Urban water usages in Egbeda area of Oyo State, Nigeria

Temitope Oyedotun

Urban water usages in Egbeda area of Oyo State, Nigeria

Temitope Dare Timothy OYEDOTUN*

* Department of Geography and Planning Sciences, Adekunle Ajasin University, P. M. B. 001, Akungba-Akoko, Ondo State, Nigeria.
(E-mail: oyedotuntim@yahoo.com)

Abstract

The increasing urbanisation of Egbeda town has put pressure on the scarce freshwater resources for the multifarious household usages. 149 households were sampled to evaluate their water usages and needs through the use of prepared questionnaires. It is discovered that the town is entering the category of "water stressed" towns which is a typical phenomenon in the 21st Century developing urban cities. As the population increases, the per capita water share diminishes. Unfortunately, the limited freshwater available are below the WHO Drinking Water Standard as observed from the analysed samples from the four main sources. Major limitations observed is peculiar in a developing country like Nigeria which include lack of accurate data and the unwillingness of many households to participate in questionnaire interview. However, the method adopted remains a vital medium by which urban water usage can be evaluated in developing countries where there's no standard water metering supplying system.

Keywords

Developing countries; water quality; water usages; contaminants; urban.

INTRODUCTION

Urbanisation, as an age-old phenomenon, has been described as the process by which human agglomerate in multi-functional settlements of relatively large size (Mabogunje, 1981; Central Bank of Nigeria (CBN), 1999). However, if this phenomenon is properly controlled and managed, it connotes civilisation and socio-economic progress (CBN, 1999) - this is being true of the Western world. If it is not controlled, on the other hand, it would be characterised with several ranges of social vices and economic problems including but not limited to environmental pollution, inadequate and poor housing provisions, disproportionate high rate of unemployment, crimes and violence, uncontrollable high poverty rate, water resources problems and a host of other developmental challenges- the emblems of many developing countries, especially those domiciled in sub-Saharan Africa. One of the important components of any area (whether urban or rural) is the development of water resources for various uses and purposes to which they can be put. Water issues have, therefore, always been on the fore-front of political and academic headlines, discussions, forums and conferences at various spheres. This is because of the water's undisputable importance to man's daily life and earthly existence. Water has always been serving communities and sustaining life through-out the history of man-kind.

There is an abundant of fresh water resources in Nigeria, particularly in the south-western region of the country (Obatoyinbo and Oyedotun, 2011) where Egbeda Local Government Area (LGA) is situated. Rijswljk (1981) estimated the groundwater resources in Nigeria at 0 – 50m depth to be 6 X 10^6 km^3 (6 x 10^6 m^3) while Hanidu (1990) estimated the total surface water resources to be 224 trillion litre per year (l/yr). However, Akujieze, *et al.* (2003) estimated the total

groundwater yield from the eight mega regional aquifers in Nigeria to be 7.2 times Rijswljk (1981)'s figures as a result of additional groundwater input/yield to the aquifers, the total of which is estimated to be 50 million trillion litre per year (Akujieze, et al. 2003). Hence, there is a notion of an assured abundant of fresh water resources in Nigeria to meet the rising populations of the country. However, a recent report by the United Nations Development Programme (UNDP) Human Development Index placed Nigeria 159 among 177 countries assessed for unavailability of safe water and also among the 30 nations with poorest quality of life worldwide (Ifabiyi, 2012). Another report by Central Bank of Nigeria as indicated in Ifabiyi (2012) stated that as much as 70% of the Nigeria's population are living on less than One US Dollars ($1) daily income with about 40% of the entire population illiterates which may not be able to apply simple hygiene (Ifabiyi, 2012). These worrying findings suggest that relatively high percentage of Nigerians is vulnerable to water borne diseases and other related water problems/issues. Furthermore, the annual renewable per capita fresh water for Nigeria has been observed to be on the decrease- the development of which is complicating the already established challenges facing the nation. Ifabiyi (2012) stated that the annual renewable per capita freshwater in Nigeria was 2,203 Cubic Metres (Cu) in 1990, and the amount was discovered to be 1,292 Cubic metres in 2003.

In a nutshell, millions of Nigerians have no access to safe water and sanitation- just like their fellows in other parts of the developing countries. They face daily problems in obtaining water for domestic purposes and other multifarious uses. Ifabiyi (2012) stated that the coverage of potable water in Nigeria was 20% in 1980 which later rose to 30% in 1985, 35% in 1991 and approximately to 55% in 2007 respectively. However, despite the increase in coverage the real service level in some rural and urban areas is about 10 and 30 litres per capita (lpcd) respectively. The service level in urban cities in Nigeria have been bedevilled by breakdown of water infrastructural facilities, the increasing negative effects of climatic changes in form of bouts of dry spells, and the geometric urban population increases as a result of rural-urban migration influx and the high birth rates which have placed so much demand on the limited urban water infrastructural facilities.

All the above issues point to the fact that Nigeria is a water stressed nation, and every efforts must be geared at addressing the water issues in the country, especially in the urban cities. The consumption and usage of contaminated and polluted water has been noted to be one of the most important causes of ill health and sicknesses, particularly in developing country (Ford, 1999). Therefore, the surveillance of freshwater (drinking water especially) supplies in urban areas is a very significant efforts at protecting the public health (Howard, et *al.*, 2002). However, the adoption and implementation of effective drinking-water surveillance is either limited or non-existence in many developing country, despite the importance of such programmes to urban dwellers and population (Howard, et *al.,* 2002). Where such exist, they focus mainly on the distribution and maintenance of piped water supplies, irrespective of the existence and use of other source/form of water for domestic or industrial use. In many urban communities in developing countries, most of the households collect water from communal sources. The pattern of water usages in urban communities in developing countries is, however, often complex as a result of variety of different sources offering different acceptability, cost, reliability and qualities (Howard, *et al.,* 2002).

The information and knowledge of the variety of water sources available to the low-income urban population will lay a solid foundation for the initialisation of effective water supply surveillance, proper design and implementation of freshwater resources management, identification of the sources of water-related illnesses and diseases, and the cost-effective approaches of meeting the water needs of growing urban populations. The main purpose of this

paper, therefore, is to assess the water usage pattern in Egbeda area, one of the urban communities in Ibadan, Oyo State of Nigeria. The paper focuses on the identification of household water usages in, and the quality of the available ones on, the urban community.

The study area

Egbeda town is the current political headquarter of Egbeda Local Government Area (LGA) of Oyo State. It is one of the 33 LGAs of the state and one of the eleven (11) LGAs that make up Ibadan Metropolis. The town is located on latitude 7^0 21'-8^0N and longitude $4^0$02' - $4^0$28'E with a total land area of approximately 191km^2(Figure 1). The Egbeda LGA was carved out of the old Lagelu LGA in 1989 (Lawal, et *al.*, 2011), the development of which has led to the rapid expansion of the town from the agrarian community to urban town.

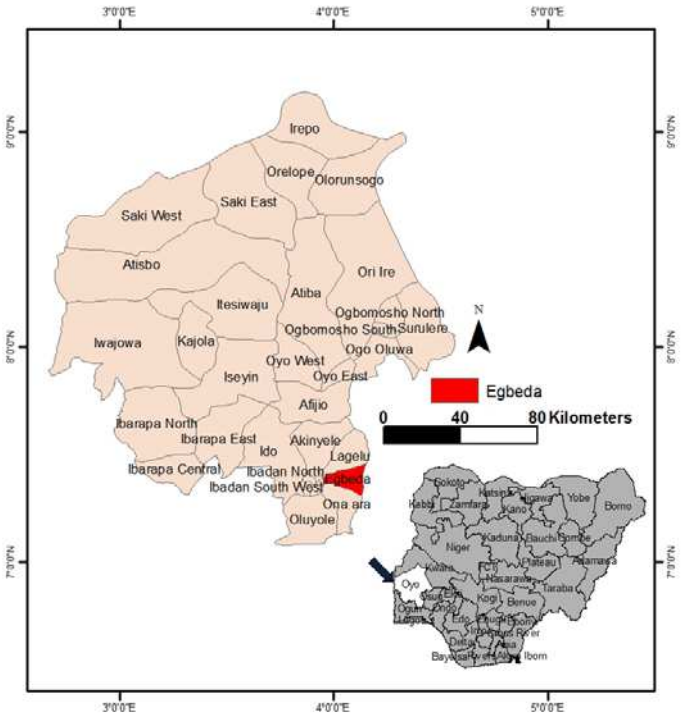


Figure 1: Map of Oyo State showing the study area (Egbeda). *Inset:* Map of Nigeria showing Oyo State.

The town lies generally on a gently rolling/undulating plain which falls below 180 metres (600ft) above sea level in most parts of the entire LGA, while the lower parts which are very close to the flood plain of River Osun, both on its right and left bank, are on the height as low as 150 metres (500 ft) above sea level. However, the entirety of Ibadan (the study area included) is made up of the rock basement complex principally. More than ¾ of the basement rock in Egbeda occur as banded gneisses, whole granite, gneisses and quartzites share the rest in almost equal proportions (Grant, 1970). The rock types are covered in most places by weathered materials and outcrop in a few places. River Osun is the main river in the study area and others like Omi, Idogun, Okesuru are tributaries to it. While these tributaries together with River Osun usually overflow their banks during the rainy season in May – October, they however dry up completely during the dry season- making River Osun to be the only permanent river in the area, the others are seasonal.

The current population figure of Egbeda area at the 2006 Housing and Population Census is 281,573 (National Population Commission- NPC, 2006). The earlier population figure of the community was 128,998 in 1991 Census. This indicates an increase of 54.2% in the total population within the space of 14 years. This sudden geometric increase in the population is

expected to have led, as usual, to an increase in the demand and usage of water for various domestic uses (cooking, drinking, bathing, washing, etc). The research is carried out at Egbeda, Olode and Alakia- which are among the 11 communities/wards that make up the Egbeda LGA.

MATERIAL & METHODS

A set of questionnaires was used to collect information from the communities on their water usages. The information derived from the questionnaire are used largely to determine the pattern of water usages in the study area. Complete interview of the inhabitants in Egbeda town is costly, time consuming and impracticable due to resource constraints. Consequently, a representative sample of 149 households in all was chosen from each of the three communities in the study area. The communities were chosen for the survey because they are relatively urban and are the main Central Business District of the LGA. The communities chosen have population of over 30,000 and they are devoid of agrarian activities. Also, the willingness of the heads of those communities to allow the researcher to carry out the survey questionnaire as well as the easy accessibility of the communities are another factor for their choice. The household heads were selected for interview from each of the communities. However, where the household heads could not provide some information/answers, the wife or any other family members are readily called upon to provide such information. The selection of the respondent at each community was done by reference to a systematic random sampling. Where any particular household head refused to grant the interview or allow the researcher to take the water samples, the house is omitted and another house was selected to replace it. The researcher ensured that both written and oral interview was conducted among the residents of the communities. The total percentage questionnaires distributed and retrieved in respect to each community visited are as shown in Figure 2 below.

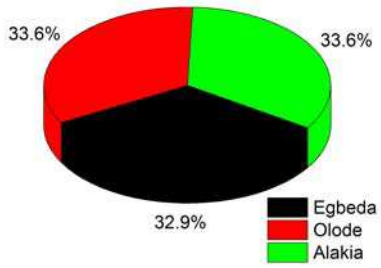


Figure 2: Distribution of questionnaires in the communities within Egbeda town.

Though there are quite a number of possible approaches to gathering information concerning water use behaviour in developing countries, including both qualitative and quantitative techniques (McGranahan, *et al.*, 1997; Howard, *et al.*, 2002), lack of data about water usage in the study area has left the researcher with no other option than the use of questionnaire to elicit information from the dwellers/residents. Apart from lack of data on water usage in the study area, the unwillingness of many households to participate in questionnaire interview is another challenge faced by the researcher. However, the use of questionnaires to elicit information on water usage remains a vital medium by which urban water usage can be evaluated in developing countries where there is no standard water metering supplying system. The questionnaire was developed for the purpose of the study and targeted at eliciting information about three (3) key main issues (after Howard, *et al.,* 2002):

- the source of domestic water use for the households, and their relative priority;
- the factors which influence the choice of water source; and,
- the extent to which differential use of water sources is in operation.

The second methods adopted in the research involved the evaluation of the water samples from the different sources identified during the questionnaire administration. Twelve water samples were collected from four different locations at each of the three communities. About 30 mL of water samples were collected using clean plastic containers, then labelled and preserved in refrigerator until they were taken to the laboratory for chemical analysis. The major cations analysed for and the findings of which will be reported in this paper include calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}) and anions such as sulphates (SO_4^{2-}), chloride (Cl^{-}) and iron (Fe^{2+}). The analysed results are then compared with the World Health Organisation (WHO) recommended standard for drinking water quality. The table 2 below gives the summary example of these recommendations.

Table 2: Summary of Physical and Chemical Characteristics and WHO (1984) standards for drinking water

Measured parameter	GW*	SW*
Temperature (°C)	27.17	24.96
pH (pH Unit)	7.91	7.70
EC (ms/cm)	437.59	106.00
TH (mg/L)	16.14	3.84
TDS (mg/L)	250.98	46.50
SAR (mg/L)	0.56	0.99
Ca^{2+} (mg/L)	45.75	4.39
Mg^{2+} (mg/L)	4.58	3.97
Na^{+} (mg/L)	11.61	7.46
K^{+} (mg/L)	19.08	7.17
Fe^{2+} (mg/L)	0.19	0.14
HCO_3^{-} (mg/L)	31.71	25.82
Cl^{-} (mg/L)	29.91	18.13
SO_4^{2-} (mg/L)	1.40	1.64
PO_4^{3-} (mg/L)	0.01	0.01
NO_3^{-} (mg/L)	3.81	6.39

GW*= Groundwater; EC = Electrical Conductivity; TH = Total Hardness; SAR = Sodium Absorption Ratio; SW* = Surface water (mean concentration) for each group; TDS = Total Dissolved Solid
Source: World Health Organization (1984, 1993, 2011)

RESULTS AND DISCUSSION

Choice of water supply and use

The analysis of the findings indicates that 89.3% of the households depend on more than one source for their domestic water supply (Figure 3). In the three communities, none of the household make use of piped-borne water taps because of the unavailability of that source in the communities. The information collected from each of the households included questions on first choice water source type, use of more than one source and any other sources used outside the home. In Alakia, hand-dug wells represent the most common first choice, followed by rain-water

during the rainy seasons and hand-held borehole during the dry season with the use of surface water as non-existence. In Egbeda and Olode communities on the other hand, the protected hand-held boreholes represent the first choice among the middle- and low- income earners, with as many as 38.2 % and 36.2% respectively making the hand-dug wells as their second choice. Other sources of water like rivers and streams are sought by the households for another uses apart from drinking and domestic consumptions. Rivers, streams and unprotected springs are being utilised in all the three communities for car washing and for laundry by low income earners (Figure 4).

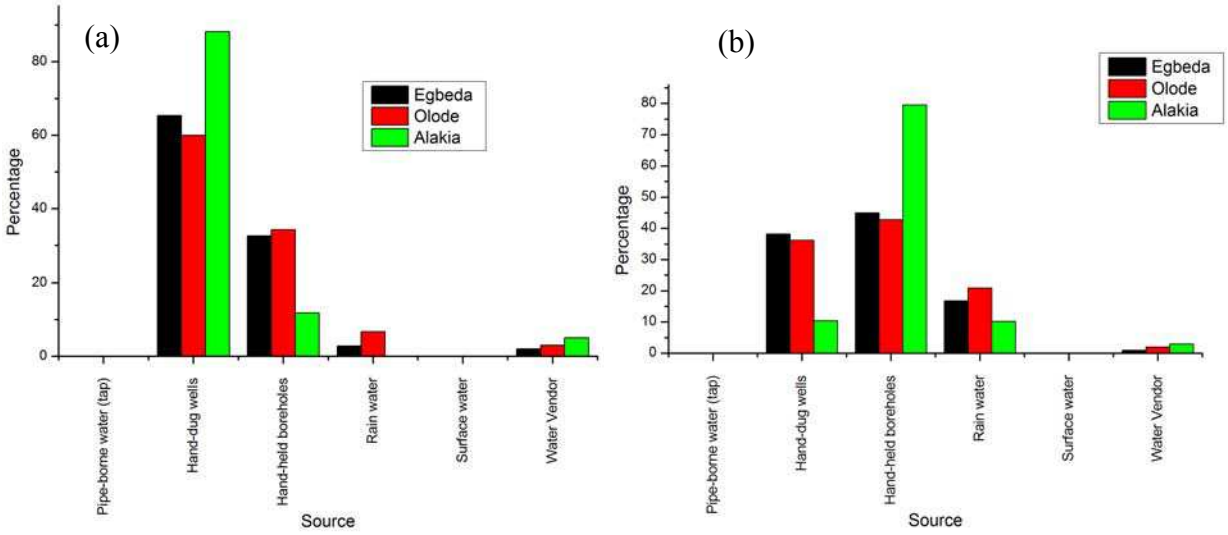


Figure 3: The percentage of (a) first choice and (b) second choice drinking water source by households.

The main reasons why no household source their domestic water supply from pipe-borne water tap is simply because there is no provision of such in the community. 76.4% of the respondents in the three communities indicate their willingness to be getting their water supply from public tap if there is a provision for it by the government while 34.6% of the respondents indicated that they would still prefer their reliance on hand-dug wells. The 76.4% who desired to source their water supply from public tap (if provided by the government) hinge their willingness on the belief that such a source will guarantee a high level of drinking water quality because of the level of treatments such would have to go through before being made available to the public. The 34.6% who are sceptical about sourcing their domestic water consumption from public taps are of the opinion that many of the government provision are not of high standard and quality. As such, the provisions of public water are expected to follow the similar patterns of other poorly provided social services by the government. They, therefore, concluded that knowing the source of their own water supply is a key to clear any doubt of what their un-trusted and selfish politicians/government may provide. Some stated that lack of continuity of such provisions and the speedy decaying nature of many public infrastructures/facilities are some of the attributes of government provided facilities which would discourage them from relying on the government supplied pipe-borne water. However, the widely indicated second choice source type for drinking and domestic water consumption is public protected boreholes in all the communities sampled for the study (Figure 3b). The number of the households with their own hand-dug wells in Alakia (72%) are more than that of Egbeda (23%) and Olode (05%)) areas respectively where majority of the households source their domestic water needs from their neighbours who have hand-dug wells within their compounds.

Figure 4: Laundry at one of the streams at the study site (Egbeda).

The high percentage (72%) of households with their own hand-dug wells in Alakia corresponds with the combined percentage of the households which identify themselves as either high income (#80,000 and above, monthly income) or middle income (#30,000 - #79,999 monthly income) which are 12% and 61% respectively compared to those with low monthly income of 27% (<#30,000 monthly income). The percentage of the households with low income is higher for Egbeda (54%) and Olode (71%) than for that of the middle and high income for both communities {Egbeda- middle (54%), high (1%); Olode- middle (28%), high (1%) respectively}. The logical conclusion that can be deduced is that the households with high and middle income tend to make provision for their own hand-dug wells to serve as continuous source of water supply for their multifarious water needs. Those with low income who could not afford such provision, however, have to rely on the generosity of their neighbours for their water supply or to make use of the public hand-held borehole in their community.

Despite the differentiation of the choice of water sources for domestic usages in the households into first and second choices, evidences from the field study and the responses of the respondents suggest that second choice are typically used several times by the households per week as no single source could meet the growing needs of the households for multifarious domestic needs like cooking, drinking, bathing, sanitary, etc. There was, therefore, little overall differentiations in frequency of use between the first and second choice sources- as also observed by Howard, *et al.* (2002) in a study on Ugandan towns. This shows that it is regular pattern in the developing world where the households source for their own water supply provision.

It is of importance to mention that the dependence of the households on different sources also depend on the seasons of the year. While many considers rainwater as the first or second choice during the rainy seasons, almost all of the respondents depend on either hand-dug wells (if they do no dry up during the dry seasons of October - February, as many as 62.3% of the hand-dug wells at the sampled households dry up during the dry season) or the protected hand-held public boreholes for their sources of water usage. However, some of the given reasons why the household depend on hand-dug wells or public protected boreholes for their source of water usages in the communities are:

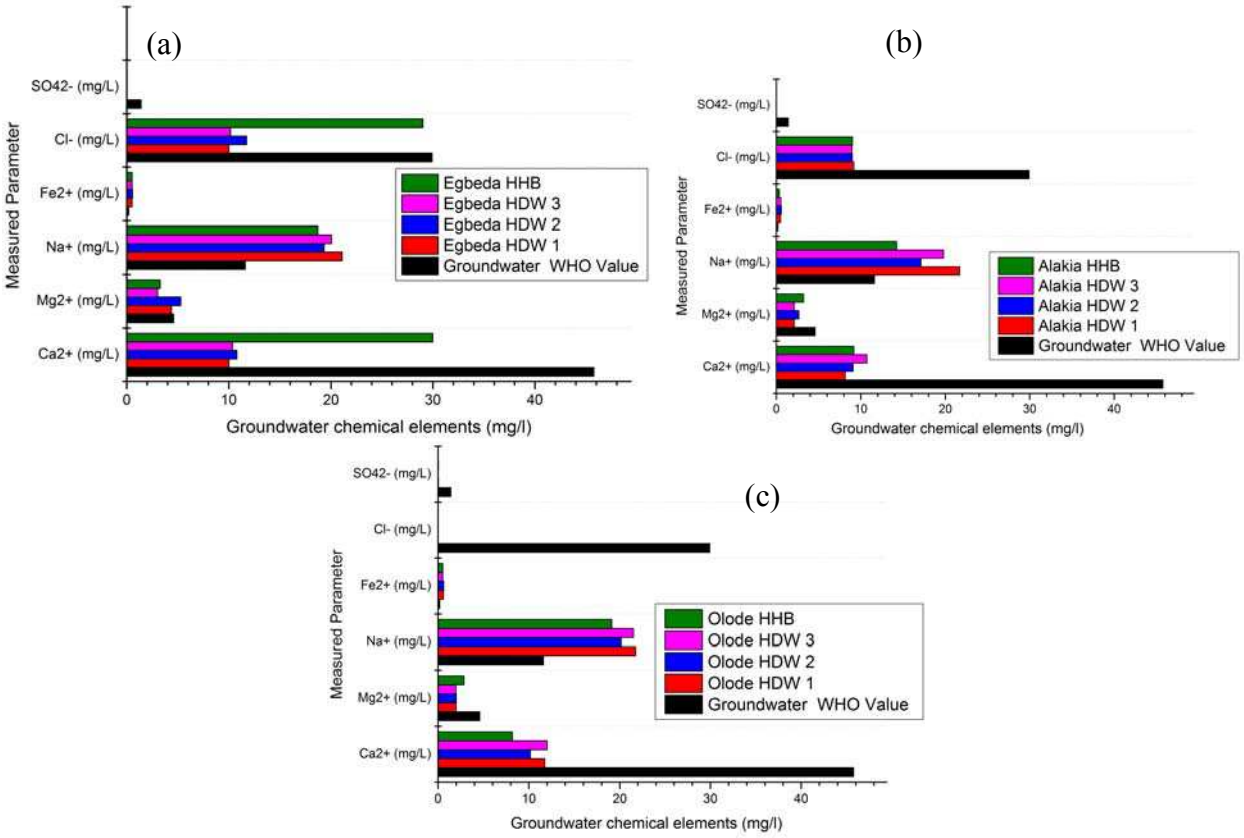
(i) the relative ease at which they can be sourced;
(ii) the relatively low cost of development, maintenance and operation; -available at the point of source;
(iii) the belief that it is of high quality than surface water (streams, rivers, etc) or rainwater which might have been contaminated with the corrugated iron roofs which many of the buildings are covered with- that is, it is of high chemical and bacteriological quality than surface water; and,
(iv) since no government has made provision for any reliable alternatives, the hand-dug wells remain their best options, etc.

Most of the hand-dug wells in the communities (62.3% in the aggregate) do not serve as the

source of water supply all year round as they dry up during the dry-season because of their limited depth which do not reach water table or over-withdrawals by the households and neighbours during the season. Many households had to depend on the public hand-held boreholes for drinking and domestic consumption, to which had to be regulated because of the intense pressure of the population on the source during the dry season. Rivers and streams are used for other uses like cleaning, car washing, toiletry/sanitary, etc (Figure 4 above).

Water quality evaluation

The water quality, whether it is used for drinking, irrigation or recreational purposes, is very important for health in both developed and developing countries worldwide. Water quality can, therefore, have impacts on health of the populace, either through the outbreaks of water borne diseases. In order to assist countries in establishing effective national or regional standards, the World Health Organisation (WHO) has developed a series of normative guidelines for the assessment of health risks and hazards through water (WHO, 1984, 1993 and 2011). The representative summary of physical and chemical characteristics of such standards is presented in Table 2 above. From the analysis of the choice of water use/supply in the study area for drinking and consumptive purposes (cooking, etc), it is discovered that aggregate 98% of the households depend on either hand-dug wells or the hand-held public boreholes for their water usages. In order to evaluate the quality of the water being used at the communities, about 30 millimetres of water samples were collected from a different hand-dug wells at the households and the central boreholes in the Egbeda community. The chemical parameters evaluated for in this paper are calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), iron (Fe2+), sulphates (SO_4^{2-}), and chloride (Cl^{-}). The findings from the analysis of the samples which are compared with WHO Drinking Standard are presented in Figure 5 a – c below.



Note: HDW: Hand-dug well, HHB: Hand-held Boreholes

Figure 5: The comparison of samples of groundwater chemical properties at the selected communities (a) Egbeda, (b) Alakia and (c) Olode with WHO established standard.

The characteristics of each chemical elements of water samples vary from one point to another as a reflection of the differences in the point of abstraction. Figure 5 above indicates the comparison of the evaluated chemical elements of water being used by the majority of the households with the WHO established standards (Table 2). The summary analyses of the selected six chemical parameters indicate that Ca^{2+}, Mg^{2+}, SO_4^{2-}, and Cl^- are far lesser than the WHO acceptable drinking water standards for the sampled water from the hand-dug wells predominantly in all the three communities except for sodium (Na^+) whose values (mg/l) are higher than the WHO standard while the values (mg/l) for the hand-held boreholes of the same elements for Chlorine (Cl^-) are very close to the WHO drinking standards at Egbeda. The magnitudes of values for iron (Fe2+), on the other hand, are higher than WHO recommended standards for the samples from the hand-dug wells in all the three communities within the Egbeda area.

The likely effects of water ingestion below or above the WHO acceptable standard on human health have been proscribed by the WHO. The summary of such effects are presented in Table 3 below. Though there is urgent need to meet the present water needs of the community, the long-term effect of consuming water of low quality on human health is far more damaging (Table 3). There is, therefore, the need to ensure that the water to be supplied in meeting the domestic needs of the households in Egbeda area are of high quality. The major threats to the groundwater quality to which the majority of households in the study area depend on are septic tank and soak-away pits leakages as well as water table interception with latrines. These are common phenomenon in developing countries where there is no central water supply system nor central sanitary disposable facilities. These kinds of anomalies do affect the physical and chemical components of groundwater parameters.

Table 3: The likely effect of water ingestion above/below acceptable level

Measured Parameters	**Acceptable Level**	**Effect above/below level**
Cadmium	0.003 mg/l	Kidney damage
Chlorine	Max 200mg/l	Eye/nose irritation; stomach discomfort
Calcium	Max 200mg/l	Indigestibility of fat in the body
Magnesium	Max 150mg/l	Gastrointestinal, liver or kidney damage
Iron	0.30 mg/l	Rusting, cancer
Sulphate	Max 400 mg/l	Allergic dermatitis
Sodium	Max 200 mg/l	Increased risk of cancer

Source: WHO, 1997

CONCLUSIONS

Nigeria was ranked the worst Guinea-worm-infected country in the last millennium (1901 – 2001) with about 2.5 million cases out of the 5-15 million cases world-wide (Akujieze, *et al.,* 2003). This is in part due to inadequate water supply, lack of access to qualitative water for consumption and contamination of available limited freshwater resources to the urban population. Ekpo (1990) reported Oyo State, of which Egbeda area is one of the cities within the state, to be among the worst hit area. The poor water supply in urban cities in Nigeria causes typhoid fever, cholera and bilharzias in areas where people depend on streams, shallow uncovered wells, pools from drilling water and where public water source are not appropriately or sufficiently treated (Akujieze, *et al.,* 2003), as well as the interception of a shallow water table

with pit latrines and soak-away pits at certain seasons of the year (Oteze, 1981) mostly in a basement complex aquifers like Egbeda area where households depend on groundwater as their water source. The findings from this study has shown that increasing urbanisation (as a result of rural – urban migration) of Egbeda town since 1989 when it was designated as the headquarter of a LGA has put more pressure on water resources with the households depending on groundwater predominantly through either hand-dug wells or hand-held boreholes in the communities. The groundwater to which the communities depend on for their domestic household consumption are, however, far below the acceptable WHO Drinking Water Standards. The governments at all levels (Federal, State and Local) are hereby encouraged to make conscious efforts to address the water supply issues and treatment in the entirety of the country (study area inclusive) so as to avoid the negative experience of the last millennium when the country was hit with water related sicknesses, illnesses and loss of lives. Lack of comprehensive knowledge of the quantity of or current water demands for both domestic and industrial uses, is responsible for the significant shortage or complete absence of potable water in urban and rural areas especially in South-western Nigeria where there is an apparent abundant of fresh water resources (Akujieze, *et al.*, 2003). However, the method adopted in this paper remains a vital medium by which urban water usages can be evaluated in developing countries where there's no standard metering supplying systems. It is, never-the-less, recommended that governments and NGOs should step into the water issues in the country so as to adopt the standard water metering, supplying and surveillance systems which are in operation in the developed countries of the world. The proper preservation and utilisation of water resources today is the proper preservation of lives and humanity tomorrow, because WATER IS LIFE!

REFERENCES

- AKUJIEZE, C. N., Coker, S. J. L., and Oteze, G. E. (2003) Groundwater in Nigeria- a millennium experience - distribution , practice, problems and solutions. *Hydrogeology Journal*, Volume 11, No 2. April, 2003. Pp259- 274
- CENTRAL BANK OF NIGERIA (CBN) (1999) Urbanization and related socio-economic problems in Ibadan Area. Research Departmental Occasional Paper No 25.
- EXPO, I. E. (1990) Nigeria's water management strategy: the journey so far. Proceedings of the First Biennial National Hydrology Symposium, IHP Maiduguri, pp 294 – 301.
- FORD, T. E. (1999) Microbiological safety of drinking water: United States and Global perspectives. Environmental Health Perspective, 107, 191 - 205
- GRANT, N. K. (1970) Geochronology of Precambrian basement rocks from Ibadan, Southwestern Nigeria. Earth and Planetary Science Letter, 10, pp 29 – 38.
- HANIDU, J. A. (1990) National growth, water demand and supply strategies in Nigeria in the 1990s. Water Resource Journal of Nigerian Assoc Hydrogeol 2(1), pp 1 – 6.
- HOWARD, G., Teuton, J., Luyima, P. And Odongo, R. (2002) Water usage patterns in low-income urban communities in Uganda: implications for water supply surveillance. International Journal of Environmental Health Research, 12, 63 – 73.
- IFABIYI, I. P. (2012) Hydrograph analysis and hydrological zones: tools for watershed and water resources planning in a sub humid tropical catchment, Nigeria. Journal of Geography and Geology, Vol. 4, No 1.
- LAWAL, J. O., OMONONA, B. T. AND OYINLEYE, O. D. (2011) Effects of livelihood assets on poverty status of farming households in Southwestern Nigeria. Paper prepared for presentation at EAAE 2011 Conference. Change and Uncertainty: Challenges for Agriculture, Food and Natural Resources. August 30 to Septmber, 02, 2011, ETH Zurich, Switzerland.
- McGRANAHAN, G., LEITMAN, J. AND SURJADI, C. (1997) *Understanding environmental problems in disadvantaged neighbourhoods: Broad spectrum surveys, participatory appraisal and contigent valuation*. Urban Management Programme Working Paper 16. Stockholm Environment Institute.

- OBATOYINBO, O and OYEDOTUN, T. D. T. (2011) Microbial/Bacteriological analysis of water resources in Ikare and Arigidi Akoko of Ondo State, Nigeria. Proceedings of the 1st EIT International Conference on Water Resources Engineering, 18 -19 August, 2011. Pages 279 -284
- OTEZE, G. E. (1981) Water resources in Nigerian environment, vol 3. Springer, Berlin Heidelberg New York, pp 177 – 184.
- MABOGUNJE, A. L. (1981) Towards an urban policy in Nigeria. In: Urbanization Processes and Problems in Nigeria, P. O. Sada and J. S. Oguntoyinbo (eds), Ibadan University Press, 1981.
- NATIONAL POPULATION COMMISSIONS (2006) *National Population and Housing Census*. National Population Commissions.
- RIJSWLJK, K. (1981) Small community Water Supplies. IRC Technical Paper Series no. 18, The Netherlands.
- WORLD HEALTH ORGANIZATION- WHO (1984): Guidelines for Drinking Water Vol. 1 Recommendations, Geneva, Switzerland.
- WORLD HEALTH ORGANIZATION (1997): Guidelines for drinking-water quality, Second Edition, Volume 3, Surveillance and control of community supplies, Geneva, Switzerland.
- WORLD HEALTH ORGANIZATION- WHO (2011): Guidelines for Drinking-water Quality Fourth Edition, Malta.