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Potable Water Security in Urban Centres of Abia State, Nigeria

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Abstract

Access to water supply particularly, potable water, is problematic in Abia State. In this study, three urban centres were selected. The survey was conducted using carefully designed questionnaire administered to the households using the systematic sampling technique. The study areas were mapped from the Google Earth and the distances between the nearest water access points from each household were determined. The results obtained revealed that the mean household of 8 persons is at variance with the national household mean of 5 persons per household and thus meeting daily requirement may not be possible. The per-capita consumption of water was estimated to be 35.9 litres per person per day, which falls short of WHO and Nigerian's water standard. Also, 40.59% of the households spend less than the required distance while 59.41% spend greater than the 200m as recommended by WHO (2000). This implies that greater percentage of the population spends more than the required distance to reach water access points. It was confirmed statistically using two-sample t-test that there is no significant difference between estimated and measured time of conveyance and that of estimated and measured distance. The study recommend amongst others that the government should give top priority attention to water supply schemes and rehabilitation projects during the allocation of funds in the national plan and budgets through the Ministry of Public Utilities.

Keywords: *Access, Water supply, Urban centres, Abia State, Nigeria.*

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Background to the Study

Water is vital for all living organisms. Water has always played and continues to play a central role in the life of man. It is a source of life, livelihoods and prosperity. It has no substitute and a veritable resource in production, agriculture, industry, energy and transport, etc. Harnessing the productive potential of water and limiting its destructive impact has been a constant struggle since the origins of human society.

Except in the driest parts of the world, water has traditionally been regarded as a public good to which no one can be denied access. According to World Health Organization (WHO, 2004), more than one billion people in low income countries lack access to safe water for drinking, personal hygiene and domestic use. Access to improved water sources not only refer to water quality but, proximity also (National Bureau of Statistics, 2005). The World Bank while commenting on the world water challenge stated that access to water supply services and sanitation is a major factor in reducing child mortality (World Bank, 2007).

Water supply in Nigeria like in other developing countries is facing serious challenges. In spite of its extreme importance, access to water supply in Nigeria with particular reference to Abia State is problematic particularly potable water. A large part of Abia population continues to have only limited or no access at all to safe drinking water. Although Nigeria is blessed with abundant water resources, governments at all levels have not been able to harness these resources to ensure a sustainable and equitable access to safe, adequate, improved and affordable water supply and sanitation to the population (Muta'a, 2012). Successive governments have been pursuing with vigour aggressive water supply programs. Despite these efforts (annual investments by the three tiers of government) in water related infrastructure, the public are still disenchanted because access to potable water and the quality of services remains poor.

The lack of access to safe drinking water and sanitation is probably directly related to poverty and in many cases to corruption and the inability of governments to develop the political will to provide water and sanitation systems for their citizens (Odafivwotu & Abel, 2014). For instance, out of the 85 million people living in urban and semi-urban areas, less than half have reasonable access to safe water supply (World Bank and Federal Ministry of Water Resources, 2007). The general picture about potable water supply in Abia State is one of either total absence or gross inadequacy of the existing system. Children and adults roam about the streets in search of water a phenomenon which is a common sight in Nigerian cities. This trend is unacceptable and brings to mind the begging question as to why the populace cannot have easy access to the most fundamental need of life.

The responsibility of providing potable water in Abia State rests solely on the shoulders of the State Water Board but all it has to show is an array of abandoned projects and obsolete equipments that have become monuments, a situation which has resulted in one of either total absence or gross inadequacy of potable water supply. Thus, the inability of the water Boards to cope with the increasing demand for water quality and quantity has paved way for increased contribution of groundwater to total water use in the study areas.

This situation has been confirmed by studies of different cities in Nigeria. For instance, despite investments and reforms, Lagos still lacks adequate treatment capacity to deliver enough clean water for drinking and household use. By the end of 2008, vigorous efforts by the state water authority achieved a water delivery capacity of 200 million gallons per day against a demand of 600 million gallons, a gap of about 66 per cent (Stimson Global Health Security, 2012). Similarly, the Warri Urban Water Board is moribund, making it incapable of supplying potable water to households in Warri-Effurun metropolis (Ohwo, 2011). These situation has made households to turn to private wells or street vendors to meet drinking water needs, which has exposed consumers to bacterial and heavy metal contamination exceeding local regulatory standards

WHO (2000) defines reasonable access to a water source as the "availability of at least 20 liters per person per day (L/capita-day) from a source within one kilometer of the user's dwelling. The United Nations and WHO standards minimally acceptable water access consists of having a source of abundant drinking water within 200 meters (WHO, 2000). This standard implies that standpipes and outside water connections can be part of the sources especially in high-density low income areas where the realistic alternative is expensive and unsafe water delivered by trucks and water vendors. A majority of the developing countries however, have been unwilling to incorporate such reduced standards in urban planning. In view of the above, therefore, this study analyses the access of households to water supply in terms of household size, household domestic water consumption, cost of water supply, distance and water collection times to water sources. There is a dearth of literature on the analysis of access to potable water supply as most of the literature reviewed was mainly from outside the study area. Going by this, this study will be the first extensive work on the topic in Abia state.

The Study Area

Abia State lies within approximately latitudes $4^{\circ}40'$ and $6^{\circ}14'$ north, and longitudes $7^{\circ}10'$ and 8° east, and shares common boundaries with Enugu State in the North and Ebonyi State in the northeast; to the west is Imo State, and to the northwest is Anambra State. To the south and southwest, it shares borders with Rivers State; and to the east and southeast with Cross River and Akwa Ibom States respectively. The State covers an area of about 5,243.7sq.km which is approximately 5.8 percent of the total land area of Nigeria. With its capital at Umuahia, it has seventeen local government areas (LGAs).

In terms of relief, Abia State lies generally on a flat and low-lying land, generally less than 120m above sea level. Geologically, there are nine main geological formations from south to north. These include: the Benin formation (Coastal Plain Sand); the Bende-Ameki Group - Eocene (Clay, clayey and shale); the Nkporo Shale Group - Upper Senionian (Shale and mudstone); the Nsukka formation (Upper Coal Measures), the Igali sandstone (False-bedded Sandstone), the Eze-Aku Shale Group and the Asu River Group (Ijioma, 2000 and Wikipedia 2006).

Abia State falls within the sub equatorial climatic zone with clearly marked dry season and double maxima rainfall in August and September. Relative humidity is usually high throughout the year. It varies considerably between the rainy and the dry seasons. The rainy months often have an average relative humidity of 80-90 percent while the dry months have an average relative humidity of 50-70 percent. The average monthly sunshine hours of the area are 4.8. The mean monthly evapotranspiration is 136mm (Abia State official website). The soils of Abia State fall within the broad group of ferrallitic soils of the coastal plain sand and escarpment (Ijioma, 2000). The vegetation is ordinarily considered part of tropical rain forest which is the dominant natural vegetation in most parts of southern Nigeria.

The national census of Nigeria carried out in 2006 puts the provisional population of Abia State at 2,845,380 while its projection to 2015 is 3,652,627. There was thus an increase of 807,247 people over a period of 9 years. The high population of the study area could have some implications for the potable water supply situation. It could lead to potable water supply shortages as a very high population will be depending on one of either total absence or gross inadequacy of the potable water by the water Board. On the other hand, the high population of the area could be used to develop potable water supply projects through proper planning and implementation.

Method of Study

This work is scientific. It employed both qualitative and quantitative approaches in data collection and analysis. The survey was conducted using carefully designed questionnaire calculated to elicit as much information as was required or considered relevant to the goals of the study. In order to test the validity and reliability of the research instrument, the preliminary survey was conducted. In the main study, 1400 copies of questionnaire were administered to the households using the systematic sampling technique. The distribution of the 1400 sampled households among the three urban areas in the state was based on quota sampling. The quota was allocated in such a way that the sample was the representative of the entire population. It was impossible to recover the expected 1400 copies of household questionnaire and on the whole, 1146 households responded. This gave 81.9% response rate and 18.1% non-response.

In the distribution of the questionnaire, mostly women and adults from 18 years and above were targeted. For example, women collect the water, wash clothes, cook meals and care for children. Exceptions do occur, but they generally occur only if the wife is sick, heavy or if a man is not married or is living alone. The women, therefore, know how much water is used for each task and are the best source of information in the household regarding the use of water.

The study areas were mapped from the Google Earth and the distances between the nearest water access points from each household were determined. Co-ordinate errors were not encountered because we adjusted the co-ordinates of Google using GPS – Global Positioning System. Though, this did not actually produce an average distance, but tells the distance the households are from the water access points. Generally, simple statistical techniques like frequency distribution, percentages and means were used as tools for comparison while tables was used to show the relationship of variables for easy analysis. Other statistical tool employed in testing the hypotheses is two-sample t-test.

Results and Discussion

Household Size

Household size and socio-economic characteristics of household have implications for water supply. The size of household has been found to affect not only the quantity of water used but also the amount of money spent daily on water supply. Using the 1146 recovered questionnaires from the various zones as shown viz; Ohafia, 150 (13.08%); Umuahia, 405 (35.34%) and Aba, 591 (51.57%), the size of the household was determined. The mean of the quantitative frequency distribution of household sizes are 7, 8.5 and 8.8 respectively. Collectively, the mean of the study area is 8.1 which is approximately 8 persons per household. This mean household is at variance with the national household mean of 5 persons per household and thus meeting daily requirement may not be possible.

Household Domestic Water Consumption

The mean household domestic water consumption from the questionnaire samples for Ohafia zone was found to be 188.3 litres which gave an average of 26.9 litres per head per day. In Umuahia, the mean domestic water consumption was found to be 333.6 litres giving an average of 39.24 litres per head per day. For Aba zone, the mean of the household water consumption was put at 339 litres which gave an average of 38.52 litres per head per day. Collectively, the per-capita consumption of water is 35.9 litres per person per day. The result of the questionnaire analysis in the study areas show that per-capita consumption of water was far below the WHO recommended standard of 115 litres per person per day and that of national water policy that prescribe water for all with 120 litres and 60 litres per capita per day for urban and peri-urban/rural areas respectively by 2020. It was noted that one of the major setbacks for inadequate quantity of water usage in the area is the high cost of water supply in relation to household's disposable income.

Cost of Water Supply

In Abia State, the amount spent on water daily by households is dependent on source type, income, household size and quantity demanded. Table 4.1 shows the average cost of water supply in the state.

Table 1: Average cost of 20 litres of water from Boreholes (N)

Zones	L.1	L.2	L.3	L.4	L.5	L.6	L.7	L.8	L.9	L.10	Total	X of distribution
Ohafia	20	20	20	20	20	20	-	-	-	-	**120**	**20**
Umuahia	10	10	7.5	10	7.5	5.0	7.5	10	10	5.0	**82.5**	**8.25**
Aba	10	10	7.5	10	5.0	10	7.5	10	5.0	10	**85**	**8.5**
Abia state											**287.5**	**12.25**

N/B: L.1 = Locations

Table 1 shows average cost of 20 litres of water from the commercial boreholes. For Ohafia area, average cost of 20 litres of water is N20.00. This is due to less number of boreholes in the area and the absence of surface streams. The only stream available in the area (Mmuori River) which is the source of their drinking water for both Elu and Ebem Ohafia is too far from the people. This is an indication that some households would find it difficult to maintain personal hygiene since the quantity of water needed daily may not be met. In all, the average for Umuahia is N8.25 per 20 litres of water which is equivalent to two jerry cans at N15.00 while the average for Aba is N8.5 per 20 litres of water. Therefore, the average cost of 20 litres of water in the study areas is N12.25k per 20 litres of water. The implication of this is that households who could not afford to spend more on the desired quantity would find it difficult to meet all their water needs.

Distances to Major Source of Water Supply

The United Nations and WHO standards minimally acceptable water access consists of having a source of abundant drinking water within 200 meters (WHO, 2000). This standard implies that standpipes and outside water connections can be part of the sources especially in high-density low income areas where the realistic alternative is expensive and unsafe water delivered by trucks and water vendors. A majority of the developing countries however, have been unwilling to incorporate such reduced standards in urban planning.

The distance matrix from households to borehole points in the study areas are shown in Tables 2, 3 and 4. The study areas were mapped from the Google Earth and the distances between the nearest water access points from each household were determined. Though this will not actually produce an average distance, but tells the exact distance the households are from the water access points.

Table 2: Distance (m) matrix from households to borehole points in Aba South (Mapped from Google Earth)

Borehole Points	Selected Households									
	HS_1	**HS_2**	**HS_3**	**HS_4**	**HS_5**	**HS_6**	**HS_7**	**HS_8**	**HS_9**	**HS_{10}**
BH_1	40.66	76.38	108.70	168.91	203.66	128.63	172.43	250.49	334.53	205.54
BH_2	35.28	116.31	100.58	90.26	106.24	144.16	178.69	192.06	206.27	195.22
BH_3	32.24	48.68	98.23	145.80	122.25	155.81	187.67	223.65	240.32	295.81
BH_4	63.32	150.81	190.90	183.31	170.17	70.15	153.48	241.83	200.53	166.43
BH_5	44.10	79.75	96.74	126.85	98.03	203.01	109.81	142.52	152.90	199.43
BH_6	88.68	141.76	261.00	289.03	368.74	318.85	454.20	556.73	537.94	692.72

NOTE: BH = Borehole HS = Household

The distance matrix in Aba South (Table 2) shows that 68.33%, representing two-third ($^2/_3$) of the households obtain their water from a source within 200m as recommended by WHO (2000). The other households, 31.67% being ($^1/_3$) whose source is greater than 200m may be those who their nearest water access points are broken down due to one problem or the other. Tables 3 and 4 are for the other study areas.

Table 3: Distance (m) matrix from households to borehole points in Umuahia North (Mapped from Google Earth)

Borehole Points	Selected Households									
	HS_1	**HS_2**	**HS_3**	**HS_4**	**HS_5**	**HS_6**	**HS_7**	**HS_8**	**HS_9**	**HS_{10}**
BH_1	152.27	190.39	316.31	464.76	521.42	488.73	226.41	213.46	446.39	520.78
BH_2	132.82	199.79	336.06	501.54	569.98	225.01	411.80	488.35	188.59	211.96
BH_3	124.20	435.60	497.69	465.77	576.45	816.49	1046.72	1045.80	1021.15	1343.81
BH_4	89.25	129.94	273.06	343.38	523.30	746.42	814.63	943.40	353.98	421.15
BH_5	141.14	218.64	283.14	286.10	304.97	321.63	365.52	173.45	485.14	497.26

NOTE: BH = Borehole HS = Household

Table 3 depicts the distance matrix from households to borehole points in Umuahia North. It was discovered that only 20% households spend less than the required 200m to reach a water source. The rest 80% of the households spend more than the 200m recommended by UN and WHO (2000) to reach a particular source or the other.

Table 4: Distance (m) matrix from households to borehole points in Ohafia (Elu and Ebem) (Mapped from Google Earth)

Borehole Points	Selected Households									
	HS_1	**HS_2**	**HS_3**	**HS_4**	**HS_5**	**HS_6**	**HS_7**	**HS_8**	**HS_9**	**HS_{10}**
BH_1	34.95	29.02	130.63	256.74	294.39	229.56	251.41	292.00	441.86	685.03
BH_2	74.28	77.95	214.10	125.25	678.80	787.56	620.14	474.20	559.50	676.86
BH_3	86.40	181.93	288.66	362.83	916.12	977.43	696.12	673.12	677.05	830.17
BH_4	120.44	101.91	372.74	269.91	946.83	1022.69	1092.34	929.24	948.36	1049.88
BH_5	52.36	90.40	169.65	169.83	894.00	1041.14	998.49	785.31	815.54	782.32
BH_6	62.10	55.65	150.44	185.48	734.96	710.97	597.14	629.91	620.91	693.01

NOTE: BH = Borehole HS = Household

The distance matrix for Ohafia (Table 4) shows that the first and second households (HS_1 and HS_2) spend less than 200m to reach a particular source or the other. Household three (HS_3) spend less than 200m to reach boreholes 1, 5 and 6 (BH_1, BH_5 and BH_6). Household four also spend less than 200m to reach boreholes 2, 5 and 6 (BH_2, BH_5 and BH_6). In all, 30% of the households spend less than the required distance. Households 5 – 10 all spend more than the required distance to reach water sources and this represents 70% of the households.

In summary, apart from Aba south whose majority of the respondents spends less than the required distance to reach water access points, other locations (Umuahia urban and Ohafia) spends more than the required distance to reach water access points. Thus, 40.59% spend less than the required distance while 59.41% of the households spend greater than the 200m as recommended by WHO (2000). This implies that greater percentage of the population spends more than the required distance to reach water access points.

Access to potable water is measured by the number of people who have a reasonable means of getting an adequate amount of water that is safe for drinking. It was discovered from fieldwork that some of the households prefer to go to a distant location whose water they think is safer than those nearest to them. The cost (affordable price) was also found to have impact on distance travelled. Residents prefer to travel to more distant locations whose price is affordable than the near but costly locations. The result of this study implies that the amount of water collected will decrease with an increasing collection time. As the collection time continues to increase, the water source is located off the threshold of the user.

Water Collection Time/Distance to a Water Source

As was explained in the methodology section, the researchers measured the collection time and distances to water sources to compare to respondents' estimated collection time and distance to water sources. This is shown in table 5.

Table 5: Comparison of the estimated collection times, measured collection times and distance to water sources

Respondents (randomly selected)	Estimated collection time (minutes)	Measured collection time (minutes)	Ratio measured to estimated times	Estimated distance (metres)	Measured distance (metres)
3	180	60	0.33	920	810
6	60	45	0.75	600	480
32	20	35	1.75	400	400
56	90	40	0.44	580	620
98	40	60	1.5	1000	700
105	30	50	1.67	500	300
120	90	50	0.56	700	400
132	30	45	1.5	800	660
159	50	40	0.8	400	220
170	10	30	3.0	300	180
201	50	35	0.7	400	250
215	30	45	1.5	190	300
243	180	80	0.44	720	460
268	15	20	1.33	210	170
403	45	28	0.62	400	280
Total	**920**	**663**	**16.89**	**8120**	**6230**
Mean	**61.3**	**44.2**	**1.126**	**541.3**	**415.3**

Table 5 shows that the average time (measured collection time) spent in water collection were found to be 44.2 minutes. This differed from the respondents' estimated collection time which put the figure at 61.3 minutes. This average time includes the amount of time it takes for a person to travel from the home to the water source, wait in queue, collect water and return home.

To confirm statistically whether there is significant difference between the estimated and measured time, hypothesis 1 was tested with two sample t-test and confidence interval thus;

1. **H_0:** There is no significant difference between the estimated and measured conveyance time

   H_1: There is a significant difference between the estimated and measured conveyance time

H_0: $_1$ - $_2$ = 0 against H_1: $_1$ - $_2$ 0

Where $_1$ is the mean of the estimated conveyance time (ECT) and $_2$ is the mean of the measured conveyance time (MCT)
95% CI for $_1$ - $_2$: (-12, 46.6)

T-Test $_1$ - $_2$ = 0 against H_1: $_1$ - $_2$ 0, T= 1.19; P=0.24; DF= 28

Both use Pooled Standard Deviation = 39.3

Here p-value = 0.24 > 0.05, therefore the alternate hypothesis (H_1) is rejected and the null hypothesis (H_0) accepted. Thus there is no significant difference between estimated and measured time of conveyance.

The times measured by the researchers' represent how long it takes to follow the routes from water source to households for respondents, but they do not take into account the various activities or characteristics of a normal water collection trip, such as greeting neighbours, carrying the water (return trip), changing routes perhaps because of terrain, person carrying the water may be sick or have injured feet, etc. Thus, collection times are influenced by many factors, not just the distance between a water source and user's dwelling. Therefore, it may not be the best way to measure accessibility.

For this reason, while the measured times are a different representation of the collection times, the researchers' realizes that better data can be collected by candidly timing a respondent while not influencing the route.

The respondents estimated distance to water supply sources is 541m while the mean distance travelled in search of water in the study area was found to be 415m. This mean distance was in tandem with the distance matrix from households to borehole points in the study areas (Tables 2 – 4). The implication of this result is that greater percentage of the residents spends more than the 200m recommended by WHO (2000) to reach water access points.

To also confirm statistically whether there is significant difference between the estimated and measured distance, hypothesis 2 was tested with two sample t-test and confidence interval thus;

2. **H_0:** There is no significant difference between the estimated and measured distance

H_1: There is a significant difference between the estimated and measured distance

H_0: $_1 - _2 = 0$ against H_1: $_1 - _2$ 0

Where $_1$ is the mean of the estimated distance (ED) and $_2$ is the mean of the measured distance (MD)

95% CI for mu ED - mu MD: (-43, 295)
T-Test $_1 - _2 = 0$ against H_1: $_1 - _2$ 0, T= 1.53; P=0.14; DF= 28

Both use Pooled Standard Deviation = 226

Here p-value = 0.14 > 0.05, therefore we do not have any evidence to reject the null hypothesis (H_0). Thus, the alternate hypothesis (H_1) is rejected and concludes that 'there is no significant difference between estimated and measured distance'. Based on mere comparisons from Table 7, one could conclude that slight differences exist, but with the use of t-test, it has been confirmed statistically that there is no significant difference between the estimated and measured time and that of distance.

Conclusion

Water has traditionally been regarded as a public good to which no one can be denied access. It is on this premise that this study examined the availability and accessibility of water to the residents of the study area through the determination of household size, household domestic water consumption, and cost of water supply, distance and water collection times to and from water sources amongst others. Therefore, if water is adequately provided in the right place at the right time in the right form, it would help remedy water accessibility problems encountered as a result of water supply inadequacies. It is recommended that government should make strenuous efforts to improve access to safe and sustainable water supplies in the state.

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