

Nature of Potable Water Supply and Demand in Jema'a Local Government Area of Kaduna State, Nigeria

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Abstract: This research work examines the nature of potable water supply and demand in Jema'a Local Government Area of Kaduna State. A total of 220 questionnaires were administered to households in five wards within the study area, although only 200 of these questionnaires were used for the purpose of analysis. Findings revealed that at some times and locations, the value of water can be very high due to scarcity, but at other times and locations it can be very low or even free due to relatively plentiful supplies. A 20-liter can of water is sold at an average rate of ₦20 in most parts of the study area by commercial water vendors. Findings also revealed that rapid population growth, increase standard of living and purchasing power, changes in social tastes and policy decisions are all important controls on water demands in the study area. These have not been accompanied by an increase in water supply, and hence water scarcities are critical especially in the months of February-April. As a result of that, the uses of alternative sources of water are indispensable. Result further revealed that an individual needs an average quantity of 37.45 liters of water per day. The low service level of water accounts for prevalence of water-borne diseases which could get to epidemic scale if not attended to promptly.

Keywords: Household, pipe-borne water, water scarcity, water vendors, water-borne diseases.

INTRODUCTION

Water is a natural resource of fundamental importance. It supports all forms of life and creates jobs and wealth in the water sector, tourism, recreation and fisheries (Ntengwe, 2005). Without water life as it exists on our planet is impossible (Asthana and Asthana, 2001). 97.5% of water on the earth is salt water, leaving only 2.5% as fresh water of which over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is mainly found as groundwater, with only a small fraction present above the ground or in the air. Freshwater is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world, and as world population continues to rise at an unprecedented rate, many more areas are expected to experience this imbalance in the near future (Wikipedia, 2008).

Water forms the largest part of most living matter. Human beings can survive longer without food than without water (Ayoade, 1975, 1988; NEST, 1991). An average man is two-thirds water and would weigh only 13 kg when completely without water (i.e., dry weight). Plants need water for photosynthesis and they take their nutrient from the soil in solution. Water is an important geomorphic agent playing a significant role in weathering the most important energy regulator in the heat budget of the earth (Ayoade, 1988).

The total domestic water needs in homes with piped water and inside sanitation is at least 115 liters per head per day. The actual amount used may be greater depending on the ease and convenience of supply (Ayoade and Oyebande, 1983). According to World Health Organization, 75 liters of water a day is necessary to protect against household diseases and 50 liters a day necessary for basic family sanitation. The international consumption figures released by the 4th World Water Forum (March, 2006), indicate that a person living in an urban area, uses an average of 250 liters/day; but individual consumption varies widely around the globe (THD, 2007). WHO and UNICEF Joint Monitoring Program currently estimates that 1.1 billion people (17% of the global population) lack access to water resources, where access is defined as the availability of at least 20 liters of water per person per day from an improved water source within a distance of 1 km (Bates *et al.*, 2008).

The number of people who rely on the earth's limited freshwater reserves is increasing everyday. In fact, a scarcity of clean, fresh water is one of the world's most pressing environmental problems (Arms, 2008). At the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, great concern was expressed about the 1.1 billion people in the world who do not have access to safe drinking water and the 2.4 billion who live without proper sanitation (Cech, 2005). The resulting human toll is roughly 3.3 billion cases of illness and 2 million deaths per year. Moreover, even as the world's

population grows, the limited easily accessible freshwater resources in rivers, lakes and shallow groundwater aquifers are dwindling as a result of over-exploitation and water quality degradation (IAEA, 2004). The UN predicts that by 2025, two-thirds of the world population will experience water scarcities, with severe lack of water blighting the lives and livelihoods of 1.8 billion. According to the UN World Water Assessment Program, by 2050, 7 billion people in 60 countries may have to cope with water scarcity (Chenoweth, 2008).

People in many parts of the world today are faced with the problem of water paucity and insecurity (Udoh and Etim, 2007). The most obvious concern about an unsafe water supply is the health risk to family or guests. Wastewater contamination serves as a source of bacteria, viruses, and parasites that can cause gastrointestinal problems or transmit contagious diseases (Arms, 2008; UMES, 2008)

Although Nigeria is known to be endowed with abundant water resources, the availability of potable water is a problem in many parts of the country (Onokerhoraye, 1995a). The Nigerian Government has long considered the provision of water supply services to be the domain of the Federal, State and Local Governments. However, the public sector has not been successful in meeting more than a small portion of the demand for water of residential and commercial users. Services are in critically short supply (FRN, 2000).

Since 1999, a huge amount of public funds have been spent on provision and management of water. However, there is still no potable water and many lack access to adequate sanitation. More than half of the deaths recorded in the nation's health facilities are caused by complications arising from bad water and poor sanitation. In the last eight years, the Federal Government attempted to develop water infrastructure like dams, but these were basically for irrigation purposes, because little attention was paid to water for domestic use. Government insists it cannot handle water supply all by itself for lack of funds, and have ceded its statutory role to shylock water producers, who do not know or care about safe water standards (Oghifo, 2008).

Successive Nigerian governments have been pursuing with vigor aggressive water supply Programs and donor agencies also have been making their impacts in the sector through expansion of water supply infrastructures. Despite these efforts the public are still disenchanted because access to safe water and sanitation is not improving (NEST, 1991; Emoabino and Alayande, 2007). Many households, often the poorest, end up purchasing water from private vendors much more expensively than from the public supply. Water supply services, where they exist, are unreliable and of low quality and are not sustainable because of difficulties in management, operation and pricing, and failure to recover costs. Many water supply systems show extensive deterioration and

poor utilization of existing capacities, due to under-maintenance and lack of funds for operation (FRN, 2000).

The value of water, therefore, is determined by two elements, supply-the cost of providing the resource in a certain quality, quantity, and location which varies in different parts of the country and demand-the utility to humans and their willingness to pay for that utility (Cech, 2005).

Statement of the problem: The World Health Organization (WHO) carried out a survey in 1975 which revealed that only 22% of the rural population in developing countries had access to safe drinking water. The findings which were published in 1976, led to the declaration of 1981-1990 as the International Drinking Water Supply and Sanitation Decade, by the United Nations Water Conference (Dada *et al.*, 1988). According to IMF (2003), growing water scarcities and water pollution in developing and developed countries alike have plunged the world into a water crisis.

In Kaduna State, the per capita potable water supply in 1976 was 76.4 liters per day. While the average proportion for the whole state was 32.1%, that of Kaduna Capital Territory was 65.3%, Zaria Local Government Area was 62% and Jema'a Local Government Area was 21.5%. In 1986, the per capita potable water supply rose from 76.4 liters to 101.9 liters a day. The average proportion for the whole state was 35.1%, whereas, Kaduna Capital Territory was 75.2%, Zaria Local Government Area was 68.5% and Jema'a Local Government Area was 18.3%. In terms of the proportion of the population of the state accessible to potable water, there was no significant change in 1986 from the situation in 1976 (Onokerhoraye, 1995b).

The demand for water is fast outpacing its availability for consumption and the supply of domestic water is seriously constrained by the rising population (Udoh and Etim, 2007). On account of this, the price of water, of whatever grade, increases daily and, this is not helped by commercial water vendors who adopt arbitrary pricing of the product. For instance, a 25-liter can of water is sold for ₦30 in most parts of Lagos State. In Kano, as in most cities and towns in the Northern part of the country, a 25-liter can of water sells for ₦50 and is rising. The farther away the source of water supplies, the higher the cost (Oghifo, 2008).

Kaduna State Water Board Authority (KSWBA), Kafanchan, whose responsibility is to pump and distribute sufficient clean water to the residents in the study area, is seriously constrained due to its inability to meet the rising demand of domestic potable water. Water consumption and use has however been greatly hampered by the increasing population brought about by the influx of people into the study area.

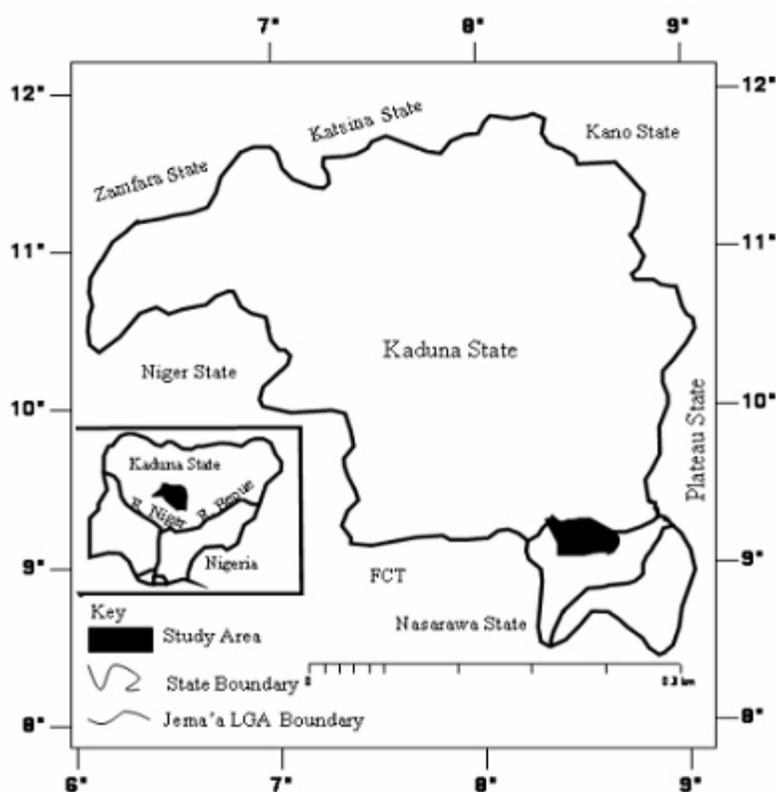


Fig 1: Map of Nigeria Showing the Study Area

This research work specifically investigates the nature of potable water supply and demand, the problems associated with water scarcity, and some possible solutions to the mentioned problems in Jema'a Local Government Area of Kaduna State, Nigeria.

Study area: Jema'a Local Government Area (Fig. 1) is located between latitude $9^{\circ} 10'$ and $9^{\circ} 30' N$ and longitude $8^{\circ} 00'$ and $8^{\circ} 30' E$. The Local Government is bounded in the East by Kagoro in Kaura Local Government Area, in the North by Zonkwa and Ungwar Rimi District of Zangon-Kataf Local Government Area, in the West by Jaba Local Government Area and in the South by Nasarawa State and in the South-East by Sanga Local Government Area respectively.

The study area has witnessed a tremendous growth in population in the last 30 years (Ishaya and Abaje, 2008). It has a population of 278,735 (FRN, 2006). With annual growth rate of 3% in the state (FRN, 2006), the 2009 projected population will be about 304,581 people. Presently it has twelve wards, namely: Jagindi, Godogodo, Atuku, Gidan-Waya, Maigizo, Kaninkon, Kagoma, Asso, Kafanchan 'A', Kafanchan 'B', Bedde and Takau (Ishaya and Abaje, 2008).

The area is designated Koppen's Aw climate with two distinct seasons, a wet season in summer and a dry season in winter. Rainfall occurs between the months of

April to October with a peak in August. The mean annual rainfall is about 1800 mm, and the mean monthly temperature is $25^{\circ} C$, while the relative humidity is about 62%. The orographic effects of the Jos-Plateau and the Kagoro Hills have positive influence on the climate influencing rainfall, temperature and relative humidity. The main type of soil is the Ferruginous tropical soil which is related to the climate, vegetation, lithology and the topography of the area. The relief is relatively flat and undulating and it influences the drainage pattern of the area (Ishaya and Abaje, 2008).

MATERIALS AND METHODS

In order to acquire data for this research work, a total of 220 questionnaires were administered to households in five wards within the study area (44 questionnaires in each ward). These wards include Maigizo, Kaninkon, Kafanchan 'A', Kafanchan 'B' and Takau. The administration of the questionnaires was to get the residents' views on nature of potable water supply and demand in the area. To ensure that people from all the social strata and income levels and groups were adequately and equally represented in the study, purposive sampling method was employed to select the respondents. This was complimented by detailed field observation of the area, and oral interviews with some

officials of the KSWBA, Kafanchan. Secondary data were gotten from officials of the National Population Commission, Kafanchan, and other related literature.

Out of the 44 questionnaires administered to households in each of the five wards, 40 each were analyzed because not all were completely returned or answered. The analysis was based on descriptive statistics and presentation. The total water demand in the area is obtained by finding the product of population figure of the study area and the average daily per capita water consumption.

Chi-square was used to test if there is: (1) significant difference in pipe-borne water supply in the study area; (2) significant difference in distance from sources of water supply in the study area, and (3) a significant relationship between inaccessibility to potable water supply and incidences of water borne diseases in the study area.

RESULTS AND DISCUSSION

The results of the field survey conducted in the study area revealed that 78% of the sampled populations were male while 22% were female and their average age is 40 years. 69% of them are married men and women, 20% singles, 8% widows/widowers, while divorces are 3%.

Potable Water Supply per Day: From the surveyed questionnaires, 63% of the respondents have pipe-borne water from Water Board in their houses while 37% do not have. 60% of the respondents that have pipe-borne water in their houses are not satisfied with the water supply; and whenever the water is pumped, 52% of the respondents said that the water does not last more than 2 h in a day, 14% said that the water last for about 2-4 h, 21% said 4-6 h, while 13% said 6 h and above (Fig. 2).

Findings using Chi-square revealed that there is a significant difference in pipe-borne water supply per day in the study area. The calculated value was 80.80, while the T-critical at 0.05 level of significant is 7.815; meaning that there is significant difference in pipe-borne water supply per day in the study area. As a result, the uses of alternative sources of water in the form of hand dug wells, boreholes, water vendors, and even streams are indispensable.

The findings also reveal that water scarcities are critical in the months of February-April. 79% of the respondents said that the amount of water supply does not meet their need throughout the year. This is true as the researcher during his field observation saw long queues of people, mostly women and children, searching for water in public taps and boreholes; while some resort to buying from water vendors in which the source of the water is always doubtful. This finding corresponds to the FRN (2000) estimation that currently only about 50% of the urban and 20% of the semi-urban population have access to reliable water supply of acceptable quality.

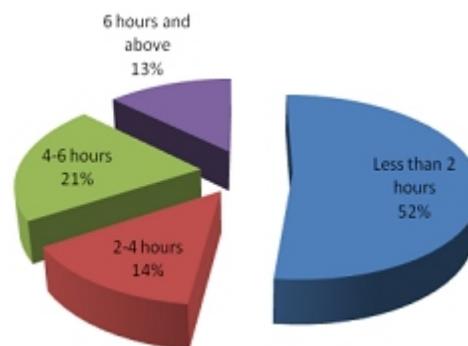


Fig 1: pipe-Borne water Supply per Day

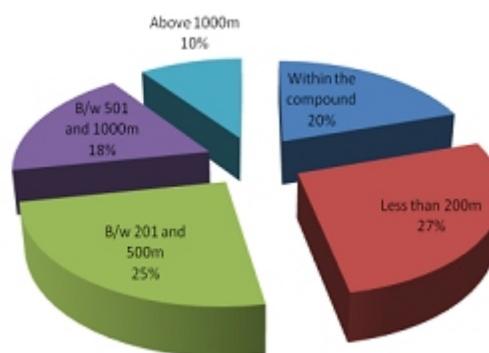


Fig 3: Distance from the Source of potable Water Supply

Potable Water Demand per Day: On the issue of distance from the source of potable water supply, 27% of the respondents said that the distance from their source of potable water is less than 200m, 25% said that it is between 201 and 500 m, 18% between 501 and 1000 m, while 10% said it is above 1000 m. Only 20% of the respondents have their source of water supply within their compounds (Fig. 3). The calculated Chi-square value was 17.8, while the T-critical at 0.05 level of significant is 9.488; meaning that significant difference exists in distance from sources of potable water supply in the study area.

Findings also revealed that 75% of the water required is use for domestic activities, and that an individual needs an average quantity of 37.45 liters of water per day. Therefore, the daily average quantity of water demand in the study area will be $37.45 \times 304,581$ liters per day, which is equal to 11,406,558.45 liters per day ($11,406.56\text{m}^3$ per day).

Controlling Factors on Water Demand: Factors that have been identified as important controls on water demands in the study area include the increase in population during the last 30 years, and hence the demand for food, housing, and other human needs have thus increased greatly, especially with the increasing standard of living and purchasing power, so that the increased productive activities generated by such demands have had a tremendous impact on the need for water. The impacts is most intense in Kafanchan 'A' and Kafanchan 'B' wards where the concentration of population and economic activities has been progressively greater. Changes in social tastes and policy decisions also affect the demand for water.

Table 1: Sources of Water and Types of Water Borne Diseases

Sources of Water	Diseases						
	Cholera	Typhoid Fever	Schistosomiasis	Dysentery	Poliomyelitis (Polio)	Guinea Worm	No Respond
Pipe borne	9	19	2	10	3	0	3
Borehole	5	15	0	8	2	1	1
Hand dug well	8	26	8	9	2	4	5
Water Vendor	4	10	5	6	3	0	2
Stream	6	4	1	2	3	6	0
Pond	1	2	1	1	0	3	0

Source: Field Survey, 2008

It is very clear that water demand in the area is more than supply. Unfortunately, the KSWBA, Kafanchan is unable to meet the water demand of the people due to: inadequate power supply, poor state of some of the equipment - they are old and need to be replaced, and reckless over-consumption and misuse of water - taps are kept running while people do other things.

Problems Associated With Water Scarcity: Water scarcity is associated with multiple adverse health outcomes, including diseases associated with water contaminated with faecal and other hazardous substances (Bates *et al.*, 2008). People in the study area do not regard water treatment a serious issue as only 47% treat their household water while others (53%) do not. Most of the respondents from the administered questionnaires also complained of water-borne diseases such as Cholera, Typhoid Fever, Schistosomiasis, Dysentery, Poliomyelitis (Polio), and Guinea Worm (Table 1). The calculated Chi square value for the sources of water and types of water borne diseases was 53.40 while the T-critical at 0.05 level of significance is 43.77. This test reveals that there is a significant relationship between the sources of water supply and incidences of water borne diseases. That is to say, inaccessibility to potable water supply may be the major controlling factor of the various water-borne diseases in the study area. About 40% of the total respondents also complain of poor sanitation, particularly households that use water closet toilet facilities.

The respondents also complain of high costs of water, especially in a large family that depends on water vendors during periods of water scarcities. A 20-liter can of water is sold at an average rate of ₦20 in most parts of the study area by commercial water vendors. Other problems encountered include frustration and disappointment due to unavailable water, and time and energy are wasted in searching for water and hauling it over great distances.

CONCLUSION

The role of water in modern society such as the urban centers of Nigeria cannot be over-emphasized. People depend on its good quality and quantity for drinking, recreation, and use in industry and for growing crops. This research work has highlighted the nature of potable water supply and demand in Jema'a Local Government Area of Kaduna State. Despite the considerable attention paid to water supply in the study area over the years, inadequate water supply remains one of the major problems.

Findings revealed that most of the people that have pipe-borne water in their houses are not satisfied with the water supply; and whenever the water is pumped, it does not last more than 2 hours in a day. As a result, the use of alternative sources of water is indispensable.

Some of the factors that have been identified as important controls on water demands in the study area include increase in population, increase standard of living and purchasing power, changes in social tastes and policy decisions. Unfortunately, the

KSWBA, Kafanchan is unable to meet the water demand of the people due to: inadequate power supply, poor state of some of the equipment, reckless over-consumption and misuse of water amongst others.

Findings also revealed that the low service level of water accounts for prevalence of water-borne diseases in the area, which could get to epidemic scale if not attended to promptly. The situation is not likely to improve without a deliberate policy on water and sanitation, particularly a policy on acceptable safety levels. This calls for concerted efforts in order to meet the Millennium Development Goal of water and sanitation for all by 2015.

Based on the findings, the following recommendations are made:

- There should be provision of alternative sources of water supply such as boreholes and public taps in strategic locations in the study area.
- There should be proper arrangement with Power Holding Company of Nigeria (PHCN) for adequate supply of power to the area where the waterworks is located.
- Proper maintenance of equipment at the waterworks should always be carried out.
- There should be constant repairs of damage pipes and taps in order to reduce leakages.
- More funds should be allocated to water resources development.
- There should be public enlightenment campaign in mass media against the reckless over-consumption and misuse of water.
- There should be constant payments of water bills by consumers.
- Increase in population and improved standards of living should always be considered in projecting water demands.
- There should be the adoption of water-efficient technologies and encouragement of economic activity that doesn't guzzle water.

REFERENCES

- Arms, K., 2008. Environmental Science. Holt, Rinehart and Winston: A Harcourt Education Company, Austin, Texas. ISBN: 13: 978-0-03-078136-0, 10: 0-03-078136-1
- Asthana, D.K. and W. Asthana, 2001. Environment: Problems and Solutions. Second Revised Edition. S. Chand and Company Ltd, New Delhi. ISBN: 81-219-1654-2
- Ayoade, J.O., 1975. Water Resources and Their Development in Nigeria. Hydrological Sciences-Bulletin, 581-591
- Ayoade, J.O., 1988. Tropical Hydrology and Water Resources. Macmillan Publishers Ltd, London. ISBN: 0-333-45946-6
- Ayoade, J.O. and B.L. Oyebande, 1983. Water Resources. In: A Geography of Nigerian Development, Eds., Oguntuyinbo, J.S., O.O. Areola and M. Filani, Heinemann Educational Books (Nigeria) Limited, Ibadan. ISBN: 978 129 525 2 (limp), 978 129 526 0 (cased).

- Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, 2008. Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change. IPCC Secretariat, Geneva, pp: 210. <http://www.ipcc.ch/meetings/session28/doc13.pdf>
- Cech, T.V., 2005. Principles of Water Resources: History, Development, Management, and Policy. 2nd Edition. John Wiley and Son, Inc, Hoboken. ISBN: 0471-65810-3 (Wiley International Edition).
- Chenoweth, J., 2008. Looming Water Crisis Simply a Management Problem. *Newscientist*. 2670:28-32. <http://www.newscientist.com/article/mg19926700.100-looming-water-crisis-simply-a-management-problem.html>
- Dada, O.O., A.C. Okuofu and E. Obele, 1988. Faecal Pollution of Well Water in Zaria City, Nigeria. *Savanna. J. Environ. Social Sci.*, 9 (2): 1-5. A.B.U. Zaria Press Ltd.
- Emoabino, I.U. and A.W. Alayande, 2007. Water Demand Management, Problems and Prospects of Implementations in Nigeria. *Practices on River Basin Management*, pp 154-159. http://www.dsi.gov.tr/english/congress2007/chapter_3/84.pdf
- FRN (Federal Republic of Nigeria), 2000. Water Supply and Sanitation Interim Strategy Note. Retrieved March 29, http://siteresources.worldbank.org/NIGERIAEXTN/Resources/wss_1100.pdf
- FRN (Federal Republic of Nigeria), 2006. Federal Republic of Nigeria 2006 Population Census. National Bureau of Statistics. Retrieved April 22, 2009 from <http://www.nigerianstat.gov.ng/Connections/Pop2006.pdf>
- IAEA (International Atomic Energy Agency), 2004. Nuclear Desalination: Water Supply and Demand. Retrieved March 29, 2008 from <http://www.iaea.org/OurWork/index.html>
- International Monetary Fund, IMF, 2003. "Plunging into Crisis" Inflation. Too High, Too Low or Just Right? Finance and Development. A Quarterly Publication of the International Monetary Fund, 40(2).
- Ishaya, S. and I.B. Abaje, 2008. Indigenous People's Perception on Climate Change and Adaptation Strategies in Jema'a Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning*, 1(8): 138-143.
- Nigerian Environmental Study/Action Team, NEST, 1991. Nigeria's Threatened Environment: A National Profile. Nigerian Environmental Study/Action Team (NEST). A NEST publication. Ibadan, Nigeria. ISBN: 978-31203-0-1
- Ntengwe, F.W., 2005. Designing a Domestic Water Supply System-The Engineer's Perspective and Considerations as a Challenge to Consumers. *Physics Chem. Earth*, 30, (11-16): 850-858. <http://ewb-uiuc.org/system/files/sdarticle.pdf>
- Oghifo, B., 2008. Water: 'Nigeria's Playing Games with Lives'. Retrieved May 7, 2008 from <http://www.thisdayonline.com/>
- Onokerhoraye, A.G., 1995. Urbanization and Environment in Nigeria: Implications for Sustainable Development. The Benin Social Science Series for Africa. University of Benin, Benin City, Nigeria. ISBN: 978-2027-46-4
- Onokerhoraye, A. G., 1995. Population Growth and the Provision of Social Services in Nigeria. The Benin Social Science Series for Africa. University of Benin, Benin City, Nigeria. ISBN: 978-2027-69-3
- Tongaat Hulett Developments, THD, 2007. Sustainable Water. Retrieved February 5, 2009 from <http://www.thdev.co.za/content/view/56/2>
- Udoh, E.J. and N.A. Etim, 2007. Analysis of Domestic Water Consumption Pattern by Farming Households in Itu, Akwa Ibom State, Nigeria. *European Journal of Social Sciences*, 5 (2): 76-82
- University of Minnesota Extension Services, UMES, 2008. Ensuring a Safe Water Supply. Shoreline Best Management Practices. Number 4 of 8 in the series. Retrieved May 6, 2008 from <http://www.extension.umn.edu/distribution/naturalresources/components/DD694d.html>
- Wikipedia, 2008. Water Resources. Retrieved April 12, 2008 from http://en.wikipedia.org/wiki/water_Resources