JOURNAL OF THE ENVIRONMENT
(JOE)
Available online at https://journaloftheenvionment.com

OPEN ACCESS

ISSN: 0795-0977

Original Research Article

DETERMINANT OF DOMESTIC WATER DEMAND AND SUPPLY IN UYO METROPOLIS OF AKWA IBOM STATE

Ukoete Kenneth Isaac and Victor Nkemdirim

***Corresponding Author**
Ukoete Kenneth Isaac
Department of Geography and Planning, Abia State University, Uturu

Abstract

This study examined domestic water demand, supply and assessed its adequacy and regularity of water supply in Uyo metropolis of Akwa Ibom State. A survey research design was adopted and twenty five settlements were systematically selected to make the study area. The determinants factors of water demand such as income, household size, distance to source and price of water and determinants factors of water supply including population, season and accessibility were identified.

Keywords: Water Demand, Water Supply, Factors of water demand and water supply

INTRODUCTION

Globally, there have been proactive reforms in the entire water sector in the last decade and reforms in policy formulation, law and regulation, technical aspects among others (African Development Bank, 2012). Mankind lacks access to adequate and safe water to meet their basic needs (Water Aid, 2012). It has been reported that about 500 million persons in over 29 countries face water shortage. Worldwide, problems related to the management of water supply and distribution exists. This is partly due to extensive industrialization, increased population density and present high rate of urbanization (Akpor & Muchie, 2012). Over one billion people worldwide do not have access to safe drinking water (USAID, 2012). 2.5 billion people, almost 50% of the developing world's population lack enhanced sanitation facilities, and unsafe drinking water sources are used by about one billion people with no safe practice and inadequate service delivery (World Bank Group, 2019).

In Africa and particularly Nigeria, the entire water sector law has undergone little growth in the last decade and is in dire need of structural reforms to become aligned with contemporary global trends (World Bank/FGN, 2012). Ezugwu (2015) in his work reported that drinking water must attain certain degree of purity, employing water quality standards. At different locations, representative water samples are collected and analysed of physico-chemical characteristics to monitor the groundwater quality (Devendra, Shriram and Atul, 2014). Nigeria is endowed with about 267 billion cubic metres of surface water and about 52 billion cubic metres of ground water annually (Ince, Bashir, Oni, Awe, Ogbechie, Korve,

Ukoete Kenneth Isaac &Victor Nkemdirim (2026). Determinant of Domestic Water Demand and Supply in Uyo Metropolis of Akwa Ibom State. *Journal of the Environment (JOE)*

Adeyinka, Olufolabo, Ofordu and Kehinde, 2013). The mean annual rainfall along the coast in the south east is 4 800mm while it is less than 500 mm in the north east (Nwankwoala, 2015). It has abundant surface water and ground water reserves. The rate of urbanization is characterized by high population in Nigeria. Although, Nigeria is blessed with abundant water resources (estimated at 226 billion cubic meters of surface water and about 40 billion cubic meters of ground water) her rural populations are largely deprived and lack access to adequate water supplies (Abebe, Techane and Girma, 2013). About 65 million Nigerians have no access to safe and adequate water supplies; the number rose dramatically to 90 million in 2015. Nigeria did not meet the MDG target of halving by 2015 the population without adequate access to improved drinking water sources. She ranks behind many other sub- Saharan African countries such as Ghana, Rwanda, Botswana, and Sierra Leone in access to potable water (Ince et al., 2013). A significant proportion of the Nigerian rural population continue to use rivers, ponds, lakes and harvested rain as their main sources of water supply (Ezugwu, 2015). This category of Nigerians faces great risks to their health and wellbeing.

The sources of the vital resource include ground source such as ground water, precipitation which includes rain, hail, snow and fog; surface source e.g rivers, stream, glacier; biological sources such as plants, and the sea, through desalination(Abdu, 2012). While its uses spans agricultural, industrial, household (domestic), recreational and environmental activities, which could be categorized as consumptive or non-consumptive in nature.

Demand for domestic water is never constant or static but always on the increase due to increase in population, economic activities and social status of individuals. Like any other products whose demand are influenced by some factors or conditions, domestic water is not an exception. Its demand is determined by several factors among which are the income of the consumer, the household size, the cost of water, its quality, the ease and convenience of access, and climatic conditions. This makes its demand differ to place, time and season to season.

As population increases rapidly, demands for food, housing and other needs also increase greatly thereby resulting in increasing demand for domestic water. Abdu (2012) asserts that the chief influencing factors are population growth, together with changes in life style, demographic structure and possible effects of climate change. The high demand for domestic water unequivocally requires a corresponding increase in its supply, which is a process or an activity by which water is provided for domestic purposes, with the requirement that water be free enough of harmful bacteria, chemical and other contamination to be drinkable, free of substance that make its taste or appearance unpleasant. If the water is to be for washing, it must be free of salt or calcium and magnesium that will interfere with the action of soap (Abdu, 2012).

Most often there is imbalance between quantity demanded and the quantity supplied especially in developing countries and even in developed nations, as the quantity demanded is more than the quantity supplied. This imbalance results in water stress which is a situation where there is not enough water for all uses whether agriculture, industrial or domestic. This is exemplified in different ways and the most common ways are increased cost of water usage, intensified competition over access to water resources and social insecurity (break out of diseases) due to lack of water (Abdu, 2012).

The continuously intensifying scarcity of water resources is a crucial problem in almost all contemporary societies. Even in areas where there are adequate quantities of water, the problem of scarcity is usually confronted through the deterioration of water quality resulting in increasing costs for most especially indoor water uses (Abdu,2012). This scenario has led to increase diseases, sicknesses and eventually death, as well as retardation in development. The World Health Organization noted a close relationship between availability of water and economic development of a nation (Yusuf, 2012).

The effects of domestic water stress are so devastating that concerted efforts are needed to ameliorate the situation by proper water management, which is an activity of planning, developing, distributing and ensuring the optimum use of water resources. Nations of the world over are making frantic efforts in planning, developing and managing of water resources so as to meet the basic needs of the people overtime to live and to maintain a life which is descent, healthy and respectable. In order to achieve this, two basic approaches are often adopted, the supply management and the demand management approaches. The supply management seeks to provide quality and quantity of water to meet the needs of users through the construction of dams, river diversions, large water supply and treatment plants (Ohwo and Abotutu, 2014). This is a traditional policy which dominated the 20th century, and depends on utilizing new water resources. This approach was successful as water transferability from remote sources was made possible because of technological advancement and economic growth. The socio-economic benefit of transferring water was greater than the cost of exploring new resources thus making the so called supply policy to prevail.

With the extensive use of domestic water and the fact that water is a finite resource, the efficiency of the supply management measures is now questionable, thereby leading to water management strategy, which is the demand management approach. This is about governance and tools that motivate people oriented activities to regulate the amount and manner in which they access, use and dispose of water to alleviate pressure of freshwater supplies. It emphasizes sustainable development by stressing that every drop of water must be utilized effectively. Demand management takes various forms among which are water metering, water billing, retrofitting with water saving devices, leak detection/repairs, design of water reticulation, grey water reuse and wise water use methods.

Statement of the Problem

In most developing countries of the world, water requirements are not investigated accurately, resulting to development of water schemes that are either over-designed or under-designed as a result of poorly estimated population and costing of water facilities. Often times, data for this work is not available and water projects are embarked upon without carrying out proper engineering economic analysis to ascertain the viability of the project. Water demand and the population it will serve should be provided in a manner to ensure provision of sustainable water system. In a study on sustainability and impact of community water supply and sanitation programmes in Nigeria by Ademiluyi &Odugbesan (2018), it was found that Governments' inability (largely due to lack of resources) to maintain water and sanitation infrastructure has been the major factor leading to the promotion of community participation in water development programmes.

The movement of people to Uyo metropolis of Akwa Ibom State for employment, education, enjoyment of urban facilities/utilities etc has been on the increase in the past decades (Udoessien,2014). It is important to realize that, an unprecedented population growth and migration, increase urban population, and urbanization are inadvertent, thus all these eventually led to the initial human settlements into villages, towns, and then into cities (Onibokun and Faniran, 2018).

There is a problem of broken pipes during road construction, as well as illegal connection or tapping. All these lead to shortage or inadequate domestic water supply and reduction in the quantity of water demanded and utilized by households. The most crucial problems in effective water supply and distribution are the pattern of unplanned sprawls in the metropolis, and the ageing water treatment and distribution system, stressing further that erosion has exposed many pipes to the risk of damage by men, vehicles and construction activities. Furthermore, the low level of technology in the country and the state in particular poses problems to domestic water management. There is difficulty in measuring the actual amount of water use through customized logging equipment and development of software (identiflow) to identify micro-components of domestic water use in terms of volume, frequency and ownership for individual. Most households do not use modern water retrofitting appliances which could reduce water wastages and ensure efficiency in water use and proper conservation of water for posterity (Udoessien,2014).

The above scenario poses problems to domestic water demand, supply and management in Uyo metropolis and this study seeks to develop water demand model that will guide in determining water demand, provide policy thrust to improve supply sources and address the management technique so as to make the product available to the present and sustainable for the future generation. The aim of this study is to assess the level of domestic water demand, supply and management in Uyo metropolis. The specific aim was to examine the factors that determine domestic water demand and supply in the study area. While the research question includes;I What factors determine the quantity of domestic water demanded by and supplied to households in Uyo metropolis?

Study Area

Uyo metropolis is located between latitude 4°58'N and 5°04'N and longitudes 7°51'E and 8°01'E of the Greenwich meridian and cuts across the following Local Government Areas (LGAs) – Uyo, Itu, Uruan, Ibiono Ibom, Nsit Ibom and Ibesikpo Asutan. The city has a total land area of 362km² and according to 2016 estimates, is the most populous city in Akwa Ibom State, which has an estimated population of 5,482,177 (Worldometer, 2020). Uyo functions effectively as a city centre and the state capital of Akwa Ibom State. It is central to other Local Government Areas and almost equidistant and easily accessible from all the other parts of the state. Also, the area is located on an elevation of about 60.96 meters (2090ft) above sea level (Worldometer, 2020). Below is a map (figure 1) of Akwa Ibom State indicating the study area (Uyo metropolis) and showing the 31 Local Government Areas.

Climate and Vegetation

Uyo is located in a partly rainforest and swampy mangrove region of Nigeria with a tropical climate. There is significant rainfall for most months of the year. Annually, rainfall is about 2509 mm, with only three months having considerably low rainfall, from December to February. The climate of the city allows for favourable cultivation and extraction of agricultural and forest products such as palm produce, rubber, cocoa, rice, cassava, yam, plantain, banana, maize, and timber. The average annual temperature is 26.4 °C and the yearly temperature range is approximately between 22 °C and 35 °C (Worldometer, 2020). The climate is classified as rainforestmonsoon on the Köppen-Geiger climate classification system. Generally, the lowest minimum and maximum temperatures occur during the months from June to September, which is the peak period of the rainy season. The highest temperatures are usually recorded in the months of November to March, February/March being the hottest months (Udoessien, 2014). Continous removal of vegetation, one of the consequences of land cover change in the city, reduces the cooling effect that vegetation provides (Ibrahim, 2015).

Geology and Soil: The subsurface stratigraphic profile of Uyo consists from top to bottom of silty clays (0-3m), sandy clays (3-15m) and sand (10-20m) respectively. Engineering geological properties of the soils reveal that the low to intermediate plasticity clays are firm and expected to yield relatively high shear strengths (Udoessien, 2014).

Relief and Drainage: The area consists of level-to-gently undulating sandy plains where rivers are few and far between. Shallow depressions contain seasonal lakes that serve as sources of rural water supply in many areas. Agriculture and the road network are also adversely affected. Soil erosion has intensified considerably especially where gullying takes place. The drainage network in the upland part of Uyo is not dense, as rivers are few and distant apart with wide interfluves. Only one major river, the Qua lboe River, traverses the entire State from north to south. A major tributary of the Cross River, the Enyong Creek, drains the highly dissected terrain in Ikono, Ibiono and ltu (Udoessien, 2014).

According to Ibrahim (2015) studies have shown that removal of vegetation, one of the consequences of land cover change in the city, reduces the cooling effect that vegetation provides.

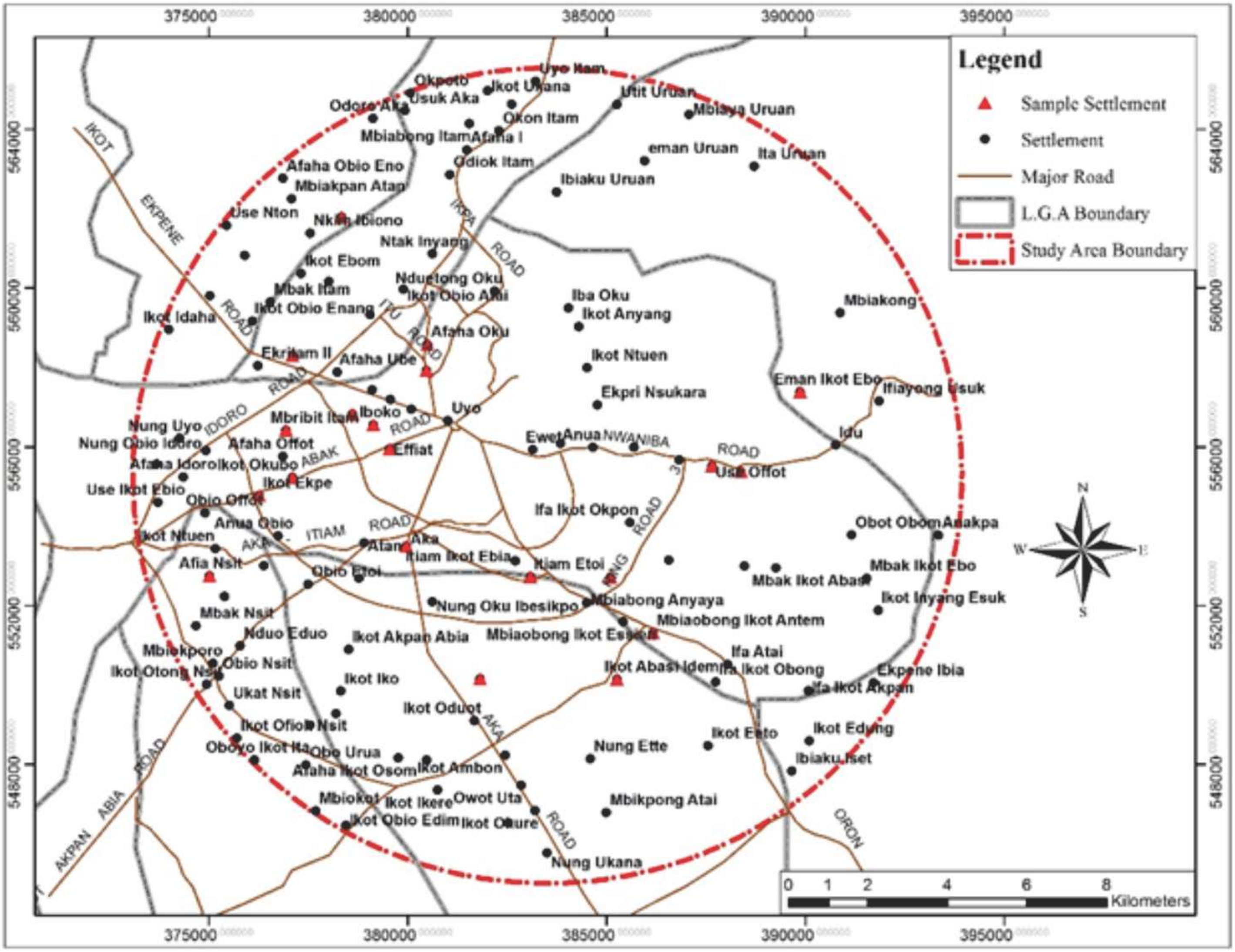

Fig. 1 : Map showing the different settlements in Uyo metropolis of Akwa Ibom State.
Source : GIS/Cartographic Studio, University of Uyo

Methodology: This research adopted survey research design procedure since the researcher is interested in studying what happens in the sample location with regards to assessing domestic water demand, supply and its management in the study area. This was achievable through, first undertaking a reconnaissance survey in order to be conversant with the study area, then administration of questionnaire schedule.

The population of this study comprises of elements relating to domestic water demand, supply and management in Uyo metropolitan area of Akwa Ibom State. The population in this case is the human population demanding, supplying and managing water for domestic purposes in Uyo metropolis. This human population is drawn from localities/settlements within the spatial coverage of Uyo metropolis. There are a total of 99 settlements/localities that makes up the study area. This is extracted from the report of the 1991 population census of Akwa Ibom State. The 1991 population of Uyo metropolis is projected to 2023 .This study employed systematic sampling technique in choosing the settlements to be sampled. This was done by listing all the settlements within the study area and selected at a regular interval after choosing the origin. For proper and wider coverage, 25% of the overall settlements shall be selected and their population projected to 2023. Also, a systematic sampling technique was used in selecting households to be administered with questionnaire in the selected localities/settlements in the study area. The private water suppliers/managers are made up of 264 private commercial borehole operators, 31 water board stand pipe and 32 Water Board Utility (kiosk) operators. Both the private commercial borehole operators and the Water Board Kiosk operators were interviewed through questionnaire administration as well as, five senior staff of Akwa Ibom Water Company. The crombach alpha statistic was used to evaluate the reliability of the instrument used and result yield a coefficients of 0.7 above which was considered good. Secondary sources information were used to collect data and were analyzed using Principal component analysis to evaluate the determinants of domestic water demand and supply in the study area.

Results and Discussion

Certain factors determine the quantity of domestic water demanded and supplied. In the demand sector the three factors were income, price of water and house hold size. In the supply sector, this was assessed in two categories; the public supply and the private supply sectors. For the public sector (Akwa Ibom State Water Board Limited) the three outstanding determinants of supply were population, cost of production and accessibility. For the private supply sector, this was further divided into three groups; private commercial borehole suppliers, private commercial water board standpipes and private commercial water board kiosk operators. The three private supply groups were each influenced mostly by these three factors population, season, and accessibility.

Diverse opinions were expressed regarding cost of domestic water, distance to water sources and frequency of water delivery. In respect to cost of water, most water board users attested that cost or price of water was affordable. For the private commercial borehole users, price of water was affordable when PHED was used but very expensive to majority of the people when generator was in use. A reduction in price of water will encourage more quantity to be demanded as attested by 78% of water board users and 87% of the private commercial borehole users. The willingness to pay showed a more favourable price of N15 per 25 litres for both public and private users.

On distance the highest proportion of 39.15% travelled between 51m-100m to water source, still a high proportion of 27% travelled 101m-150m, while a few, 1.77% travelled between 251 and above. Majority of respondents 56.7% saw the distance as unfavourable and a problem as against 43.46%. This resulted in the quest for home connection by 83.95% of respondents.

Frequency of water delivery indicated no serious problems as water was readily available and 87% and 72.2% of private and public users respectively got supply daily. Moreover, 84.7% and 86.3% of private and public users respectively were contented with service delivery, though delays sometimes were witnessed.

Conclusion and Recommendation

The private sector(private commercial borehole) plays a significant role and dominates as the major source of domestic water which majority of residents depends on. In spite of the abundance of water in the study area, the quantity of domestic water demanded by households is generally low and varies among localities, the sources and nature of supply. Moreover, there is a relationship between the quantity of water demanded with household size as well as with household facilities.The determinants of domestic water demand and supply are combinations of several factors which vary between the public and the private sectors. For the demand sectors, the outstanding factors include household size, household income, average distance to water source, cost of water and educational level. In the supply sector with reference to public supplier, the factors are population, cost of production and accessibility, while for the private commercial borehole supplier the factors are population, season and price of water.

It is evident that the sustainability of domestic water demands proper management of the product and requires the efforts of both demand and supply sectors without which the idea of sustainability would be mirage. Domestic water demand, supply and management are quite interrelated and the interplay of these three has a far reaching effects on domestic water situations in the study area. It is hoped that the understanding of these relationships would helped greatly in solving domestic water problems in the study area.

In the area of domestic water supply, the private sector played a significant role. To complement the private sector, the public sector (Akwa Ibom State Water Board Limited) should invest more resources in order to increase its densification thereby reducing the problems of distance to water sources.

ii. Domestic water demand management is necessary for efficient use and effective management of domestic water. However, this must be applied with extreme care and caution in order not to worsen the already low capita demand.

iii. In order to reduce pressure on public and private suppliers as well as the amount spent on domestic water demand, rain water harvesting should be encouraged, especially for outdoor uses.

vii. Domestic water consumers should be encouraged to use retrofitting appliances which saves water and guard against wastage.

References

- Abebe, T., Techane, B. & Girma, G.(2013). Rural water supply management and sustainability: The case of Adama Area, Ethiopia. Journal of Water Resource and Protection 5: 208-221. http://dx.doi.org/10.4236/jwarp.2013.52022.
- Ademiluyi, I.A. & Odegbasan, J.A.(2018). Sustainability and impact of community water supply and sanitation programmes in Nigeria. African Journal of Agricultural Research. 3(12): 811-817.
- Abdu, H. (2012). Determinants of Household Water Demand: A case of study of Mekelle-Ethopia. Msc Dissertation, College of Business and Economics, Department of Economics, 120p.
- Adeniji-Oloukoi, G. (2012). Assessment of the Quality of Spring Water in Ibadan, Nigeria. Journal of Applied Sciences in Environmental Sanitation 7(4): 263-268.
- Akpor, O.B. & Muchie, M. (2012). Challenges in Meeting the MDGs: The Nigerian Drinking Water Supply and Distribution Sector. Journal of Environmental Science and Technology, 4(5):480-489. https://scialert.net/abstract/?doi=jest.2011.480.489
- Ezugwu, C.N. (2015). Groundwater contamination and potential health effects. International Journal in IT and Engineering. 3(1):83-93
- Ibrahim, J.A. (2015). Ensuring sustainable water supply in Lagos, Nigeria. Master of Environmental Studies Capstone Projects. 58. http://repository.upenn.edu/mes_capstones/58
- Idowu,T., Awomeso,E. and Martins,N. (2012) An evaluation of demand for and supply of potable water in an urban centre of Abeokuta and Environs,Southwestern Nigeria. J. Dev. 3(2):60-71.
- Ifenna, I. & Chinedu, O. (2012). Heavy Metals Levels of Physico-Chemical Parameters of Potable Water in Nnewi, Anambra State, Nigeria. Archives of Applied Science Research, 4(5): 2094-2097.
-
- Imad, H.U., Akhund, M.A., Ali, M., Pathan, A.A.& Ahmed, A. (2019). Non-Volumetric Pricing is a Threat to Water Reserves. Civil Engineering Journal. 5(2), 422-428.
-
- Ince, M., Bashir, D., Oni, O., Awe, E.O., Ogbechie, V. Korve, K., Adeyinka, M.A., Olufolabo, A.A., Ofordu, F. & Kehinde, M. (2013). Rapid Assessment of Drinking Water Quality in the Federal Republic of Nigeria: Country Report of the Pilot Project Implementation in 2004-2005. WHO/UNICEF.
- Nwankwoala, H.O. (2015). Hydrogeology and Groundwater Resources of Nigeria. N Y Sci J 2015; 8(1): 89-100]. (ISSN: 1554-0200). http://www.sciencepub.net/newyork. 14
- Ohwo, O. & Abotutu, A.(2014). Access to potable water supply in Yenagoa Metropolis. American Journal of Water Resources, 2 (2): 31-36. DOI:10.12691/ajwr- 2-2-1
- Onibokun, I and Faniran, E. (2018). An Assessment of the Impact of Abattoir Effluents on River Illo, Ota, Nigeria. Journal of Environmental Science and Technology, 1(2):56-54.
- Udoessien,E.(2014).Basic Principles of Environmental Science,Etilicus Inter.Pub.,Uyo,AkS.
- United States Agency for International Development. (2012). Access to Water Sanitation and Hygiene (WASH), retrieved on April 11.
- WaterAid Nigeria. (2012). Federal Government tasks WaterAid in Nigeria to lead monitoring and evaluation of WASH projects. (accessed 17 January 2012).
- World Bank/Federal Republic of Nigeria.

(2012). Water Supply & Sanitation Interim Strategy Note, November 2000, (accessed 11 April).

- World Bank Group. (2019). Water and Sanitation PPPs. Washington, DC. The International Bank for Reconstruction and Development
- Worldometer. (2020). Nigeria Population, www.worldometers.info/world-population/nigeria-population, (accessed 15 September).
- Yusuf,A. (2012). An analysis of the domestic water demand and supply in ilorin metropolis, kwara state. Res. J. Environ. Earth Sci. 1(1)16-21.