EVALUATION OF WATER DEMAND AND ITS QUALITY IN KAJURU LOCAL GOVERNMENT AREA (LGA), KADUNA STATE, NIGERIA

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Abstract

This study evaluates water demand and its quality in Kajuru Local Government Area of Kaduna State, Nigeria with a view of ascertaining whether water demand matches/equals the available improved water. The data were collected through the interpretation of satellite imageries, structured questionnaire administrative and oral interviews. The study found out that 53% of the respondents do not care/boarder about the quality of water they drink. Additionally, location of water supply system is negatively skewed. A community, for instance, has 17 systems while 30 communities have one system each! In conclusion, the study recommends that the people of the study area may opt for boiling method of water treatment since it is more economical and easily accessible.

1.1 **Background to the Study**

A basic objective of water resources evaluation is to meet the demand for water for various uses and by various users. The major abstractive uses of water are for irrigation, water supply for domestic and industrial uses (Ayoade, 2003). The water requirements for their purposes now and in the future must be known in order to facilitate rational planning and optimum utilization of the available water resources.

Water demand by humans' world over is highly variable. Water demand can for example, be detected by its availability, environmental conditions and level of development of a given region. How much one needs water, if its availability is limited one may not be able to meet the required demand. Those living and/or working in a hot climate are likely to use much more water than people in temperate region. Urban inhabitants require more water than rural dwellers. According to Valtin (2002), an individual thirst provides a better guide for how much water they require rather than a specific fixed quantity. Individual's typical use of water is a function of how much water he/she needs. At any rate, water is highly necessary for life. For instance, portable water is clean and cleans dirty things.

Water and sanitation coverage rates in Nigeria are amongst the lowest in the world. Access to an improved water source stagnated at 47% from 1990 to 2006, but increased to 54% in 2010. In urban areas, access to an improved water source actually decreased from 80% to

65% in 2006, but or then recovered to 74% in 2010 (WHO/UNICEF, 2010). The situation is however worse off in the rural areas of the country. The Local Government Authorities (LGAs) totalling 774 that are responsible for the provision of rural water supplies and sanitation facilities in their areas, only a few have the resources and skills to address the problem. In other words, local governments often do not have the resources to finance water investments. Only few LGAs have rural water supply divisions. Many of the rural communities are therefore, left at the mercy of water and sanitation committees (WASCOs), which are saddled with operation and maintenance of water facilities (Wikipedia, the free encyclopedia).

Accurate statistics on access to water especially in urban centres of Nigeria is getting more difficult to obtain since so many households depend mainly on private constructed/developed water sources such as hand dug wells, boreholes, tube wells and rain water during the rainy season. Laah (not dated) had however, earlier documented that the statistics on access to water and sanitation are conflicting, due to divergent definitions, indicators and methodologies applied by different agencies.

From the foregoing, it is glaring that water demand is barely meant in both the rural-urban centres of Nigeria.

It was noted by the Florida Keys (not dated) that water quality describes the condition of the water, including chemical, physical and biological characteristics, usually with respect to its suitability for a purpose such as drinking and swimming. This follows that water demand and quality are interrelated in terms of water use. For instance, required water demands can only be attained through good water quality. Going by a popular documentation that water covers some 70% of the earth's surface, potable water or improved water wouldn't have been a scarce resource. But unfortunately, approximately 97.2% of it is saline and just 2.8% is fresh (David, 2000). In this instance, issue of water quality limits availability of improved drinking water. To put in another way, drinking water must meet the required water quality otherwise; it cannot be safe enough for drinking.

Although, scientific measurements-physical, chemical, biological and radiological characteristics are used to determine water quality, its determination is typically made relative to the purpose of the water. Different uses raise different concerns and therefore different standards are considered. On this basis, work in the area of water quality is mainly focused on water that is treated for human consumption, industrial use or in the environment (Nancy, 2009; Johnson et al, 1997). At any rate, poor water quality can pose a health risk for people, animals and ecosystems.

In Nigeria, many entities have been involved in rural water supply and sanitation, which include Federal Ministry of Agriculture and Rural Development, River Basin Development Authorities and State Water Agencies. Others are Local Government Councils and external supporting agencies-United Nations Children Fund, the World Bank, Global 2000 and Water Aid. Each of these institutions employs its own implementation strategies and involves individual communities and local Government Areas at varying degrees. But, Nwankwoala (2011)'s work has revealed that these interventions have recorded less than 50% access to safe water in rural areas of Nigeria. The National policy on Water Supply and Sanitation (NPWSS (2008) documents that the people of Kajuru LGA are faced with the challenges of accessing adequate and affordable wholesome water supply from water supply system infrastructures. Similarly, according to Kaduna State Ministry of Lands and Country Planning (KSMLCP (2006), there are no piped water supply systems connected to the households, rather, available systems are either households or communal based and situated at some distances from their households making accessibility a crucial issue. And it has also been noted by Amori and Makinde (2012) that access to safe and potable water system is the ease of reaching a facility or obtaining a service from a facility quickly and cheaply.

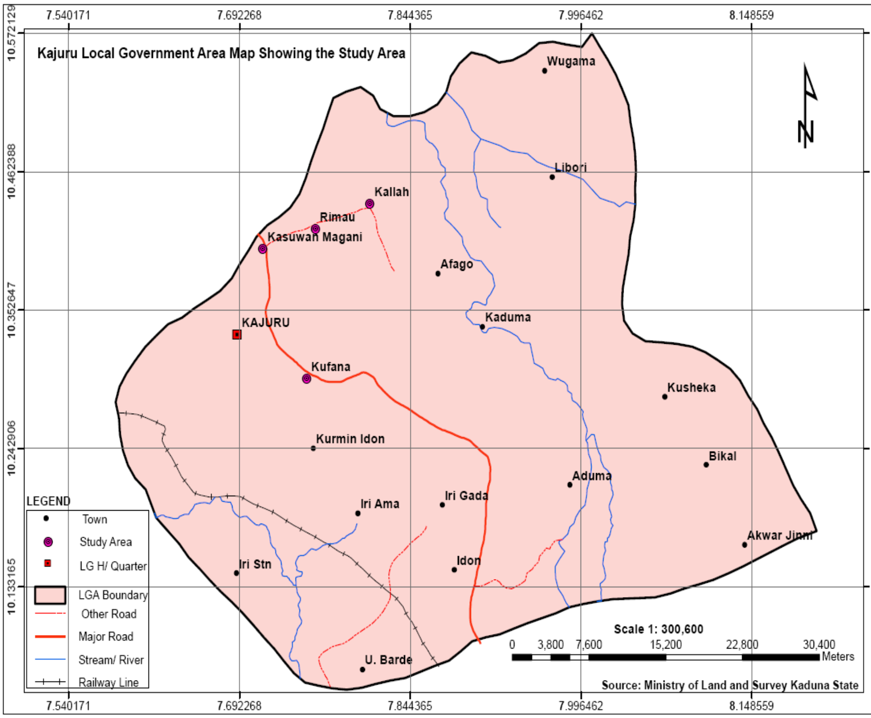
Moreover, in line with the above assorted findings, Kaduna State Ministry of Water Resources Investment Action Plan revealed that Kajuru LGA in 2008 has one of the lowest accessibility of less than 30% (in the state) in spite of government efforts to improve the situation. The aforementioned developments do not guarantee personal hygiene and water related household sanitation. None of these studies has ascertained the quality of water in use in the study area and therefore constitutes a problem to this work.

Arising from the above, in this paper, effort is made to evaluate fresh water demand and its quality with a view of ascertaining whether the water demand matches/equals the available drinking water. The investigation is therefore, to find out the:

i. Number of water supply systems in the study area
ii. Level of awareness of water quality and effects of consumption of unimproved sources
iii. Quality of water supply accessible to the study area

1.2 The Study Area

The study area for this work is Kajuru LGA of Kaduna state. It is located between latitudes 10^o 03' N and 10^o57' N and longitudes 7^o 05' E and 8^o 15' E (Jibril et al 2016 in press) (Fig 1).



The administrative Headquarters of the LGA is Kajuru town. The LGA has a landmass of 2,365km^2. The wet season varies from March to October with the wettest occurring between June and September. The average annual rainfall is 1,406mm with a minimum of 1090mm and a maximum of 1,812mm (Kaduna State Water Board, 2009). Rainfall is absent or very unusual from November to February. According to Jibril (2010), the available abundant surface water resources of the rainy season dry up in the dry season thus limiting the ground water reserves especially within the basement complex area in which

Figure 1: Kajuru Local Government Area.

Source: Kaduna State Ministry of Lands and Country Planning (2006).

i. The modern alluvium of present day river channels and the ancient alluvium of fadama under silts. These alluvium forms shallow aquifers in the study area but often fails in the middle of the dry season due to fluctuation in the water table.

ii. Abnormally thick regolith overlying basement complex granite and meta-sedimentary rocks and fractures in the fresh granitic rocks filled with detritus.

Development of ground water through drilling of boreholes and sinking of deep wells for improved water supply is within this hydro-geological unit. Parkman (1997) also indicates that ground water potentials as related to geology can meet the demand mainly of rural communities and some-semi urban areas.

1.3 Methodology

Satellite imageries LANDSAT-7ETM, 2010 and Quick Bird 2009 of Kajuru was obtained and interpreted to identify locations of the various water supply systems developed in the communities. Thereafter, coordinates of the water supply systems were taken with handheld Global positioning system, Garmin legend cx.

The 1991 & 2006 census figures were projected and used for comparison of water demand on one hand and available water and accessibility projections on the other hand.

Water quality samples analysis was done following universally accepted procedure (NSDWQ, 2007). A total of 17 samples were taken as follows: Kufana 5 samples (from 2 hand pump boreholes, 2 protected wells and 1 unprotected well); Kasuwan Magani 6 samples (4 from hand pump boreholes and 2 from unprotected wells); Rimau 3 samples (1 sample from hand pump boreholes and 2 from protected wells) and in Kallah, 3 samples were taken from hand pump boreholes.

However, the followed procedures in the analysis of the water samples are:

i. Containers were thouroughly cleaned, sterilized and water samples were taken to the laboratory on the same day they were taken from the source

ii. Water samples were preserved by cooling at 4^0c and transferred to the laboratory within 24 hours after sampling in order to retard chemical or bacteriological changes that could take place

iii. Laboratory analysis for each parameter under investigation was done using standard equipment and method as shown in Table 1.

Table 1: Equipment and Method of Laboratory Analysis

S/N	PARAMETER	EQUIPMENT/METHOD USED
A	**Physical**	
	pH	Wagtech Meter
	Turbidity	Hach Turbimeter
	Total Solids	Gravemetric method
B	**Chemical**	
	Nitrate	Hach Spectrophotometer
	Chloride	ArgentIometric Method
	Total Hardness	Ethylenediamenitetraacetic(EDTA) METHOD
	Flouride	SPADNS colorometric Method
	Iron	Hach Spectrophotometer
	Manganese	AAS
C	Bacteriological	
	Faecal coliform	Membrane filter technology

Source: Kaduna State Water Board Laboratory, 2009

1.4 Discussion of Findings

1.4.1 Water Supply Systems in Kajuru LGA

There are 143 improved water systems distributed in 50 communities of the 96 communities in Kajuru LGA as at 2015. This follows that 46 communities in the study area do not have any improved water supply system. As contained in Table 2, one community has 17 water supply systems, which is the highest number obtained by a community. 30 communities have a water supply system each. Other distributions are contained in Table 2.

Table 2: Number of Water Supply Systems in Kajuru LGA

No of Communities	No of Water Systems	Total
30	1	30
4	3	12
2	4	8
5	2	10
2	5	10
1	6	6
1	7	7
1	9	9
2	10	20
1	14	14
1	17	17
50		143

1.4.2 Quantification of Water Demand and Theoretical Accessibility in the Study Area

In 2010, there were 115 improved water sources in Kajuru LGA with a projected population of 117,620. The water demand was 3,529m^3/day and theoretical available water from these sources was 1,725m^3. This means that 57,500 (48.9%) of the people had access to available water sources while 60,120 (51.6%) had no access. In 2012, there was an increase of 28 improved water sources bringing the total number to 143 serving an additional 14,000 people. However, with a 3% population growth, the population of Kajuru Local Government Area had grown to 132,381 with a water demand of 3,971m^3/day. Water available from the 143 sources was 2,135m^3/day, serving 71,500 (54%) while the number of people not served increased from 60,120 to 60,881 but the percentage of people not served dropped from 51.6% to 46%. It should be noted that these results however gives only the theoretical access to water on a general basis and not the actual accessibility, which has to do with functional water systems.

Table 3: Potable Water Supply Demand and Accessibility Projections

YEAR	2010	2013	2016 (MDG Targets)
Projected Population	117,620	132,381	144,655
Water Demand	3,529m^3/d	3,971m^3/d	4,340m^3/d
Theoretical Available Water	1,725m^3/d	2,145m^3/d	3,231m^3/d
No of Water Systems	115	143	289
Population Served(Theoretical)	57,500 (48.9%)	71,500 (54%)	107,696 (74.5%)
Population not Served(Theoretical)	60,120 (51.6%)	60,881 (46%)	36,959 (25.5%)

1.4.3 Level of Attainment of Millennium Development Goal 7 in Water Supply in 2013

As contained in Table 3, there is an increase of 5.1% of population served (theoretical) between 2010 and 2013 i.e. about 1.28% increase per year. The projected population of the study area in 2016 is 144,655 with a total water demand of 4,340m^3/day, which means that an estimated total number of improved water sources of 289. This would provide 107,696 people with the minimum National standard of 30 litres per capita per day and the attainment of the recommended 74.5% MDG target with only 25.5% (36,959) of the population not having access to improved water supply. At this current development trend, in 2013, 60,881 of the people (46%) do not have access to improved water supply falling short of the target of 41,621, and by 2016 the Number would have increased to 61,068 instead of dropping to 36,959. Figure 2 shows the trend of development and the recommended trend to meet the MDG target 7.

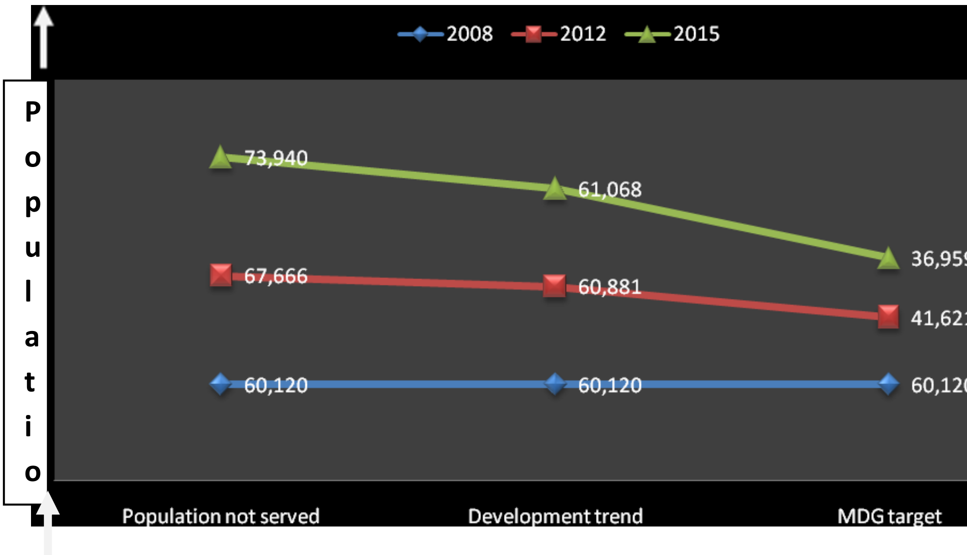


Figure 2: Trend of Development of Water Supply Sources in Kajuru LGA.

1.4.4 Level of Awareness of Water Quality and Effects of Consumption of Unimproved Sources:

Knowledge of community members about water quality and effects of consumption of unimproved water sources need to be ascertained so as to know how the community members care about the type of water they drink. An investigation into this revealed that 47% of the respondents claimed that they do not care about the type of water they drink. On the other hand, 78% of them have an idea of the consequences of drinking contaminated water while only 22% of them claimed not to know. It is only 39% of the respondents practice basic water treatment of filtration, boiling, and where available, chemical treatment with alum and chlorine (Fig 3). This practice makes members of the communities vulnerable to water borne and water related diseases as they take water quality they drink for granted.

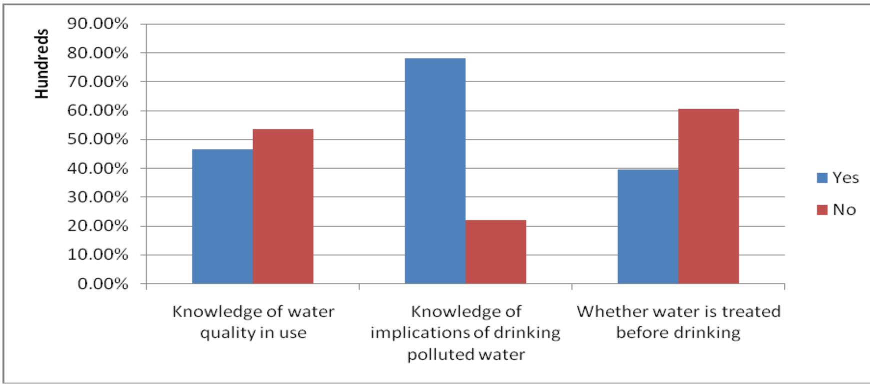


Figure 3: Knowledge of Water Quality in Use

1.4.5 Quality of Water Supply Accessible to Kajuru Communities

Result of laboratory analysis shows that all water from three sources of boreholes, protected wells and unprotected wells fell short of meeting the pH averaging 5.24 for boreholes, 4.93 for protected wells and 4.90 for unprotected wells, indicating that water from these sources is on the acid side. Three (3) samples of water from boreholes out of 11 samples did not comply with NASDWQ standard in terms of odour, turbidity and colour. Further investigation showed that it was due to poor construction of the facilities. The communities in Kasuwan Magani where the 3 boreholes are located have abandoned the use of water from these boreholes except for specific use. All three (3) samples from protected wells and (3) from unprotected wells showed compliance to the physical parameters of odour, turbidity and colour. All 17 samples from all three sources showed substantial compliance with regard to chemical parameters such as total dissolved solids, total hardness, nitrate/nitrite concentration and fluoride and sulphate contents of the water.

All 11 water samples from boreholes and three samples from hand dug wells installed with hand pumps were free from faecal contamination as they substantially complied with bacteriological limits, averaging 4.3cfu/ml and 5.25cfu/ml respectively (fig 4). However, all unprotected wells did not pass the bacteriological test as they contained coli form count exceeding permissible limits, averaging 16cfu/ml indicating that the water source has been contaminated by human excreta.

Results of the water sample analysis as shown in figure 4 show that the water quality of properly constructed boreholes and improved concrete wells with pumps is potable and meets the requirement for domestic water supply while that of open wells, ponds, streams are often prone to contamination by human or animal faeces. No water sample analysis was done for rain water supply as the survey was done during the dry season.

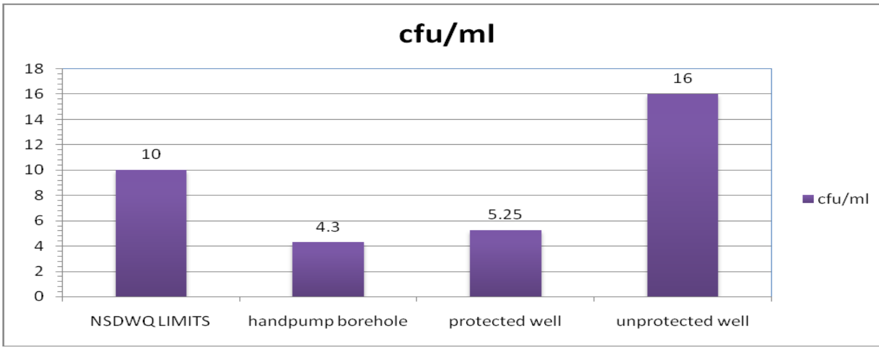


Figure 4: Average Faecal Coli Form Count of Samples from Various Sources.

Virtually, most water requires some type of treatment before use. However, the extent of the treatment depends on the source of water. For example, part of findings of this work indicates that open wells, ponds and streams can be polluted by animal and human faces. There are appropriate technology options in water treatment some of which include community-scale and household-scale point-of-use (POU) designs, filtration and chemical disinfection and boiling.

It is however, the view of this paper that the people of the study area may opt for boiling method of water treatment. This is on the basis of the fact that fuel wood is readily available, which makes the method more economical and since they cannot store boiled water in sterile conditions, they can boil water as many times as the need arises.

1.5 Conclusion

Accurate data/statistics on access to drinking water in rural and urban centres in Nigeria is getting more difficult to obtain since so many households depend on hand dug wells, boreholes, tube wells and rain water sources. And most of these water systems are located in private enclosed homes. Hence, the household members using these sources are not accessible. Those using the aforementioned sources either have no access or do not willingly wish to patronize government owned systems mainly due to the fact that the pipes are poorly maintained and in some instances, lack of power or fuel for pumping water leading to intermittent supply of drinking water to consumers. Additionally, divergent definitions, indicators and methodologies applied by different agencies in the country also account for conflicting statistics on access to portable water. Against this back drop, further research in area of access to improved water supply should focus and/or turn searchlight on private owned (enclosed) water supply systems. This will give a total empirical data on water demand and its quality not only in the study area but elsewhere in Nigeria.

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