

Evaluation of Sources of Household Water Consumption in Makurdi Metropolis Nigeria

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Abstract: This study evaluates the sources of household water consumption in the area using both primary and secondary data. Structured questionnaires were administered to four hundred households from four major wards using the convenience sampling method. Statistical Package for Social Science (SPSS) was used to analyze the data collected. The study reveals that most households use more than one water source and the major sources used are Sachet (79.6%), hand-dug wells (61.3%) and water vendors (51.7%). Results on ownership of water source reveal that 56.9% of hand-dug well users own the hand-dug wells. About 28.3% of borehole users own boreholes and 31.7% pipe borne water users are connected to the pipe borne water source. Only 10.2% of the sample is connected to the public pipe borne water source. Most households use sachet water (79.6%) for drinking. Water from hand-dug wells is used for cooking (46.8%) and for other purposes (53.2%). Hand-dug wells had the highest number of positive responses on the sufficiency of quantity from the source while pipe borne water had the most negative responses. It is therefore, concluded that public potable water supply is inadequate and in some cases unavailable. The major source of household water consumption identified in the study area is Hand-dug well. It is recommended that Public water supply should also be improved by getting more households connected and making the supply more regular.

Key words: Evaluation • Household • Water • Consumption

INTRODUCTION

Pipe-borne water is the major way of urban water distribution globally. However, population growth and industrialization have put a lot of pressure on water resources the world over [1]. Reports by international bodies like the United Nations (UN) and World Health Organization (WHO) and other non-governmental organization have indicated that water supply is not always commensurate with demand worldwide [2]. The UN predicts that by 2025, two-thirds of the world's 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 [3]. Various water supply schemes are being operated to help alleviate the problem of water supply. [4] reported that owing to deficiencies in piped water availability, households invest in coping strategies in the form of alternative supplies and storage facilities to supplement piped water. Such schemes are conventional or unconventional, the unconventional is

rain harvesting which is one method strongly advocated and experimented upon by developing countries. The conventional ones are mostly employed in the form of infrastructures such as boreholes, hand dug wells and shallow wells, treated surface water (pipe borne) and spring harnessing. [5] reported that more than half of the total respondents in Oyo state of Nigeria indicated borehole and well as the sources of water used most frequently, while rainwater is the least frequently used. [6] reported that only 3% of the people have access to clean and safe pipe-borne water while the remaining 97% relied on streams, rain water, wells and springs for their domestic uses in Ijebu North Area of Ogun state. [7] observed that the water supply situation in some cities in Nigeria is so poor that people say they are willing to pay a significant amount in cash on a regular basis in order to have access to reliable and safe water delivered through common types of facilities like wells and boreholes with hand pumps and motorized pumps.

According to [8] Pipe-borne water is largely absent in Makurdi and where it is available, it's unreliable and may not be safe for drinking as most pipes are rusty and have

leakages. This is because the town's pipe network is old and rusty. Leaks sprout all over when water is pumped from the existing water treatment plant. When the Water Board is not pumping water, the contaminated pool of water at the leakage points may flow back into the pipes and may be pumped into households when pumping activity resumes. Also, during the rainy seasons water contaminated by faeces deposited in open spaces is washed into the pipes through these leakages. Thus contaminated water may be distributed into households when pumping activity is resumed. Consumers of such contaminated water are exposed to high health risk. Ineffective service delivery has also manifested in form of unreliable and inconsistent supply from the state water board. Households have therefore imbibed other unconventional schemes to cope with the water situation. This study is aimed at identifying and evaluating the various water sources used by households in Makurdi. Determinants of residential per capita water demand of the study area have been reported elsewhere [9].

MATERIALS AND METHODS

The convenience sampling method was adopted for the study. Questionnaire and personal observations were used for collection of primary data using a sample size of 400 households. The sample households were selected from four wards of Makurdi. The locations were High-level, Judges Quarters, North Bank and Wadata. 393 valid questionnaires were retrieved after administration and SPSS used for statistical analysis of the data obtained. Rain water was not included in the study because the data was collected in the month of March which is dry season in the year 2015.

RESULTS AND DISCUSSION

Sources of Water Used: The sources of water used by the various locations studied are shown in Table 1. From the survey conducted, about 79.6 % of the households depend on packaged water (sachet) as a source for drinking because of the unavailability of potable water for drinking. The three major source of water identified in the study area are sachet, hand-dug well and vendor (Mai Ruwa) which indicate the unavailability of public water supply. However households in Judges Quarters and North Bank (55.5% and 66.7% respectively) were seen to use more of boreholes which could be because of the economic status of those in Judges Quarters, while for those in North Bank it could be because of the

unavailability of hand-dug wells since the nature of the soil strata has led to digging of only a few hand-dug wells. 86% of households in High Level indicated the use of hand-dug wells as a source which was the highest while North Bank had only 33.3 % households who use hand-dug well water.

High Level households had the highest percentage (53%) of pipe borne water use which could be because the area has an old pipe network and most of the pipes in the locations are broken so when water is supplied, the residents fetch from the broken pipes and store for use. Many households in Wadata and North Bank indicated use of water from vendors (77.4% and 77.8% respectively). The vendors usually buy or fetch water from any available source into jerry-cans. The water is then conveyed to the buyers using manual trucks. This source of water can be seen as unsafe because the origin is usually not known, the hygienic condition of the storage containers (jerry-cans) and the vendor is not known. Also, the water is most likely to be contaminated during handling because it is transported on the street over long distances. The study also reveals that households in Judges Quarters have more availability of potable water as shown in Table 4 and so do not require buying water from vendors which explains the few number 5.9 % of those who use water from vendors in the area.

Ownership of Water Source: Ownership of water sources by the residents of Makurdi Metropolis is depicted in Table 2. Only a few households in the study area own the sources of water which indicates that most of the residents either buy or get water from their neighbors. 34.9% of the sample own hand-dug wells, 9.9% own Boreholes and 10.2% are connected to pipe borne water source. The results show that 56.9% of hand-dug well users own the hand-dug wells. 28.3 % of borehole users own Boreholes and 31.7% pipe borne water users own pipe borne water source. More households in Judges Quarters were seen to own the water sources which indicate that households in Judges Quarters have more access to water than the other locations.

Source Used for Drinking: The study reveals that there is a high dependence on sachet water for drinking in the study area as seen in Table 3. Most residents of Makurdi have resorted to drinking sachet water because of the unavailability of potable water. 76.6% of the sample indicated the use of sachet water for drinking which reveals that most households spend money on drinking water. Judges Quarters had the highest sachet water users

Table 1: Sources of water used by households in the study area

Sources of Water	Number of Households indicating sources of water used				
	Judges Quarters F (%)	North Bank F (%)	High Level F (%)	Wadata F (%)	Total F (%)
Hand-dug well	62(61.4)	33(33.3)	86(86.0)	60(64.5)	241(61.3)
Bore Hole	56(55.5)	66(66.7)	8(8.0)	5(5.4)	138(35.1)
Pipe borne	38(37.6)	23(23.2)	53(53.0)	12(12.9)	126(32.1)
Mai-Ruwa (Vendor)	6(5.9)	77(77.8)	48(48.0)	72(77.4)	203(51.7)
Tank	11(10.9)	27(27.3)	17(17.0)	48(51.6)	103(26.2)
Sachet	89(88.1)	83(83.8)	68(68.0)	73(75.5)	313(79.6)
Bottle	1(1.0)	0(0.0)	0(0.0)	0	1(1.0)
River	0(0.0)	13(13.1)	0(0.0)	1(1.1)	14(14.2)

Table 2: Ownership of water source in the study area.

Household Location	Number of households indicating ownership of sources of water		
	Hand-dug well F (%)	Borehole F (%)	Pipe borne F (%)
Judges Quarters	52(51.5)	26(25.7)	20(19.8)
North Bank	18(18.2)	11(11.1)	5(5.1)
High Level	37(37.0)	1(1.0)	14(14.0)
Wadata	30(30.1)	1(1.1)	1(1.1)
Makurdi (Total)	137(34.9)	39(9.9)	40(10.2)

Source: Field Survey (2015).

Table 3: Sources of water used by households for drinking

Sources of Water	Number of households indicating various sources of water				
	Judges Quarters F	North Bank F	High Level F	Wadata F	Total F (%)
Hand-dug well	6	2	5	1	14(3.6)
Bore Hole	21	25	5	1	52(13.2)
Pipe borne	12	5	30	12	59(15.01)
Mai-Ruwa (Vendor)	0	5	1	3	9(2.3)
Tank	0	10	8	15	33(8.4)
Sachet	89	83	68	73	313(79.6)
Bottle	1	0	0	0	1(0.3)
River	0	0	0	0	0(0.0)

Source: Field Survey (2015).

Table 4: Sources used for cooking by households

Sources of Water	Number of Households indicating source for Cooking				
	Judges Quarters F	North Bank F	High Level F	Wadata F	Total F (%)
Hand-dug well	54	21	70	39	184(46.8)
Bore Hole	43	60	6	2	111(28.2)
Pipe borne	33	13	28	11	85(21.6)
Mai-Ruwa (Vendor)	2	34	16	35	87(22.1)
Tank	8	6	6	33	53(13.5)
Sachet	0	0	0	0	0(0.0)
Bottle	0	0	0	0	0(0.0)
River	0	6	0	1	7(1.8)

Source: Field Survey (2015)

of 89 households and High Level had the lowest with 68 households which indicate that those in Judges Quarters are able to afford sachet water because of their economic status. For High Level, it could be because the residents have access to pipe borne water (Table 1) so their dependence on sachet water is reduced. This also explains why high-level with 30 households recorded the highest number of households who use pipe borne water for drinking.

Households who indicated the use of borehole water for drinking were more in North bank, followed by Judges Quarters and only one household in Wadata. The ownership of boreholes in Judges Quarters (Table 2), the several borehole users in North Bank and the few borehole users in Wadata (Table 1) could be the reason for the household's choices since the distance from water source affects household choice. This is similar to findings by [10] that distance from water sources affect household's choice. The longer the distance to a particular source of drinking water, the lower will be the demand for same. No household in Judges Quarters indicated the use of water from vendors or tank for drinking. Household's characteristics such as household size and the household welfare have a strong impact on the choice of drinking water source [10]. The reason for a few households indicating the use of water from vendors, hand-dug wells, tanks and river could be because of the unreliable quality of water from the sources.

Source Used for Cooking: More households use hand-dug well water for cooking in the study area than the other sources identified in the area as seen in Table 4 except for North Bank where the nature of the soil strata has led to the digging of only a few hand-dug wells. The unavailability of water from the state water supply scheme could be the reason for using hand-dug wells. The hand-dug wells are also available to households in the neighborhoods even when it is not privately owned by the user as seen in Table 1. Besides, most times getting water from the hand-dug well is free of charge and could be the reason for the choice.

Judges Quarters and North Bank (43 and 60 respectively) have more households who use water from boreholes for cooking. The reason for the choice in Judges Quarters could be because of the availability of boreholes in the area while for North Bank it is likely because of the unavailability of hand-dug wells. As seen in Table 2, only a few households in North Bank own boreholes and water from boreholes even when obtained

from a neighbor's house is usually at a cost. However, because of the unavailability of other sources, especially the hand-dug wells, the residents in North Bank resort to the use of water from boreholes even though most times they have to pay. Only a few households in High Level and Wadata 2 use water from borehole for cooking maybe because of the unavailability of the source in the locations (Table 1).

More households in Judges Quarters and High Level (33 and 28 households) use pipe borne water for cooking while more households in North bank 34 and Wadata 35 use water from vendors for cooking. Most of the households who use water from tank for cooking are in Wadata. It is Only North bank and Wadata that have households who use water from the river for cooking because of the areas proximity to the river.

Sources Used for Other Purpose: The sources of water used for other purposes presented in Table 5 followed the same trend as those used for cooking in Table 4. More households (53.2%) indicated the use of hand-dug well water as a source for other purposes than they did for cooking. There was also an increase in the use of sources that are not potable and a decrease in the use of the more potable sources. The change in the choice of source could be because households are more willing to use less potable water for other purposes than for cooking and drinking.

Household Perception on Sufficiency of Quantity from Water Sources: The results in Table 6 show that more households in Judges Quarters and North Bank indicated that water from borehole was very sufficient. Generally, the perception about sufficiency of boreholes as a source among its users is more positive (29.1%) than negative (6.4%) probably because the quantity drawn from a borehole is normally determined by the owner and those who do not own boreholes usually fetch for free or pay a small amount of money so the water from the source is usually available and affordable.

High Level (37.0%) had more households indicating that hand-dug well as a source is very sufficient. However comparing this with those who indicated the use of hand-dug well as a source (Table 1) and ownership of source in (Table 2), it was observed that probably only those who own hand-dug wells indicated hand-dug well as a very sufficient source. The sufficiency of hand-dug well was also generally positive because only 47 out of 224 who responded indicated insufficiency.

Table 5: Sources of water used by households for purposes other than drinking and cooking

Sources of Water	Number of Households indicating Source Used for other Purposes				
	Judges Quarters F	North Bank F	High Level F	Wadata F	Total F (%)
Hand-dug well	60	21	79	49	209(53.2)
Bore Hole	33	55	5	3	96(24.4)
Pipe borne	32	10	22	5	69(17.6)
Mai-Ruwa (Vendor)	3	36	20	40	99(25.2)
Tank	8	5	2	24	39(9.9)
Sachet	0	0	0	0	0(0.0)
Bottle	0	0	0	0	0(0.0)
River	0	13	0	1	14(3.6)

Source: Field Survey (2015).

Table 6: Household perception on sufficiency of water sources

Water Source	Response	Number of households				
		Judges Quarters F (%)	North Bank F (%)	High level F (%)	Wadata F (%)	Makurdi (Total) F (%)
Borehole	No Response	46(45.5)	31(31.3)	90(90.0)	87(93.5)	254(64.6)
	Very Sufficient	26(25.7)	19(19.2)	1(1.0)	3(3.2)	49(12.5)
	Sufficient	9(8.9)	22(22.2)	3(3.0)	2(2.2)	36(9.2)
	Enough	14(13.9)	13(13.1)	1(1.0)	1(1.1)	29(7.4)
	Insufficient	6(5.9)	14(14.1)	5(5.0)	0(0.0)	25(6.4)
	Very Insufficient	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Total	101(100)	99(100)	100(100)	93(100)	393(100)
Hand-dug well	No Response	41(40.6)	70(70.7)	18(18.0)	40(43.0)	169(43.0)
	Very Sufficient	25(24.8)	15(15.2)	37(37.0)	19(20.4)	96(24.4)
	Sufficient	9(8.9)	5(5.1)	16(16.0)	14(15.1)	44(11.2)
	Enough	14(13.9)	3(3.0)	9(9.0)	11(11.8)	37(9.4)
	Insufficient	12(11.9)	5(5.1)	18(18.0)	7(7.5)	42(10.7)
	Very Insufficient	0(0.0)	1(1.0)	2(2.0)	2(2.2)	5(1.3)
	Total	101(100)	99(100)	100(100)	93(100)	393(100)
Vendors	No Response	96(95.0)	26(26.3)	59(59.0)	28(30.1)	209(53.2)
	Very Sufficient	1(1.0)	16(16.2)	2.0(2.0)	23(24.2)	42(10.7)
	Sufficient	1(1.0)	26(26.3)	21(21.0)	8(8.6)	56(14.2)
	Enough	1(1.0)	12(12.1)	10(10.0)	19(20.4)	42(10.7)
	Insufficient	2(2.0)	18(18.2)	8(8.0)	14(15.1)	42(10.7)
	Very Insufficient	0(0.0)	1(1.0)	0(0.0)	1(1.0)	2(0.5)
	Total	101(100)	99(100)	100(100)	93(100)	393(100)
Pipe borne	No Response	66(65.3)	68(68.7)	36(35.0)	76(81.7)	246(63.6)
	Very Sufficient	11(10.9)	1(1.0)	6(6.0)	4(4.3)	22(5.6)
	Sufficient	10(9.9)	5(5.1)	5(5.0)	5(5.4)	25(6.4)
	Enough	5(5.0)	5(5.1)	9(9.0)	4(4.3)	23(5.9)
	Insufficient	7(6.9)	8(8.1)	18(18.0)	0(0.0)	33(8.4)
	Very Insufficient	2(2.0)	12(12.1)	26(26.0)	4(4.3)	44(11.2)
	Total	101(100)	99(100)	100(100)	93(100)	393(100)
Tank	No Response	91(90.1)	75(75.8)	89(89.0)	54(58.1)	309(78.6)
	Very Sufficient	4(4.0)	4(4.0)	1.0(1.0)	7(7.5)	16(4.1)
	Sufficient	3(3.0)	14(14.1)	5(5.0)	22(23.7)	44(11.2)
	Enough	1(1.0)	0(0.0)	0(0.0)	7(7.5)	8(7.0)
	Insufficient	1(1.0)	6(6.1)	5(5.0)	2(2.2)	14(3.6)
	Very Insufficient	1(1.0)	0(0.0)	0(0.0)	1(1.1)	2(0.5)
	Total	101(100)	99(100)	100(100)	93(100)	393(100)

Source: Field Survey (2015)

Table 7: Regularity of tap water supply.

Response	Number of Households indicating Regularity of Tap Water Supply				
	Judges Quarters F (%)	North Bank F (%)	High Level F (%)	Wadata F (%)	Total F (%)
No Response	21(20.8)	50(50.5)	17(17.0)	41(44.1)	129(32.8)
Very Good	9(8.9)	0(0.0)	6(6.0)	0(0.0)	15(3.8)
Good	19(18.8)	2(2.0)	11(11.0)	3(3.2)	35(8.9)
Satisfactory	19(18.8)	2(2.0)	5(5.0)	7(7.5)	33(8.4)
Poor	5(5.0)	5(5.1)	26(26.0)	5(5.1)	41(10.4)
Very Poor	28(27.7)	40(40.4)	35(35.0)	37(39.8)	140(35.6)
Total	101(100)	99(100)	100(100)	93(100)	393(100)

Source: Field Survey (2015)

About 24.2% of households in Wadata find water from vendors to be very sufficient which was the highest recorded, North bank with 26.3% had more households who indicated the source as sufficient. The unavailability of boreholes and pipe borne water in Wadata shown in Table 2 could be the reason for more households in Wadata choosing vendors (Table 1). Most of the water supplied by vendors in this area is also obtained from the water treatment plant or the river because of their proximity to the area. More vendors are also available to distribute the water to the households in Wadata and North Bank because the vendors are predominantly persons of northern Nigerian origins who live in Wadata and North Bank so are available when their services are needed. It is good to note that less positive responses are recorded in terms of sufficiency of vendors which could be because households have to pay for the water and they might not have it supplied at the time and in the quantity required.

The response on the sufficiency of pipe borne water among those who have access to the source was more negative than positive. Only 36.4% of the sample responded while 63.6% did not respond. This could be because only 10.2 % of the households indicated being connected to the source (Table 2). High Level had the most households who indicated the use of pipe borne water (Table 1) and also recorded the most insufficiency of the source which could be because of the inconsistent supply from the Water Board as stated by [8].

Regularity of Tap Water Supply: Response of the residents to question on the regularity of tap water supply shows that tap water supply is generally poor in Makurdi. Only 3.8 % indicated that the supply was very good and these households were located in Judges Quarters and High Level. Households who responded that the supply was good were also more in Judges Quarters (18.8%) and High Level (11.0%), maybe because more households are connected in these areas as shown in Table 2. No

household in North Bank and Wadata indicated that tap water supply is very good and only a few households in North Bank (4.0%) and Wadata(10.7%) also indicated that the supply is either good or satisfactory. The results as shown in Table 7 indicate that the regularity of tap water supply in Judges Quarters and High Level is better than that in North Bank and Wadata. On a general note, out of the 67.1 % responses on the regularity of tap water supply, 46 % of the responses from the households were negative and only 21.1 % were positive which shows that the regularity of tap water supply in Makurdi is generally poor.

CONCLUSIONS

The various sources of water available for household consumption in Makurdi namely: hand-dug well, borehole, pipe borne, mai-ruwa (vendor), tank, sachet, bottle and river were evaluated. From the result of the study, the most used sources were sachet (packaged) Water, water from hand-dug wells and water from vendors. Only 10.2% of the sample is connected to potable water source. It was observed that households who do not own hand-dug wells fetch water from their neighbors at no cost but may have to pay when fetching from a neighbors borehole. It can be seen that a lot of money is spent on water because most households buy packaged water for drinking as the available alternative for public potable water supply. Also, water from vendors which is another major alternative is paid for. Cooking and other household water using activities are done with water from hand-dug well in most households. Based on response from households, the quantity of water from hand-dug well is more sufficient than the other sources. Regularity of tap water supply is also generally poor. It is therefore concluded that public potable water supply is inadequate and unreliable. The major source of household water consumption identified in the study area is Hand-dug well.

Recommendations: Based on the findings of the study, it is recommended that:

- Public water supply should be improved by getting more households connected.
- Supply of water from the water board should be made more regular so that connected households can have sufficient water to meet their needs.

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