EVALUATION OF DOMESTIC WATER SUPPLY SYSTEM: CASE STUDY OF BOSSO COMMUNITY, MINNA, NIGER STATE, NIGERIA

J. J. Musa, and P. Y. Aileku

Department of Agriculture and Bioresources Engineering, Federal University of Technology, P. M. B. 65, Minna, Nigeria
Corresponding Email: johnmusa@futminna.edu.ng

ABSTRACT

Water supply system plays a vital role in preserving and providing a desirable life to the public. The reliability of sources of water supply is an essential component to every development. In this study, a detailed analysis of the major factors behind people's choice for a particular source of water in Bosso Community was investigated. To achieve this, an investigative research approach method was employed by randomly distributing one hundred and fifty (150) structured questionnaires within Bosso community. The result showed that, 14% of the households in Bosso community obtain their drinking water from Tap water, 8% from the wells dug in their respective homes, 10% from boreholes, 58% from packaged water and 10% from water vendors whose exact source of water is unknown. It was observed that majority of the residential areas in Bosso community do not depend on the tap water supply rather they depend on dugged wells and bore holes. It was therefore concluded that large water storage facility and pump stations should be provided at major areas of the town to service the residents with treated water.

Keywords: *Water supply, reticulation, public-private partnership, Bosso*

1. INTRODUCTION

Since independence of Nigeria from her colonial masters, several administrations have made water supply to growing population its primary target, thus many water supply schemes have been and are still being commissioned to satisfy political promises and aspirations without resources maintenance consideration (Onuoha *et al*., 2012).
Water distribution system plays a vital role in preserving and providing a desirable life quality to the public, of which the reliability of supply is a major component. Reliability analysis of a water distribution system is concerned with its ability to deliver water to individual consumers in the required quantity and under a satisfactory pressure (Musa and Fumen, 2013).
Domestic water supply is water used for all useful domestic purposes including consumption, bathing and food preparation. The need for domestic water supplies for basic health protection exceeds the minimum requirement for consumption (drinking and cooking). Additional volumes are required for maintaining food and personal hygiene through hand and food washing, bathing and laundry. Without water, people's health and livelihoods can be severely affected; the education of children (particularly girls) suffers as the daily tasks of survival take precedence overall other

concerns (Onuoha *et al*., 2012). It is recognized all over the world that water is a vital resource for the existence of man and also a commanding factor with respect to the development of human civilization.

The importance of good quality and quantity of water for use by man cannot be over emphasized as there are still a lot of cases of diarrhoea in sub-Saharan Africa. Water, the most essential commodity in human life is becoming very scarce due to human activities. The availability of potable and safe water is a problem in developing countries of Africa especially Nigeria (Agbabiaka *et al*., 2014). Nigeria in the recent time is experiencing an increasing change in her population coupled with increased urbanization and living standards (Owoeye and Adedeji, 2013). Thus the increasing needs of water for domestic and other uses, places an increasing demand on our water resources. Water as a vital resource is not in short supply in Nigeria particularly in Minna but regulating its availability and ensuring even distribution is in fact a serious challenge. However, the quantity of potable water availability to the inhabitants of this community has received cries of inadequacies (Adepoju and Omonona, 2009). The rapid urbanization process in Bosso has taken its toll on overcrowded dwellings, high rate of pollution, inadequate household facilities, and carefree attitude of people toward poor environmental conditions which have been the precondition for deteriorating environment.

Water is a movable natural resource that can be administered in various methods pertaining to specific socio-economic activities. This involves ground water drilling, rainwater harvesting, hauling, stockpiling and redirecting. These are typical features of water that makes it unique as compared to other innate reserves. This being the case, any kind of water management that hampers the natural course will result in an adverse effect upon the natural environment and put human health at risk.

The purpose of domestic water delivery systems is to transport potable water from a water treatment facility to residential consumers, for use as drinking, cooking, sanitary conditions, and other domestic purposes (Hickey, 2008). Water supply also is essential for business and industry to operate in a municipal environment (Alayande, 2005). Of no less importance is the need to supply water to properly located fire hydrants with maximum pressure for an effective level of fire protection.

The objectives of this work is to study and evaluate the installed municipal water supply delivery system by identifying the physical components of the specified water distribution and supply system in Bosso community, Niger State; to assess the water delivery system capability and ascertain whether the system is meeting the water supply demand and to proffer possible solutions to the domestic water supply problems encountered in Bosso community.

2.0 METHODOLOGY OF RESEARCH

2.1. The Study Area

Bosso is one of the twenty-five local government areas in Niger State, with its headquarters in Maikunkele with a land mass of 1,592 km^2 and a population of 147,359 (NPC, 2006), with Latitude 9° 39' 11" N and Longitude 6° 30' 57" E. Bosso like every other community in the north central area of Nigeria is divided into two seasons of wet and dry period within a year with an annual rainfall of 578 mm and a mean temperature of 34 ^{0}C (Musa *et al*., 2011).

2.2. Data Collection

This study was conducted using the Investigative Research Approach method, which deals with the distribution of questionnaires, personal interview and field observations. These were done using structured questionnaires to households in Bosso community in addition to field observation, focus group discussions, and informal interviews. Secondary information were also collected from the internet, Census and survey reports, news reports, journals as well as other published and unpublished documents. Table 1 presents the distribution pattern of the questionnaires to the Government Reserved Area (GRA), Bosso Village, Tudun Fulani, Dusten Kura Gwari and Dusten Kura Hausa, respectively.

Table 1: Distribution pattern of questionnaires

Area	No of Questionnaires	% of Total Questionnaires
GRA	40	26.67
Bosso Village	40	26.67
Tudun Fulani	30	20.00
Dusten Kura Gwari	20	13.33
Dusten Kura Hausa	20	13.33

The questionnaires contained both close and open-ended questions. The close-ended questions were meant to capture direct answers from the respondents, while the open-ended questions were also meant to allow the respondents to express their views as they wish. This was also meant to arrive at relevant information that could not be obtained by the close-ended questions. The entire field data collection covered 150 households of Bosso which also implies that 1 % of the total population in the community was covered. During the administration of the questionnaires, field observation was carried out to fully understand what people go through when they clamor for water. The questionnaire was structured to obtain both primary and secondary data which was to be completed by the selected households within the study area.

The Statistical Package for the Social Scientists (SPSS) and MS Excel 2010 were employed to analyze statistically the obtained information from the questionnaires.

3.0. RESULTS AND DISCUSSION

3.1 Major Source of Household Drinking Water

A total of 150 questionnaires were administered and only 147 (98%) were returned.The source of water in the study area depends upon the regularity and the adequacy of supply of tap water, well water, borehole, other sources of water. Figure 1 shows that 14% of the households in Bosso community obtain their drinking water from the tap water, 8% from the wells dug in their respective homes, 10% from their boreholes, 58% from packaged water and 10% from water vendors. This is similar to the work carried out on public perception of potable water supply in Abeokuta South west, Nigeria by Odjegba *et al*. (2015).

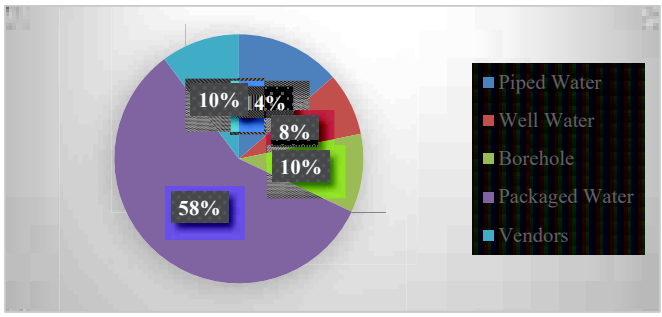

Fig. 1: Major Source of Household Drinking Water.

Despite the efforts of all the three levels of government, the effect of clean potable water and its constant availability is yet to be felt in the Bosso community. This community is known to house one of the campus of a higher institution, thus the rate of provision of water through the water Board has in the recent time not being able to meet the growing demand of the public because of the population explosion in the area. The study showed that 46% of the residents had reticulated water system and other sources of water (borehole and open wells) connected to their various residents which provide them the much needed water for their domestic use and improving the sanitary condition of the community. This is similar to the work of Odjegba *et al*., (2015) which looked at public perception of potable water supply in Abeokuta South west, Nigeria and that of Ndiyo *et al*., (2013) who reviewed the domestic water supply and basic sanitation gaps in local government areas in Cross River State, Nigeria in relation to Millennium Development Goals (MDG) investments. The percentage of those that were not connected to the Water Board network was 54%. This percentage state that they depend mainly on wells and boreholes from neighboring houses for their daily provision which only meets some of the basic needs which is similar to the study carried out by Ajadi (2010). The 46 % confirmed that they obtain a higher quantity of treated water from the public source of water supply other than the private water supply system of wells and boreholes. The study showed that the water supply is not sufficient to meet the water demand over the projected future due to inefficiency of the piped water supply system and the inadequacy of alternative private sources of potable water and also the increasing population.

3.2. Condition of Tap Water Supply

The survey results indicated that only about 7% of the respondents have satisfactory condition of tap water supply; about 37% of the respondents have poor conditions of water supply, while the remaining 66% do not have tap water running in their houses. Figure 2 shows the response of the residents of Bosso community with respect to the condition of the reticulating system. Thirty three percent (33%) of the respondents being served through the reticulated systems observed that their taps produce particles which they have to either allow to settle down or sieve before use. The particles observed were dirty brown in color which is an indication of rusting in the pipes servicing the various residents. 67 % of those served with reticulated systems stated that such particles are found in the water they collect. On further interview, the residents whereby particles were found in their water stated that most of the pipes were laid in the mid 70s, thus the rusting could be linked to the age of the pipes. They also stated that the Water Board bill them certain amounts which they are willing to pay more provided there will be an improved service delivery to their various homes.

This is similar to the situation reported by Ayanshola, *et al*., (2013) who evaluated the willingness of the public to pay for reliable and sustainable household water use in Ilorin, Nigeria.

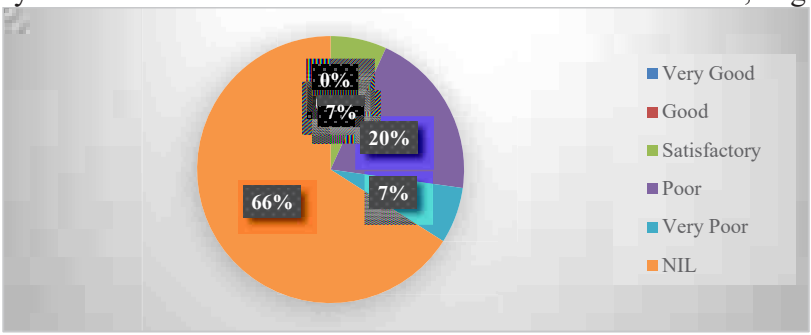

Fig. 2: Condition of reticulatry system for Water Supply in Bosso Community

Due to inefficiency of the other alternative sources of water, the purchase of water from water vendors have become rampant in Bosso community. When asked during the survey, the respondents stated that a jerry can of water is sold for about N20 – N25 during the rainy season, and N30 - N40 during the dry season. A tanker of 5000 liters of water is purchased for between N7,500 and N10,000 depending on the distance. A bag of sachet water is sold for N120 and a pack of bottled water costs N500 within the community. Ariyo and Jerome (2004) in their studies reported similar figures.

3.3. Water Collection and Storage

Water from the public water supply system and from the alternative sources are collected and stored to service the needs of various homes over a period of time. Figure 3 shows that 8% of the respondents store water in Jerry cans, 20% of the respondents store in open and covered buckets, 31% of the respondents store water in basins and the remaining 41% of the respondents store water in tanks or reservoirs privately purchased or constructed. This they stated will provide water for domestic use for a minimum of two days and maximum of four days before the next supply. This is similar to the works of Ubani *et al*., (2013) and Gerlach and Franceys (2006).

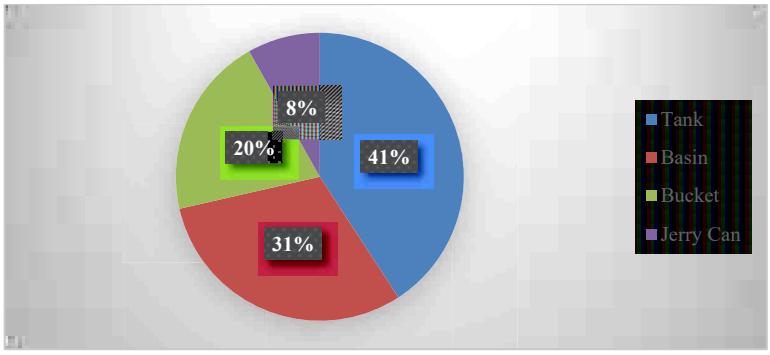

Fig. 3: Storage mediums for water by residents of Bosso Community.

4. Conclusions

Provision of water supply and management poses a serious challenge to most cities in Nigeria. The increasing pressure on government in relation to challenges emanating from the water sector has made the private sector participation inevitable just as it has brought improved performance to some few developing nations where it has been practiced. Evaluation of water supply and distribution system in Bosso community was studied to measure the ability of meeting the consumers demand. It was discovered that majority of the residential areas in Bosso community do not depend on tap water supply rather they depend on water vendors, dugged wells and bore holes. This has resulted in the drilling and digging of boreholes and open wells in most residential homes. These methods of underground water extraction possess many environmental hazards such as landslides. Due to the topographical nature of Bosso and its environment, a large water storage facility and pump stations should be provided at major areas of the town to service the residents with treated water. This will reduce the rate of drilling and digging of boreholes and wells, respectively and will further enhance prompt supply of water at every other day to the residents of the town.

One of the policy trusts of National Water supply and Sanitation (NPWSS), 2000 and the MDG's goals are to provide; adequate and potable water supply to the urban and rural population by the year 2015. To achieve the national and state water supply policy objectives major institutional reforms must be carried out in our water sector. This requires the dramatic scaling up of efforts, both in terms of the extent of action required and the speed with which these actions must be undertaken by the various arms of government and the public. The NPWSS policy and World Bank programmes have identified commercialization and private sector participation as some of the options in solving these problems. Public-Private-Patternership (PPP) option for water supply offers one of the ways out of the urban water problems in our city and meeting the 2015 MDGs. Once it is promoted and appropriate division of roles for the identified partners is decided, improvement will be recorded without further increase in investment by government.

REFERENCES

Adepoju, A. A and Omonona, B. T. (2009). Determinants of Willingness to Pay for Improved Water Supply in Osogbo Metropolis; Osun State, Nigeria. Research Journal of Social Sciences , 4: 1-6,

Agbabiaka, T. O., Sule, I. O. and Oyeyiola, G. P (2014). Spatial Assessment of Public Water Supplies in Densely Populated Areas of Ilorin Metropolis, Kwara State, Nigeria. Fountain Journal of Natural and Applied Sciences: 3(1): 20 – 28

Ajadi. B. S. (2010). Potable Water Availability and Consumption Pattern in Ilorin Metropolis, Nigeria. Global Journal of Human Social Science, Vol. 10 Issue 6, pp 44 – 50.

Alayande A. W. (2005). Water Demand Management. Paper delivered at the Urban Water Supply Facilities Maintenance Course held at National Water Resources Institute, Kaduna. November 7th -18th, 2005.

Ariyo, A., and Jerome, A. (2004). Privatization in Africa: Lessons from the Ghanaian and Nigerian Experience", Public and Private Sectors: Towards a Balance, Unit 3, African

Development Yearbook Perspective, Volume 10 (2003/2004):edited by Karl Wohlmuth and Tobias Knedlik, Forthcoming.

Ayanshola, A. M., Sule, B. F., and Salami, A. W. (2013). Evaluation of Willingness to Pay for Reliable and Sustainable Household Water Use in Ilorin, Nigeria. Ethiopian Journal of Environmental Studies and Management Vol. 6, pp 754 – 762. http://dx.doi.org/10.4314/ejesm.v6i6.6S

Gerlach, E., and Franceys, R. (2006). A partnership model to deliver water and sanitation to the Urban Poor. 32nd WEDC International Conference, Colombo, Sri Lanka, pp

Hickey H.E. (2008). Water Supply Systems and Evaluation Methods. Water Supply System Concepts, Water Supply System Concepts. Vol. 1. *https://www.usfa.fema.gov/downloads/pdf/.../**water_supply_systems_volume**_i.pdf*

Musa, J. J., Adewumi, J. K., Adeoye, Mustapha, I. H., and Adebayo, E. S. (2011). Physico-chemical Assessment of Groundwater as a Source of Domestic Water Use in Some Selected Settlements in Minna, Niger State. IUP Journal of Science & Technology, Vol. 7, No. 2, 35-44

Musa, J. J., and Fumen, G. A. (2013). Assessment of Potable Water Supply Sources In Ilorin Metropolis, Kwara State, Nigeria. Int. J. Agril. Res. Innov. & Tech. 3 (1): 1-4

Ndiyo, N. A., Okon, E. O., and Olumide, A. S. (2013). Bridging domestic water supply and basic sanitation gaps in local government areas: lessons for MDGs' investment in Cross River State, Nigeria. Global Advanced Research Journal of Peace, Gender and Development Studies Vol. 2 (4): 61-80

NPC (2006). National Population Census: National and State Population and Housing Tables, Vol. 1. www.population.gov.ng/index.php/census (Accessed date: 14/07/2015)

Onuoha, S. N., Idike, F. I., and Orakwe, L. C. (2012). Water Supply Resources for Domestic Purposes in Auchi Metropolis of Edo State, Nigeria. International Journal of Engineering and Technology Volume 2, No. 6, 1032 – 1039

Ubani, N. O., Jude, D. E., Okonkwo, U. C., Nduka, N. B., and Chibundu, I. (2013). Water Pipeline Network Analysis Using Simultaneous Loop Flow Correction Method. West African Journal of Industrial and Academic Research Vol.6 No.1; Pp 4-21

Owoeye, J. O., and Adedeji, Y. M. D. (2013). Poverty, Sanitation and Public Health Nexus – Implications on Core Residential Neighborhood of Akure, Nigeria. International Journal of Developing Societies, Vol. 2, No. 3, 96-104. DOI: 10.11634/216817831302448

Odjegba, E. E., Odjegba, O. A., Ikenweiwe, N. B., Martins, O., and Sadeeq, A. Y. (2015). Public Perception of Potable Water Supply in Abeokuta South west, Nigeria. J. Appl. Sci. Environ. Manage. Vol. 19 (1): 5 - 9