correlated with quantity of domestic water in Bauchi Town. This implies that large household size,

households with higher educational levels, higher income and married households will require more water supply than the others. Therefore areas with concentration of high income, high levels of education, large household size and married households need to be supplied with more quantity of water. In another study of the pattern of domestic water use in Bauchi Metropolis, Istifanus, (2017) found out that every Muslim need additional 7 litres of water per day for prayers alone. In a socio-cultural city such as Bauchi Metropolis where residential wards and density areas are highly polarized along religious lines with Muslim and Christian concentration in separate areas (table 9), water supply must be guided by this consideration. Another household characteristic that has implications for water supply is the source of water supply at household level. The study found out that 49% of households obtained water from wells, 5% from streams, 7% from public boreholes, 26% from public tap and 13% from private boreholes and water vendors (Table 7). The over reliance on wells for water may not be unconnected with the fact that 61% of households are not connected to the public water network (table 11). There is therefore the need to improve connectivity of households to the public water network.

In a correlation, study of domestic water use and socio-cultural factors Istifanus et al (2019) established the relationship between gender and water use. They found out that females use more water than males. In fact, on the average females use 15 litres more than males in a day. Perhaps gender has a more practical implication for water supply particularly when it comes to institutional water supply. Water supply to male and female hostels in schools, male and female wards in hospitals, girls and boys schools,

correctional centers and IDPs camps must incorporate such considerations. Another household characteristic of note is the educational level. House with tertiary education consumes 61% of the total water supply in Bauchi metropolis. In most Nigerian cities where the elites are found in GRAs and other exclusive estates should guide water supply authorities in the discharge of their duties.

Istifanus et al (2019) noted another scenario where high-income earners who constitute 30% of households in Bauchi demand the supply of 40% of total water supply in Bauchi. In addition, households who live in flat types of houses need a supply of over one-third of total water supply in Bauchi. Furthermore, married households demand more supply of water than single households do.

Theoretically and practically it can be seen that household characteristics have implications for water supply and should therefore be used as a guide in any water supply scheme.

## **8. Conclusion and Recommendation**

Household characteristics have profound implications for water supply as demonstrated in this study. It is therefore recommended that any water supply program for urban water supply schemes to the various urban sectors must consider these peculiarities particularly, areas with concentration of different gender, high income, educated people, modern housing estates, and other social status. It is also recommended that water supply should be metered so each household can be supplied according to their need.

## **References**

- Abrashinsky, N. (2004). Domestic Use of Water, International Environmental Problems and Policy, University of Wisconsin-E and Claire USA
- Ali, M. & Tarfa, A.B. (2012). State of Water Supply and Consumption in Urban Areas at Household Level. A Case study of East Wollaga Zone Ethiopia. *British Journal of Humanities and Social Sciences*, 5(2), 1-15.
- Ayanshola, A.M F. & Salami, A.W. (2010). Modelling of Domestic Water Demand at Household Level in Illorin Nigeria. Retrieved May 6, 2014 from <http://www.unilorin.edu.ng/publication/s/ayanshola/modelyofresident>
- Amori, A.A. & Makinde, A.A. (2012). Evaluation of Access to Public Water Supply in Two Major Cities in Nigeria., *American Journal of Environmental Engineering* An Am, 2(6),148-151.  
doi:Doi:10.5923/j.ajee.20120206.01
- Bogoro, A.G. (2012). *The Role of Women in Household Solid Waste Management in Bauchi Metropolitan Areas*. Bauchi.- Nigeria: Unpublished Ph.D Thesis, ATBU, Bauchi. Bauchi State - Nigeria.
- Cochran Cotton, W.A. (1985). Municipal Water Demand Study, Oklahoma City and Tulsa. *Oklahoma Water Research*, 7(21):941-943.7
- Chowdry, S. & Al-Zahrani, M. (2013). Characterizing Water Resources and Trends of Sectorwise Water Consumption in Saudi. *Journal of King Saud University-Engineering Sciences*, 1-18.
- Environment Canada. (2011). Residential Water Use in Canada. *Environmental Indicators*, <https://www.ec.gc.ca/indicateursindicators/default.asp?.lang=eng&nav=7e808512/>.
- Ezenwaji, E.E., Anyadike, N.C & Igu, N.I. (2014). Optimal Allocation of Public Water Supply to the Urban Sectors of Enugu, Nigeria;. *A Linear Programming Approach. Applied Water Science*, 4, 73-78. doi:Doi10.1007/513201-013-01031-0
- Food and Agricultural Organization (F.A.O), (2006). *Irrigation in the Middle East Region in Figures*. Food and Agricultural Organization of the United Nations FAO Water Reports 34 Rome.
- Harbin Statistical Year Book (2004). Retrieved August 20, 2008 from <http://www.stats-hihab.gov.cn/hrbzfwhrbnews-searchindex.php>
- Howe, C. W. & Linaweaver, F. (1967). The Impact of Price on Residential Water Demand and its relation to system design and price structure. *Water Resources Research*, 3(1): 13-32.
- Istifanus, V. (2017), Analysis of Quantity of Domestic Water Use in Bauchi Metropolis; *IOSR Journal of Environmental Science, Toxicology and Food Technology*. 2(6)1: 1-5
- Istifanus, V. (2017). Pattern of Domestic Water Use in Bauchi Metropolis;

Journal of Resources  
Development and Management.

- Istifanus, V., Abulkadir, A., Bwala, H. B., (2019). Correlation Study of Domestic Water Use and Socio-Cultural Factors in Bauchi Town, Bauchi State- Nigeria. *International Journal of Engineering Research and Advanced Technology*. Vol5, Issue 5, pp19-27 e-ISSN 2454-6139.  
[www.ijerat.com](http://www.ijerat.com)
- Kaur R., Wani S.P, Singh AK and Lal K. (2012). Wastewater Production, Treatment and use. *Agricultural Research Institute*, 101-113.
- Krejcie, R.N. & Morgan D.W. (1970). DetermininG sample size for research activities, education and psychology measurement. *30*, 607-610.
- Lu, T. (2007). *Research Of Domestic Water Consumption: A Field study in Harbin China. unpublished M.sc project at Loughborough University U.K. U.K.*
- Mini, C. (2013). *Domestic Water Use and Landscape Vegetation Dynamics in. Los Angeles: Ph .D Desertification, University of California, Los Angeles, CA 90095.*
- Milner, M. (2006). "Thames Water Fails to Plug Leaks but profit rise 31%. Retrieved August 13, 2015, from <http://businessguardianco.uk/story/01802686,00html>
- Millennium Development Gold Reports. (MDGR). (2013). Nigeria: Progress Report on Water and Sanitation in Nigeria UNDP.*
- National Population Commission. (N.P.C). (2006). Federal Republic of Nigeria Official Gazette.*
- National Water Policy (NWP) 2004, Federal Republic of Nigeria, Federal Ministry of Water Resources Abuja.
- Ojo, O.M. (2014). Availability and use of Domestic Water in Osiele Areas of Ogun State, Nigeria. *Research Journal in Engineering and Applied Sciences*, 3(2), 104-107.
- Olujuyigbe, A.E. & Fasakin, J.O. (2010). Citizens Willingness to pay for Improved Sustainable Water Supply in a Medium Sized City in South Western Nigeria. *Current Research Journal of Social Sciences*, 2(2), 41-50.
- Okeola, O.G. & Sule, B.F. (2010). Empirical Estimates of Long-term Water Demand for off Kwara State Nigeria. *2nd Annual Civil Engineering Conference, University of Illorin Nigeria*, 122-181. Retrieved May 6, 2014 from [http://www.unilorin.edu.ng/publications/okeolaog/okeola\\_10.pg](http://www.unilorin.edu.ng/publications/okeolaog/okeola_10.pg)
- Schleich, J. & Hillenbrand, T. (2007). Determinants of Domestic Water Use in German. Working Paper Sustainability and Innovation number. *Fraundesfe Institute System and Innovation Research*. 3(1) pp27-34
- Sule, B.F., Ayonshola, A.M. & Salami, A.W. (2006). Water Consumption Pattern in Illorin Kwara State Nigeria. Retrieved May 6, 2014, from <http://www.unilorin.edu.ng/publication/ayanshola/waterconsumption>
- Sustainable Water and Sanitation in Africa (SUWASA). (2012). *Rapid*



*Assessment of Bauchi State Water Board Facilities, SUWASA . Bauchi Nigeria.*

Uzoamaka, C.D. (2010). *Qualitative Analysis of Drinking Water in Enugu Urban and its Health Implications . Akwa: Unpublished Ph.D Dissertification, Namdi Azikiwe University, Akwa.*

World Health Organization. (W.H.O). (2003). Retrieved July 21, 2015, from Domestic Water Quantity, Service, Level and Health: from <http://www.who.int/watersanitationhealth/>

Ward, K. (2011). *Water Reuse Research Agender, Taxes Water Development Board,.* Alan Plummer Associates.

Zhang, H.H. (2005). Domestic Urban Water Use. It Implication for Municipal Water Supply in Bejing. *Journal of Habitat International.*