EFFECT OF SELECTED FACTORS ON WATER SUPPLY AND ACCESS TO SAFE WATER IN NIGERIA

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ABSTRACT

This paper evaluated access to safe water supply in Nigeria. Information on access to drinking water and water supply were acquired from literature and archives. The information were analyzed using analysis of variance (ANOVA). Effects of selected factors (number of local government areas in the State, hydrological areas, geopolitical zones, gender populations, presence of donor in the State, land size of the State and year of State creation) on access to safe water were assessed. Selected States (Katsina, Kano, Osun, Benue; Bauchi, Gombe, and Kaduna) were visited to confirm methods of water supply. The study revealed that the national average of access to piped water supply, protected wells; borehole and water vendors were 17.5%; 12.8%; 11.6% and 4.0% respectively. The National average of access to safe water supply was 45.9 %. The study revealed that Taraba and Ebonyi States had the least access to piped water supply of 0.8% and 0.9% respectively. Kwara and Lagos States had the highest access to piped water supply of 59.5 % and 51.1% respectively. Taraba (12.7%) and Zamfara (21.7%) States were the lowest contributors to access to safe water supply. The effects of the selected factors on water supply and access to clean water in Nigeria were in order of land size of the State ($F_{36,1} = 222.10$; $p = 5.66 \times 10^{-10}$), number of Local Government Areas in the State ($F_{36,1} = 210.619$; $p = 1.29 \times 10^{-16}$), hydrological areas ($F_{21,3} = 5.839$; $p = 0.0046$), geopolitical zones ($F_{15,3} = 5.40$; $p = 0.0096$), year of State creation ($F_{3,3} = 8.497$; $p = 0.056$) and presence of donors. Statistical analysis revealed that the selected factors were significant factors at 95% confidence level. The study concluded that States like Zamfara, Taraba, Akwa Ibom and Ebonyi needed to intensify their efforts to meet Millennium Development Goals and Vision 20: 20 of halving their population with access to unsafe water supply by the year 2020.

Keywords: Access to Safe Water Supply Technologies, Piped Water, Borehole, Millennium Development Goals

INTRODUCTION

Access to potable water is measured by the number of people who have reasonable means of getting an adequate (quality and quantity) amount of water that is safe for drinking, washing and essential household activities. Adequate access to potable water means that women and children will spend limited time in fetching water that could be used actually for drinking, cooking and other tasks (Ishaku *et al*., 2011). It is a key component in poverty alleviation efforts and reflects the health and sanitation of people in the country. It shows the country's capacity to collect and distribute treated water to consumers (Ishaku *et al*., 2011). Safe water includes treated surface water, as well as untreated but uncontaminated water from natural springs and sanitary wells and protected boreholes. Several literature (Fair *et al*., 1971; Tebbutt, 1991; Steel and McGhee, 1991; Metcalf and Eddy, 1991; John De Zuane, 1996) described in details impurities in various sources of water and processes required for their removal. According to the World Health Organization (WHO and UNICEF, 2004) assessment, there are at least 5 million deaths per year due to the use of unsafe drinking water and at least 1.4 billion people do not have access to drinking water (Matthys, 2000; Ganvir *et al.,* 2002). Significant portions of these deaths occurred in developing countries such as Nigeria, India, etc. According to Ishaku *et al.* (2011), about 3.5 billion people worldwide had access to piped water supply. Another 1.3 million people had access to an improved water source through other means than house connections including standpipes. More than 1.2 billion people did not have access to an improved source of water. This shows that the sources of water of these people are either unprotected wells or springs canals, lakes or river. The water stress in urban areas is mounting as urbanization goes unchecked and the strain on resources (water supply and sanitation) increases. A recent assessment of drinking water and sanitation in Africa showed that Nigeria is not on course towards the Millennium Development Goals (MDGs) of drinking water and sanitation target (Eduvie *et al.,* 2011; WHO and UNICEF, 2012a). Improvement on access to safe water is a crucial element in the reduction of juvenile mortality, morbidity, particularly in rural areas. Literature (Karibo, 2005; Cookey *et al.,* 2008; Ishaku *et al.*, 2011; Otun *et al.,* 2011; Eduvie *et al.*, 2011; Akpabio, 2012; Oke and Ismail, 2013; WHO and UNICEF, 2013) provided information on global and regional access to safe water. However, information on factors that have an influence on access to drinking water in Nigeria is rare. Figures 1 and 2 provide a global trend of access to clean water and sanitation practice respectively. Figures 3 and 4 provide information on the relationship between sanitation practices, piped water and wealth in sub-Sahara Africa. Further information on Nigeria can be found in McCurry (1976); Akintola (1980); Oteze (1989); Kogbe (1989); Alagbe (2002); Olayinka (2009). There are reports on the lack of access to potable water, poor sanitation practices, water-borne diseases, a low national average of access to safe water and many other critical issues in sub - Sahara. These reports show that there is the need to evaluate access of Nigerians to drinking water technology (safe water supply). This study therefore evaluates Nigerians' access to clean water supply technology with particular attention to the effect of the land size of the State, population, the number of the Local Government Areas (LGAs) in the State; geopolitical zones, State creation and hydrological areas (HAs) on access to safe water.

MATERIALS AND METHOD

Information on access to safe water technology and water supply in Nigeria were obtained from the Ministry of Water Resources and Inec *et al.* (2010). In Inec *et al.*(2010), assessment of drinking water quality was embarked upon through the efforts of United Nations Children's Fund (UNICEF) and World Health Organisation (WHO) with the support of Department for International Development (DFID), to survey drinking water quality and access to safe water in six developing countries namely Nigeria, China, Ethiopia, Jordan, Nicaragua and Tajikistan. In Nigeria, the assessment was conducted in twelve States across the eight Hydrological Areas (Table 1) of the country. A total of 31152284 households were selected for the project. The eight Hydrological Areas (HAs) and six geopolitical zones of the country were selected as the broad areas of the assessment. From the Hydrological Areas, States were selected based on available technology options, the location of the State in the Hydrological Area, population served, and the potential for water quality hazards (industrial activities, upstream, downstream, oil sector, intensive farming, salt water intrusion, and mining operations). Information on percentage distribution of household by State and primary sources of drinking water were employed for the assessment of access to safe water. The information on access to drinking water technology and water supply in Nigeria obtained from the literature (Inec *et al.*, 2010) on households were used in this study as an indicator of safe water supply. The information were grouped into hydrological areas, geopolitical zones and year of State creation to evaluate the effect of each of the group. In the hydrological area (HA) classification, Inec *et al.*(2010) was used while classification according to geopolitical zone was done using guideline from Ismail and Oke (2013). Classification of the State creation by their age was conducted as follows: States created between 1960 and 1976 (first generation States) and States created between 1977 and 1996 (new generation States). Access to safe water technologies was evaluated using analysis of variance (ANOVA). The effects of hydrological areas, geopolitical zones (Figure 5); population the age of the State, land size of the State, the number of Local Government Areas (in the States and geopolitical zones and hydrological areas); donors and State on access to safe water were assessed. Selected States (Katsina, Kano, Osun, Benue; Bauchi, Gombe, and Kaduna) in Nigeria were visited to ascertain access to safe water supply technologies.

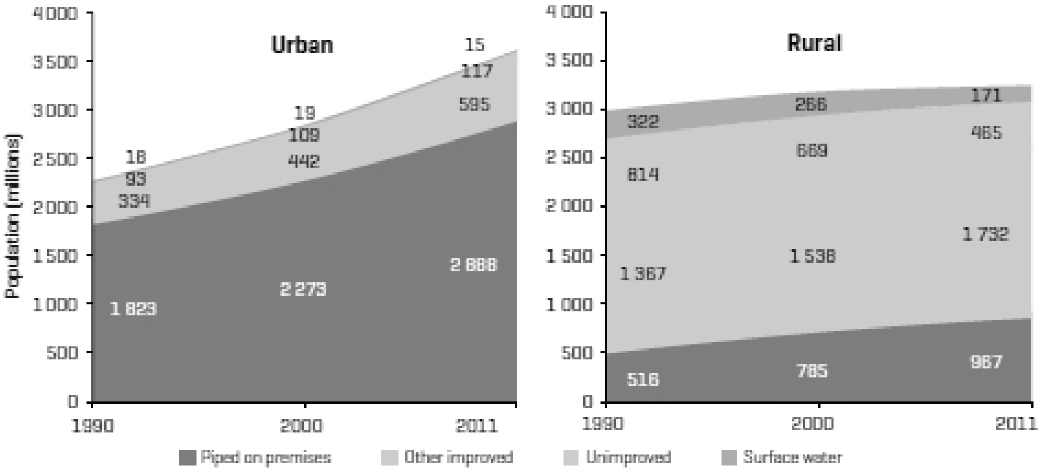


Figure 1a: Global Trend of Access to Safe Water in Urban and Rural Areas (Reprinted from WHO and UNICEF, 2013 with permission number 199273)

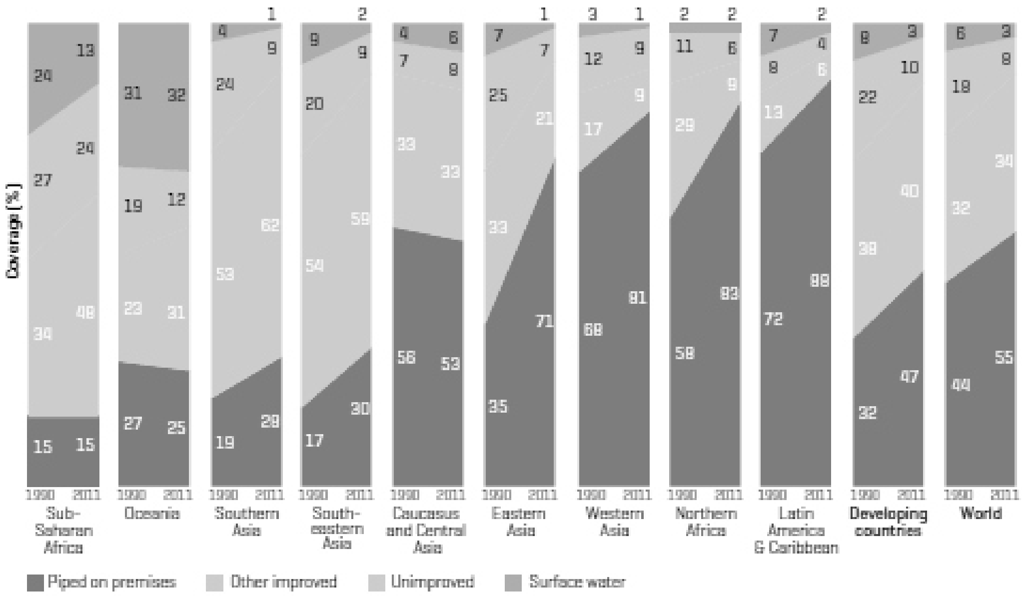


Figure 1b: Global Trend of Access to Safe Water in Various Regions and in the World (Reprinted from WHO and UNICEF, 2013 with permission number 199273)

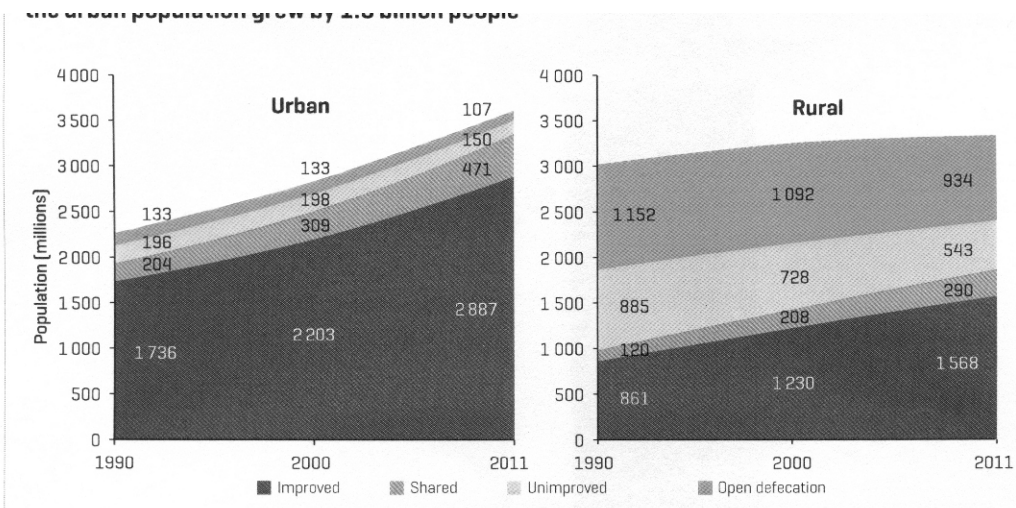


Figure 2a: Global Trend of Sanitation Practices in Urban and Rural Areas (Reprinted from WHO and UNICEF, 2013 with permission number 199273)

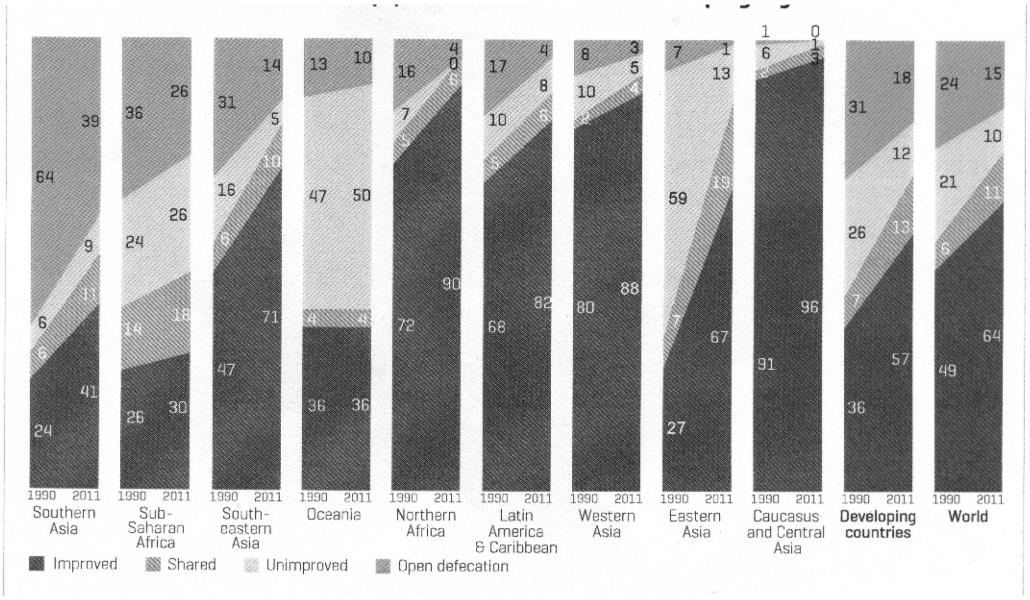


Figure 2b: Global Trend of Sanitation Practices in Various Regions and in the World (Reprinted from WHO and UNICEF, 2013 with permission number 199273)

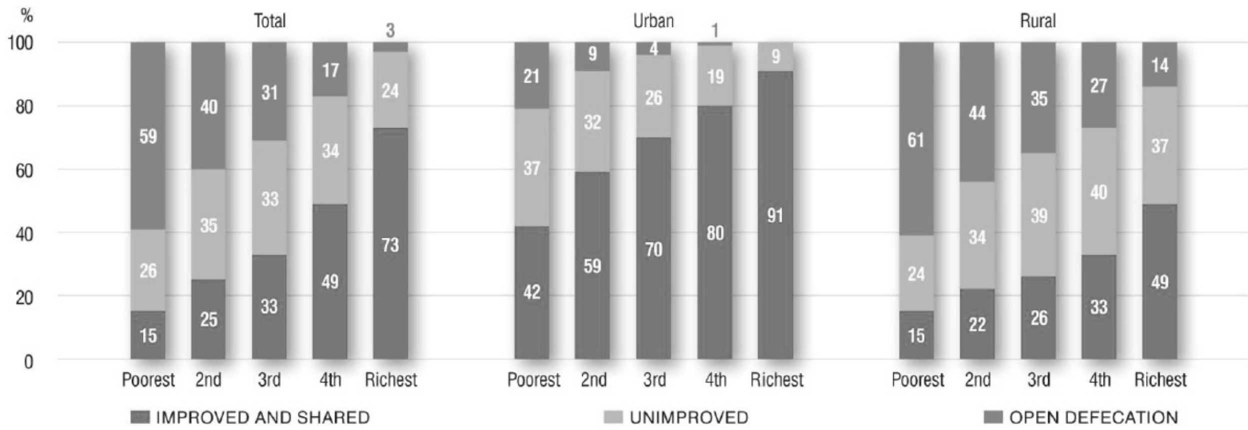


Figure 3: Relationship between Wealth and Sanitation Practices in sub- Sahara Africa (Reprinted from WHO and UNICEF, 2012b with permission number 199273)

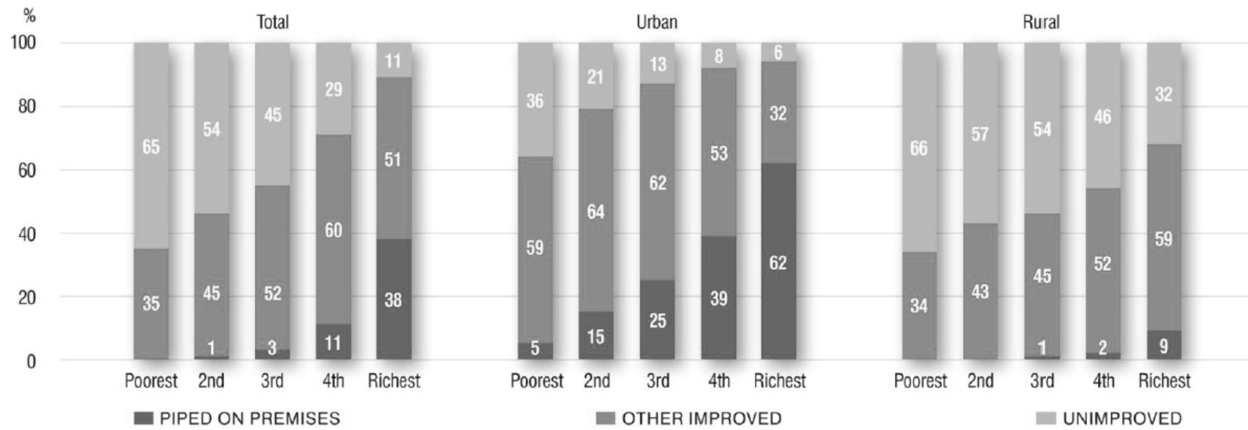


Figure 4 : Relationship between Wealth and Access to Piped Water in Sub- Sahara Africa (Reprinted from WHO and UNICEF, 2012b with permission number 199273)

Table 1: States in the hydrological Areas (Inec *et al.,* 2010)

Description	Hydrological Area 1	Hydrological Area 2	Hydrological Area 3	Hydrological Area 4	Hydrological Area 5	Hydrological Area 6	Hydrological Area 7	Hydrological Area 8
States of the Federation	Kebbi, Sokoto, Zamfara and Katsina	Kaduna, Kwara, FCT and Niger	Adamawa, Gombe, Taraba and Bauchi	Benue, Plateau , Nassarawa and Kogi	Rivers, Anambra, Delta and Bayelsa	Oyo, Lagos, Osun, Ondo, Ogun, Ekiti and Edo	Enugu, Akwa Ibom, Cross River, Ebonyi, Abia and Imo	Kano, Borno, Yobe and Jigawa

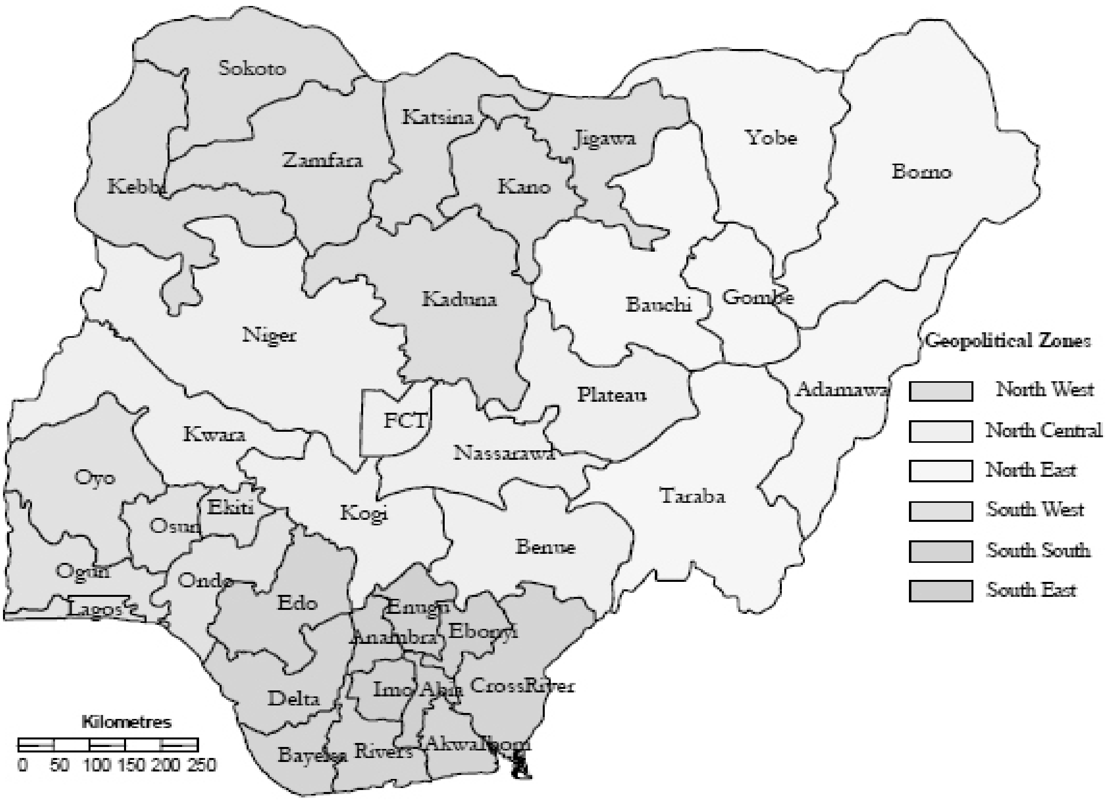


Figure 5: Map of Nigeria Showing the 36 States, Federal Capital Territory and the Six Geopolitical Zones (Source: Oke and Ismail, 2013; Ismail and Oke, 2013)

Computations of the effects and ANOVA were conducted as follows:

$$E_{HAs} = \frac{\sum_{i=1}^{N} X_{ai}}{N_s} \qquad (1)$$

Where; E_{HAs} is the effect of HAs on access to safe water; N_s is the total number of the States in the HAs and X_{ai} is the total percentage of access to safe water in the Has

$$E_{Las} = \frac{\sum_{i=1}^{N} X_{lai}}{N_{las}} \qquad (2)$$

Where; E_{Las} is the effect of Land size of the State on access to safe water; N_{las} is the total surface area of the States and X_{lai} is the total percentage of access to safe water in the State.

$$E_{Geo} = \frac{\sum_{i=1}^{N} X_{gi}}{N_{gs}} \qquad (3)$$

Where; E_{Geo} is the effect of geopolitical zone on access to safe water; N_{gs} is the total number of the States in the geopolitical zone and X_{gi} is the total percentage of access to safe water in the geopolitical zone

$$E_{LGAs} = \frac{\sum_{i=1}^{N} X_{\lg ai}}{N_{\lg s}} \qquad (4)$$

Where; E_{LGAas} is the effect of the number of LGAs in the State on access to safe water; N_{lgs} is the number of the LGAs in the State and X_{lgai} is the total percentage of access to safe water in the State.

$$E_{Pop} = K \frac{\sum_{i=1}^{N} X_{pai}}{N_{ps}} \qquad (5)$$

Where; E_{pop} is the effect of population on access to safe water; N_{ps} is the total population in the State; K is an imperial constant and X_{pai} is the total percentage of access to safe water in the State.

Sum of Squares (SS), Mean Square (MS) and F-Value were computed as follows (Gardiner and Gettinby, 1998; Guttman, *et al.,* 1971):

$$SSA = \left(E_{HAs}\right)^2 r\left(2^{k-2}\right) \quad (6)$$

Where: SSA is the sum of squares of factor A; r is the replication of the data (= 1) and k is the level of the factor (= 2)

$$MSA = \frac{SSA}{a-1} \quad (7)$$

Where: MSA is the mean square of the factor and a-1 is the degree of freedom of the factor (a is the total number of the sample).

$$F = \frac{MSA}{MSE} \quad (8)$$

Where: MSE is the mean square of the error and F is the F-value

RESULTS and DISCUSSION

Statistical Analysis of Access to Safe Water and Water Supply in Nigeria

Access to the safe water supply can be through any of the following sources of water: piped water, borehole, tube wells; protected dug wells or springs, water vendors through vehicles, animals (carmel and donkey) and water tankers (Figure 6). Figures 6 (a, b, c and d) provide pictorial of some of the technologies in place and sighted during visitations to some of the selected States (Katsina, Kano and Kaduna States). Figures 6 (e to h) provide access of Nigerians (Kaduna State) to various sources of water and the purpose. The study revealed that access to safe water technologies varied across the States, HAs; LGAs and geopolitical zones. About 18 and 46 people out of 100 Nigerians had access to piped water and safe water respectively. These values were lower than values obtained in other regions of the world (Figure 1b), which indicates that Nigeria needs to improve on access to safe water technologies. Figure 7 presents access to vehicles (tanker, water vendor and animal) as water supply technology. From the figure, Kano, Imo, Kogi and Anambra States had the highest number of the facility. These two services (animals and vehicles) were standard in Kano State. Also, the study revealed that these services (animals and vehicles) were common because of the distance of the water sources (rivers, wells, dams, etc.) to the cities, town or urban areas. In Kogi, Anambra and Imo States water vendors and water tankers were the common means of water transport. The study revealed that 19.3 %, 19.7 % and 16.8 % of the households had access to the aforementioned sources of water supply in Kogi, Anambra, and Imo States respectively. This result could be accredited to many factors such as geological formation, sources of water supply (surface and groundwater), distance of the sources of water to the settlement and culture of the people.

Figures 8 to 12 show access to the protected wells (Figure 8); piped water (Figure 9); boreholes (Figure 10), tube wells (Figure 11), and all the safe water supply technologies (Figure 12). The study revealed that Zamfara, Taraba, Ebonyi, Bayelsa and the Akwa Ibom States were among the States with the least access to safe water technologies (piped water, protected well, etc.). Kwara and Lagos States had the highest access to these safe water supply facilities (piped water, protected well, etc.). This result could be attributed to the age of the State (Zamfara, Taraba, Ebonyi, Bayelsa and Akwa Ibom States are new generation States created in 1991) as well as the location of these States. Lagos and Kwara States are among the oldest States in Nigeria. Lack of access to safe water in Zamfara State could be attributed to the geology, low annual rainfall, high annual evaporation, poor funding by the government, improper selection of contractors and poor community mobilization (Yaya *et al.,* 2003). Figure 12 presents access to all safe water technologies. Variation in access to these safe water supply technologies could be ascribed to soil type and structure, geology, yield from groundwater and properties of the aquifer, as well as the location of the State. Akpabio (2012) reported that there were boreholes in some communities in the coastal areas in Nigeria, but most of the boreholes are not functioning due to improper selection of contractors and poor job delivery. Lack of access to non-toxic water in all the communities in coastal areas had forced them to depend on rainwater harvesting while about 50% of the people sourced their water from streams, rivers, hand dug and shallow wells. These hand dug wells were not properly sited and poorly built (lack of awareness and skill on sanitation and health, Karibo, 2005; Akpabio, 2012).

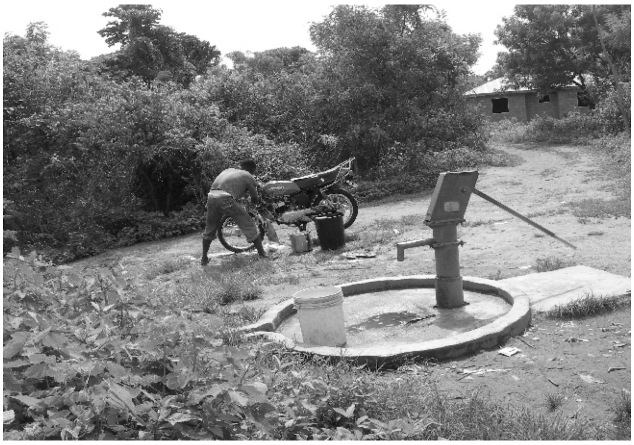


Figure 6a: Hand Pump Borehole as Source of Water Supply

Figure 6b: Local Vehicle for Transporting Water from Well

Figure 6c: Water Tanker collecting Treated Water

Figure 6d: Bicycle for Transporting Water from the Stream

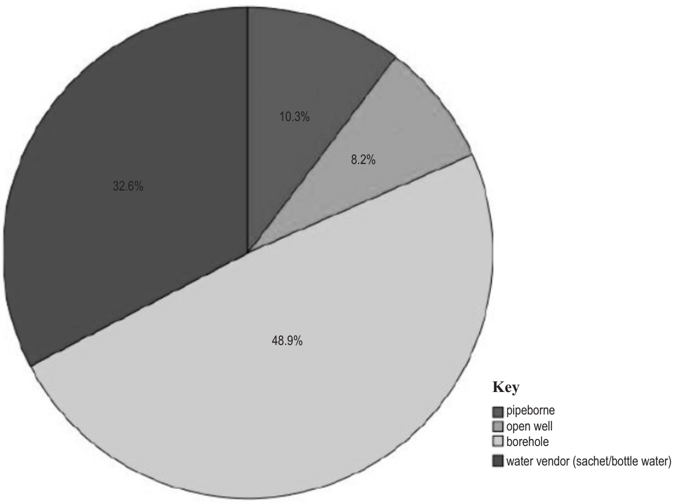


Figure 6e: Source of Drinking water in Kaduna South Local Government Area, Kaduna State (Source: Daniel, 2014)

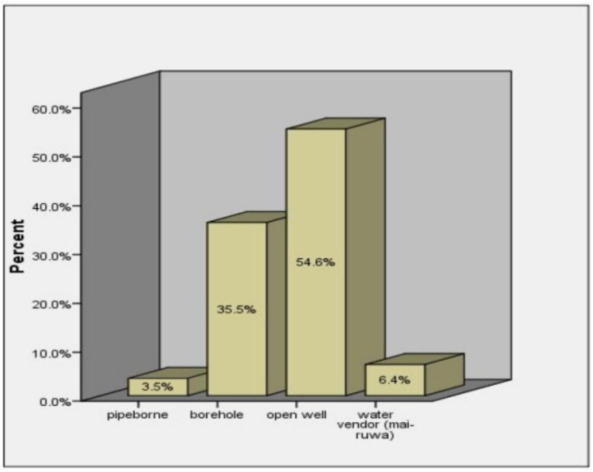


Figure 6f: Source of Water for Washing in Kaduna South Local Government Area, Kaduna State (Source: Daniel, 2014)

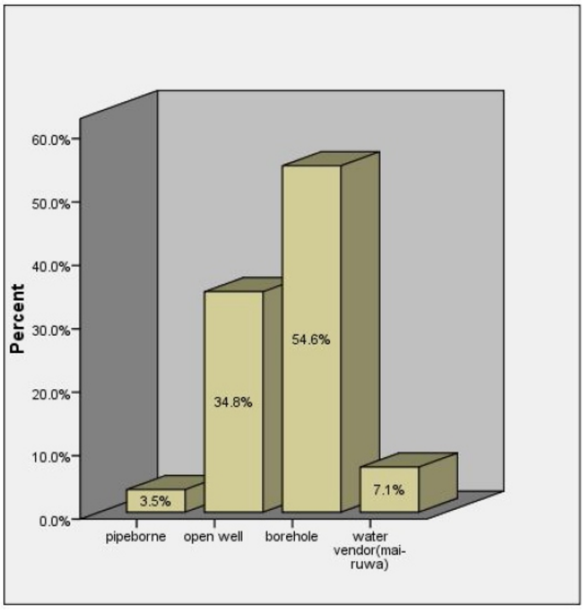


Figure 6g: Source of Water for Sanitation Practices in Kaduna South Local Government Area, Kaduna State (Source: Daniel, 2014)

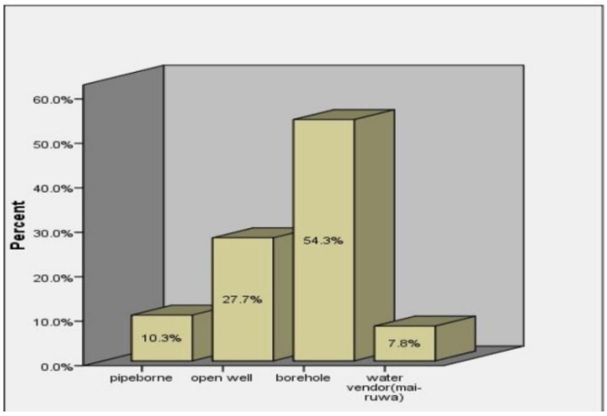


Figure 6h: Source of Water for Cooking in Kaduna South Local Government Area, Kaduna State (Source: Daniel, 2014)

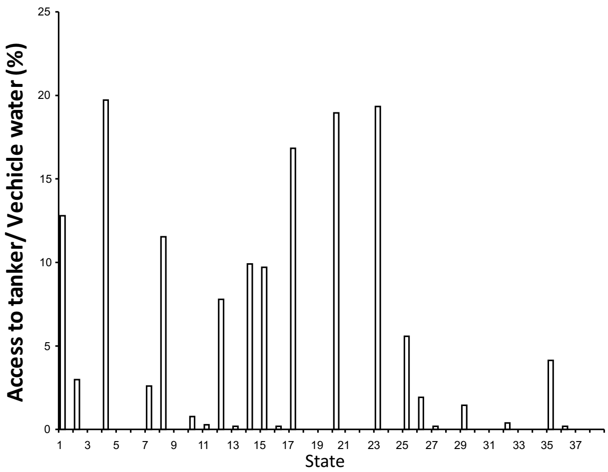


Figure 7: Access to Tanker / Vehicle water per state (Developed from Inec *et al.*, 2010)

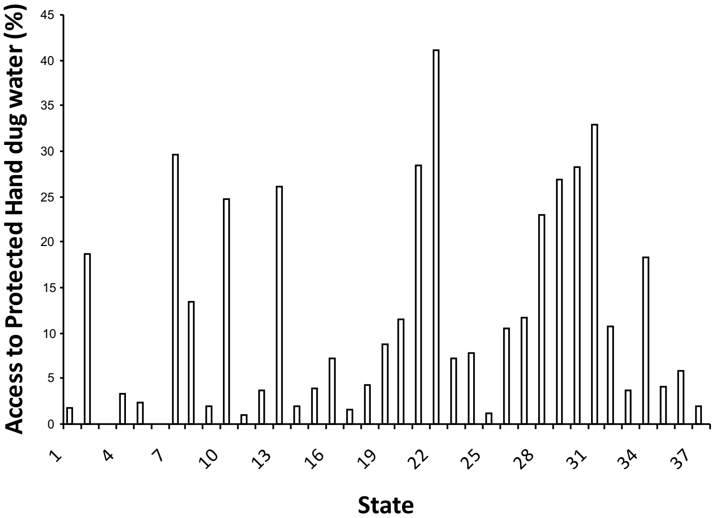
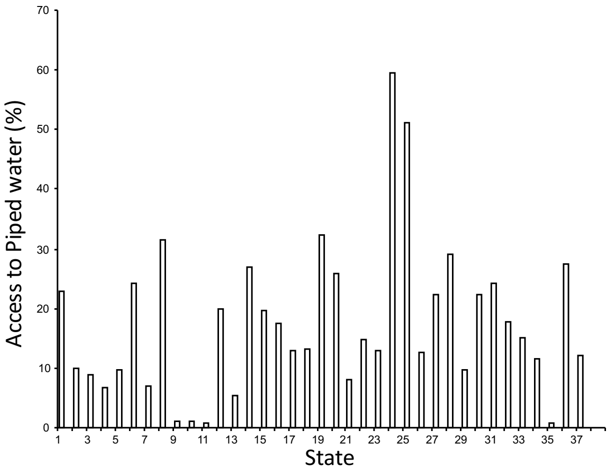


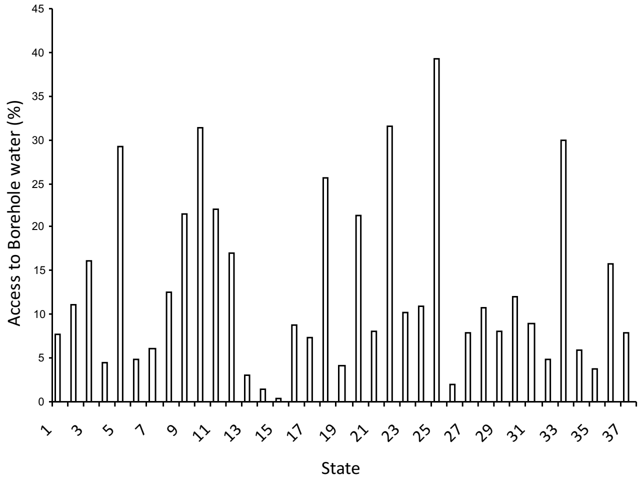
Figure 8: Access to Protected Hand dug well water per state (Developed from Inec *et al.*, 2010)

Key

SN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STATES	Abia	Adamawa	Akwa Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross River	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna	Kano

SN	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
STATES	Katsina	Kebbi	Kogi	Kwara	Lagos	Nasarawa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara

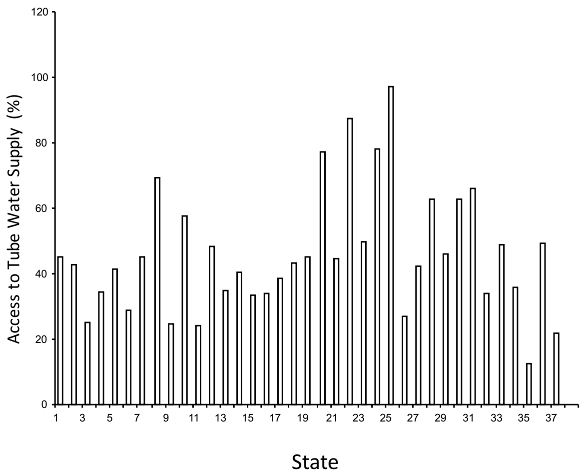


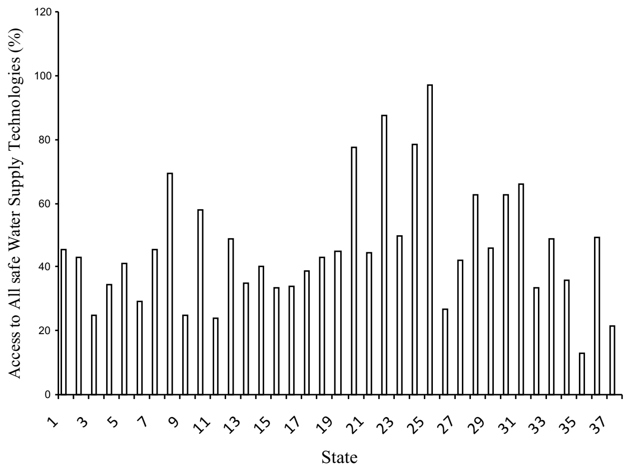


Key

SN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATES	Abia	Adamawa	Akwa Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross River	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna	Kano	Katsina	Kebbi

SN	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
STATES	Kogi	Kwara	Lagos	Nasarawa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara





SN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATES	Abia	Adamawa	Akwa Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross River	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna	Kano	Katsina	Kebbi

SN	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
STATES	Kogi	Kwara	Lagos	Nasarawa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara

Effects of the Selected Factors on Access to Safe Water in Nigeria

. Statistical evaluation of the information on access to safe water technology and water supply in Nigeria revealed that:

i. For the improved water supply sources: Piped water supply had the highest average of 17.5 % per State followed by boreholes; protected hand dug wells and vehicles (animals and tanker vendors) with averages of 12.8, 11.6, and 4.0 % per State respectively.
ii. For the unsafe water sources, the use ponds, stream and rain- harvest water had the highest national average of 37.8% compared to 6.3 % per State for unprotected hand dug wells. This observation can be accredited to the availability of surface water in all the zones and population of people living in rural areas of the country where piped water or boreholes were not available.

Tables 2 to 16 show the statistical evaluation of access to safe water technology and water supply in Nigeria and effects of selected factors. From these tables, it can be specified that:

- population of the State had a significant effect on access to safe water technology and water supply in Nigeria ($F_{36;\ 36}$ = 386.89; p = 1.1 x 10^{-37}, p < 0.05 and $F_{108;\ 3}$ = 10.3395; p = 4.88 x 10^{-6} Guttman *et al.,* 1971, Tables 2 and 3 respectively);
- there was a significant difference within the population of the male and female (Table 17) within the States ($F_{36;\ 1}$ = 41.53;p = 1.78 x 10^{-7});
- there was difference between access to various sources of water within the 36 States and FCT ($F_{108;36}$ = 0.781; p = 0.798 and $F_{36;\ 1}$ = 1.43 x 10^{-16}; p = 1.00 Tables 3 and 4 respectively);
- between the 36 States and FCT, there was difference between access to improved and unimproved sources of water supply ($F_{36;\ 1}$ = 1.731; p = 0.200), but the differences were not significant at 95 % confidence level;
- geopolitical zones had a significant effect on access to safe water technology and water supply in Nigeria ($F_{15;3}$ = 5.47; p = 0.0096) at 95 % confidence level;
- there was no significant difference between access to safe water among the States in the same geopolitical zones ($F_{15;5}$ = 0.65; p = 0.663) at 95 % confidence level (Table 5);
- the effect of geopolitical zones and the number of LGAs in the State on access to safe water within the 36 States and FCT was not significant ($F_{20;5}$ = 0.928; p = 0.484) at 95 % confidence level (Table 6);
- the effect of geopolitical zones and the number of LGAs in the State on access to safe water between the improved water sources was significant ($F_{20;4}$ = 205.80; p = 6.07 x 10^{-16}) at 95 % confidence level;
- number of LGAs in the State had a significant effect on access to safe water (Table 7; $F_{36;3}$ = 210.619; p =1.29 x 10^{-16}) at 95 % confidence level;
- the effect was not significant between the 36 States and FCT ($F_{36;36}$ = 1.127; p =0.360) at 95 % confidence level (Table 7). The effect of the number of LGAs in the State on access to safe water was significant within improve water sources. This observation could be attributed to more funds for States with a higher number of LGAs through Federal allocation and availability of man power to supervise water supply projects.
- the land size of the State had a significant effect on access to safe water ($F_{36;1}$ = 222.102; p = 5.66 x 10^{-17}) at 95 % confidence level; and there was difference between the land size of the States and FCT ($F_{36,\ 36}$ =1.045; p = 0.448; Table 8). This result could be accredited to various sources of water (streams, ponds, etc.) in the States with larger land size and minimal sources of water in the States with smaller land size. In addittion, the States with smaller land size (Abia and Lagos) converted the little available sources of water to improve water sources compared to bigger land size States (Sokoto and Gombe) with more unprotected water sources.

Table 2: Effects of Population on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State	5.287×10^{13}	36	1.47×10^{12}	386.89	1.1×10^{-37}
Within the Gender	1.576×10^{11}	1	1.58×10^{11}	41.53	1.78×10^{-7}
Error	1.366×10^{11}	36	3.8×10^{9}		
Total	5.317×10^{13}	73			

Table 3: Effects of State on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State	3182.005	36	88.39	0.781753	0.798
Within the Improved Water Sources	3507.14	3	1169.04	10.33958	4.88×10^{-6}
Error	12211.04	108	113.06		
Total	18900.19	147			

Table 4: Effects of State on Access to Unimprove and Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State	3.64×10^{-12}	36	1.01×10^{-13}	1.43×10^{-16}	1.00
Within the Water Sources	1224.338	1	1224.338	1.731462	0.20
Error	25456.04	36	707.1123		
Total	26680.38	73			

Table 5: Effects of Geopolitical Zones on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State in the Geopolitical Zones	106.5791	5	21.31583	0.65	0.663
Within the Improved Water Sources	535.0734	3	178.3578	5.47	0.0096
Error	488.9558	15	32.59705		
Total	1130.608	23			

Table 6: Effects of Geopolitical Zones and LGAs on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between LGAs in the Geopolitical Zones	11.10989	5	2.221979	0.927891	0.483729
Within the Improved Water Sources	1971.314	4	492.8284	205.8035	6.07×10^{-16}
Error	47.89311	20	2.394655		
Total	2030.317	29			

Table 7: Effects of LGAs on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between LGAs in the State	6768.208	36	188.0058	1.127	0.360159
Within the improved Water Sources	35112.55	1	35112.55	210.619	1.29×10^{-16}
Error	6001.59	36	166.7108		
Total	47882.35	73			

Table 8: Effects of Land Size of the State on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State	6507.126	36	180.7535	1.0447	0.448174
Within Improved Water Sources	38427.98	1	38427.98	222.1019	5.66×10^{-17}
Error	6228.705	36	173.0196		
Total	51163.81	73			

Table 9: Effects of HAs on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State in the HAs	199.5015	7	28.50022	0.678307	0.688583
Within Improved Water Sources	735.9929	3	245.331	5.838891	0.004593
Error	882.3509	21	42.01671		
Total	1817.845	31			

Table 10: Effects of LGAs and HAs on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between LGAs in the HAs	0.281111	7	0.040159	0.362943	0.913603
Within Improved Water Sources	1.750655	3	0.583552	5.273971	0.007196
Error	2.323598	21	0.110648		
Total	4.355365	31			

Table 11: Effects of Land Size and HAs on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between HAs	3.721681	7	0.531669	4.478821	0.003456
Within Improved Water Sources	1.578548	3	0.526183	4.432608	0.014543
Error	2.492853	21	0.118707		
Total	7.793082	31			

Table 12: Effects of State Creation on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State Creation	9.192952	1	9.192952	1.356779	0.328299
Within the Improved Water Sources	172.7196	3	57.5732	8.497171	0.056136
Error	20.32672	3	6.775573		
Total	202.2393	7			

Table 13: Effects of LGAs and State Creation on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State Creation	0.001562	1	0.001562	0.151307	0.723255
Within the Improved Water Sources	0.400522	3	0.133507	12.93556	0.031922
Error	0.030963	3	0.010321		
Total	0.433047	7			

Table 14: Effects of State Creation and Land Size on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the State Creation	6.84×10^{-6}	1	6.84×10^{-6}	0.000911	0.977823
Within the Improved Water Sources	0.271287	3	0.090429	12.03475	0.035232
Error	0.022542	3	0.007514		
Total	0.293835	7			

Table 15: Effects of Male Population on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the States	6400.325	36	177.7868	1.011403	0.486526
Within the Improved Water Sources	38593.33	1	38593.33	219.5518	6.77×10^{-17}
Error	6328.164	36	175.7823		
Total	51321.82	73			

Table 16: Effects of Female Population on Access to Improve Water Sources

Source of Variation	Sum of Squares	Degree of freedom	Mean Square	F- Value	P-value
Between the States	6401.07	36	177.8075	1.011632	0.486258
Within the Improved Water Sources	38572.34	1	38572.34	219.4564	6.82×10^{-17}
Error	6327.471	36	175.7631		
Total	51300.88	73			

Table 17: Population of Nigeria in respect to gender by State (Source: NPC, 2010; NBS, 2012)

STATES	General Information			1991 Population			2006 Population		
	Geopolitical Zones	Number of LGAs	Land Size (Sq km)	Males	Females	Total	Males	Females	Total
Abia	SEZ	17	4902.24	933039	980878	1913917	1434193	1399806	2833999
Adamawa	NEZ	21	38823.31	1050791	1051262	2102053	1606123	1561978	3168101
Akwa Ibom	SSZ	31	6772.09	1167681	1241633	2409314	2044510	1875698	3920208
Anambra	SEZ	21	4816.21	1374671	1421804	2796475	2174641	2007391	4182032
Bauchi	NEZ	20	49933.87	1443792	1418095	2861887	2426215	2250250	4676465
Bayelsa	SSZ	8	9415.76	584117	537576	1121693	902648	800710	1703358
Benue	NCZ	23	31276.71	1368965	1384112	2753077	2164058	2055186	4219244
Borno	NEZ	27	75480.91	1296111	1239892	2536003	2161157	1990036	4151193
Cross River	SSZ	18	21636.60	956117	537576	1493693	1492465	1396501	2888966
Delta	SSZ	25	17239.24	1271932	1318559	2590491	2074306	2024085	4098391
Ebonyi	SEZ	13	6421.23	670451	783431	1453882	1040984	1132517	2173501
Edo	SSZ	18	19819.28	1095156	1086849	2182005	1640461	1577871	3218332
Ekiti	SWZ	16	5887.89	759986	775804	1535790	1212609	1171603	2384212
Enugu	SEZ	17	7660.17	998157	1126911	2125068	1624202	1633096	3257298
FCT	NCZ	6	7753.85	205299	166375	371674	740489	664712	1405201
Gombe	NEZ	11	17982.03	748631	740489	1489120	1230722	1123157	2353879
Imo	SEZ	27	5182.82	1166448	1319167	2485615	2032286	1902613	3934899
Jigawa	NWZ	27	24515.62	1455780	1419745	2875525	2215907	2132742	4348649
Kaduna	NWZ	23	45711.19	2041141	1894477	3935618	3112028	2954534	6066562
Kano	NWZ	44	21276.87	2958736	2851734	5810470	4844128	4539554	9383682
Katsina	NWZ	34	24971.22	1860658	1892475	3753133	2978682	2813896	5792578
Kebbi	NWZ	21	37727.97	1035723	1032767	2068490	1617498	1621130	3238628
Kogi	NCZ	21	29581.89	1039484	1108272	2147756	1691737	1586750	3278487
Kwara	NCZ	16	34467.54	773182	775230	1548412	1220581	1150508	2371089
Lagos	SWZ	20	3496.45	3010604	2714512	5725116	4678020	4335514	9013534
Nasarawa	NCZ	13	27271.50	602533	605343	1207876	945556	917719	1863275
Niger	NCZ	25	74108.58	1252466	1169115	2421581	2032725	1917524	3950249
Ogun	SWZ	20	16980.55	1147746	1185980	2333726	1847243	1880855	3728098
Ondo	SWZ	18	15195.18	1121898	1127650	2249548	1761263	1679761	3441024
Osun	SWZ	30	8699.84	1043126	1115017	2158143	1740619	1682916	3423535
Oyo	SWZ	33	28245.26	1711428	1741292	3452720	2809840	2781749	5591589
Plateau	NCZ	17	27216.95	1054676	1049860	2104536	1593033	1585679	3178712
Rivers	SSZ	23	10432.28	1655441	1532432	3187873	2710665	2474735	5185400
Sokoto	NWZ	23	33776.89	1191618	1205382	2397000	1872069	1824930	3696999
Taraba	NEZ	16	60291.82	759872	752291	1512163	1189463	1091020	2280483
Yobe	NEZ	17	46909.76	714729	684956	1399685	1206003	1115588	2321591
Zamfara	NWZ	14	35170.63	1017256	1055920	2073176	1630344	1629502	3259846

A Statistical assessment of the effect of selected factors revealed that:

- hydrological areas had a significant effect on access to safe water ($F_{21;3} = 5.839$; $p = 0.0046$; Table 9);
- between the States in the HAs, the effect of HAs on access to safe water was not significant ($F_{21;7} = 0.678$; $p = 0.689$, Table 9) at 95 % confidence level;
- the number of LGAs in the State and HAs of the State was a significant influence on access to safe water ($F_{21;3} = 5.274$; $p = 0.0072$) at 95 % confidence level; and the effect was not significant between the States and FCT ($F_{21,7} = 0.363$; $p = 0.914$) at 95 % confidence level (Table 10).
- the effect of land size of the State and HAs of the State on access to safe water was significant ($F_{21;3} = 4.432$; $p = 0.0145$) at 95 % confidence level; and the effect was significant between various safe water sources within the States and FCT ($F_{21,7} = 4.4788$; $p = 0.003$) at 95 % confidence level (Table 11). This observation could be attributed to variation in the geology, volume and intensity of rainfall and other hydrological factors, socio-economic status and political factors;
- creation of State had a significant consequence on access to safe water ($F_{3;3} = 8.497$; $p = 0.056$) at 95% confidence level; and between the State in the same generation of the State creation, the effect of State creation was not significant ($F_{3;1} = 1.357$; $p = 0.328$, Table 12) at 95 % confidence level. This result could be attributed to the availability of various sources of water in various hydrological areas (Oke and Ismail, 2013; Oke *et al.,* 2014), older States had enough funds when created compared to new generation States created during the economic recession.
- the effect of number of LGAs in the State and State creation on access to safe water was significant ($F_{3;3} = 12.936$; $p = 0.0319$) at 95 % confidence level; but the effect was not significant between the 36 States and FCT ($F_{3,1} = 0.151$; $p = 0.723$) at 95 % confidence level (Table 13);
- the effect of creation of State and land size of the State on access to safe water ($F_{3;3} = 12.035$; $p = 0.0352$; $p < 0.05$) at 95% confidence level; but between the States in the same generation, the effect of State creation and land size was not significant ($F_{3;1} = 0.0009$; $p = 0.978$, Table 14) at 95 % confidence level,
- the effect of male population on access to safe water was found to significant ($F_{36;1} = 219.552$; $p = 6.77 \times 10^{-17}$) at 95 % confidence level; but the effect was not significant between the 36 States and FCT ($F_{36,36} = 1.011$; $p = 0.487$) at 95 % confidence level (Table 15);
- the effect of female population on access to safe water ($F_{36;1} = 219.456$; $p = 6.82 \times 10^{-17}$) was significant at 95 % confidence level; and the effect was not significant between the 36 States and FCT ($F_{36,36} = 1.012$; $p = 0.486$) at 95 % confidence level (Table 16).

Visitations to some of the selected States (Benue, Osun, Katsina, Kaduna and Kano) revealed that some of the donors in Nigeria were UNICEF. These donors assisted some States in the State Water and Sanitation Projects between 1981 and 2013; Japanese International Cooperation Agency's (JICA) rural water supply projects between 1992 and 1994; United Nations Development Project (UNDP)-Rural Water supply between 1988 and 1993; European Union (EU) water and sanitation programme between 2002 and 2009; Department for International Development's (DFID) water and sanitation pilot project between 2002 and 2015; Water Aid's rural water supply and sanitation programme (1996-2010); United State Agency for international Development; World Health Organization and World Bank, individual, senatorial projects; religion bodies, group of people. The presence of these donors had contributed positively to access to safe water and sanitation in the visited states. A project tagged Sanitation, Health and Water in Nigeria (SHAWN I and II) by DFID was acknowledged in Benue and Katsina States. The project contributed momentously to access to safe water and sanitation in the two States.

CONCLUSION

This study investigated access of Nigerians' to safe water based on State, population, gender populations, donor's presence, the number of LGAs in the State, and HAs. The study revealed that access to safe water in Nigeria was a function of many factors such as the age of the State, location (geopolitical zone or hydrological area) and population. The study concluded that:

i. Access to safe water in Nigeria is above continental (Africa) average of 45 %;
ii. The value is below the World average of 52.4 %;
iii. Access to safe water was a function of: the location, the State, the region (geopolitical zone), number of the LGAs in the State, the HAs, and the climate; and
iv. Some States in the country were closer to the vision 20: 20 (in the year 2020 Nigeria will be among the first 20 countries in the access to safe water) and MDGs, while other States were below national average as well as far from MDGs;

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