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Availability, coverage, and access to the potable water supply in Oyo State Nigeria

Habeeb Solihu [a,b,*], Solomon Olakunle Bilewu [b]

[a] Addis Ababa Institute of Technology, Addis Ababa University, Ethiopia
[b] Department of Water Resources and Environmental Engineering, University of Ilorin, P.M.B. 1515 Ilorin, Kwara, Nigeria

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ABSTRACT

This research centered on investigating the availability, coverage, and access to potable water supply in Oyo State, Nigeria. Relevant data was sourced from the Federal Ministry of Water Resources, Abuja, and analyses were carried out using both descriptive and paired t-test methods of analyses on SPSS. It has been established that there was availability of water supply, though inadequate, and groundwater was found to be the preponderate potable water supply source. Also, the coverage to the potable water supply was found to be 27.3% while about 62.74% have access to the available potable water supply which implies that most of the sources were from the individuals' arrangements. To avoid overexploitation of groundwater which might have great impacts on the surroundings, it has been suggested that the government should improve on the water supply through other sources especially by improving the performance level of the existing major surface water schemes. The paired-samples *t*-test were statistically significant where $p < 0.05$ (at a 95% confidence interval), indicating a statistically strong correlation between the coverage and access to potable water with a significant increase in means from ($M = 27.30$, SD = 16.61, $N = 33$) to ($M = 62.74$, SD = 25.36, $N = 33$). Therefore, access and coverage data were divided into two parts; one part for a relationship equation development while the other part for the validation by estimating the Nash-Sutcliff Efficiency (60%) and the Coefficient of Determination (88.5%); making it possible to predict access to potable water provided that information on water supply facility coverage is known. This will improve the data gathering process and also for checking whether the Sustainable Development Goal 6.1 is met specifically in this study area.

1. Introduction

Water is unarguably an essential commodity after air with an unparalleled value and there is virtually nowhere water is not important, be it in the biosphere as humans barely survived few days without water because a constant supply of water is needed to replenish the fluids lost through normal physiological activities, such as respiration, perspiration, urination, (Shalom et al., 2011), atmosphere because the role of water in our environment is highly complex (Navalpotro et al., 2013), and lithosphere (Aderogba et al., 2012; Mayers, 2005). Also, water is known as a key component in the production and management of resources such as food, energy, and materials (EEA, 2012).

One of the major challenges faced by decision-makers in most developing countries like Nigeria is supplying adequate water to meet increasing population water demand and among several reasons is the inability of the existing water supply systems to meet the challenges of providing clean water for the populace (Shittu et al., 2015). According to these researchers (Coster and Otufale, 2014; Aribigbola and Omosulu, 2002; Agbelemoge and Odubanjo, 2001; Jideonwo, 2014) when comparing the population growth rate with existing public water supply in most developing countries especially in rural and semi-urban centers is generally inadequate and unreliable. Again, virtually all urban areas in Nigeria suffer water supply shortages relative to demand and according to (Lawal and Basorun, 2015), the public water supply is erratic, intermittently unreliable, and, in some cases, inaccessible, thus resulting in high dependency on supplementary sources. Additionally, about half the water in drinking water distribution systems in developing countries is lost to leakage, vandalism, and illegal hook-ups (UN-Habitat, 2002; Hall, 2014).

There are about 36 and 12 State Water Agency and River Basin Development Authorities in Nigeria but because of the reduced management by the Government relative to other sectors, these agencies and authorities still depend on obsolete water equipment (Tolulope et al., 2018). However, several attempts have been made by the government

* Corresponding author at: Addis Ababa Institute of Technology, Addis Ababa University, Ethiopia.
E-mail addresses: solihu.habeeb@aait.edu.et (H. Solihu), bilewu.so@unilorin.edu.ng (S.O. Bilewu).

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to improve water accessibility in Nigeria such as 47% in 2008 while 54% and less than 50% in urban and rural households respectively in 2010 which are less than 65% of the National target (WaterAid, 2007). Yilgwan et al. (2010) stated that Nigeria been the largest single country in Africa is the worst hit by lack of access to safe water with virtually three-quarters of its population unable to access safe water.

The paucity of infrastructure for effective and treatment and distribution of water accounts for the incidence of high morbidity and mortality rate associated with water-borne diseases in developing countries (Shalom et al., 2011). Furthermore, the epileptic and frequent fluctuations observed in power supply in Nigeria in the last three decades has made it difficult for existing water treatment plants and booster stations to operate optimally as electric power is not available to power them and distribute water effectively to the end-users (Amori et al., 2012) which has made the poverty rate on the increase and it is more critical in the rural areas with attendant lower access to public services and infrastructures like schools, health facilities, roads, water, and electricity (Mbafor and Kinge, 2008). Historically, in Nigeria, one of the key elements of the Millennium Development Goals was the provision of water in every home by the year 2015 and the target at the global level is to reduce poverty level through adequate provision of potable water (Aderogba et al., 2012).

Over the years, inadequate public water supply has been one of the greatest challenges faced in most of Nigeria and especially Oyo State. Despite the efforts of both the government and non-governmental bodies in ameliorating this challenge, the problem persists as the access to public water supply decreased extensively from 14 (1990) to 6% (2008) (W. World Health Organisation and J. M. P 2010), and currently, no evidence that the Millennium Development Goal (MDG) on water access has been achieved at the end of the year 2015 according to WHO (1996) definition of Access to water. Although according to Omole, 2013, as documented in 2010, MDG 7c was realized when over 2 billion people gained access to improved water sources, however, projections have shown that Nigeria may be an exception even several years after the goal was met in most other parts of the world (Omole, 2013). Similarly, (Okechukwu, 1984; Uteibe, 2002) pointed out that the decrease in water quantities relative to demand started in Nigerian cities after the Nigerian civil war between 1967 –1970 (Ezenwaji et al., 2016).

As the world is focusing on the Sustainable Development Goals (SDGs) where the water sector is specifically using both the Joint WHO/UNICEF Joint Monitoring Program (JMP) and the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) produced by the WHO in affiliation to the UN-Water to achieve SDG 6.1 to set other goals, this work seeks to document the current access to public water in the study area by investigating the availability, coverage, and access to public water supply through examining the nature of the available public water supply, quantifying the total area covered and those left uncovered by the available public water supply distribution facility, estimating the percentage of the population with access to public water as defined by the WHO and establishing whether the MDG has been met or not in the study area. Again, Christiana (2017) has concluded that priority needs to be given to improve water supply, especially in rural and suburban communities to enable Nigeria to attain the SDG 6.1 by 2030.

In the study area, as in many developing countries, water supply is perceived more as a social service rather than an economic venture. The UNICEF reports that achieving Sustainable Development Goal 6 by 2030 in Nigeria requires extraordinary efforts and that funding for the sub-sector is weak. It is therefore a worthwhile venture to pursue a method of data derivation or projection in the face of dwindling scarce financial resources for planning purposes (United Nations Children and Education Fund, 2021). In the context of the study area, intermittent pipe supply is quite a normal occurrence both in theory and practice (Galaitsi et al., 2016; Totsuka et al., 2004).

Table 1
Breakdown of minimum water requirement for an average Nigerian.

Activity	Water Volume Required (liters/capita/day)
Cloths washing	10
Drinking and Cooking	5
Utensils	5
Bathing	20
Body washing	5
House cleaning	5
Water closet (WC)	20
Miscellaneous	10
TOTAL	80

source: Idowu. and Martins (1998).

2. Description of the study area

Oyo State is located in the South-West of Nigeria and consists of 33 Local Government Areas. It covers a total of 27,249 km^2 of landmass. The landscape consists of old hard rocks and dome-shaped hills, which rise gently from about 500 m in the southern part and reaching a height of about 1219 m in the north. The topography of the State is of gentle rolling low land in the south, rising to a plateau of about 40 m. A map of the study area is shown in Fig. 1.

3. Materials and methods

3.1. Data collection

Water availability and good coverage should often result in improved access. However, poor funding for water infrastructures in many developing countries has manifested in the inability to meet the MDG on water and sanitation, which now threatens the potential achievement of the SDG6. The funding situation also affects the continuous gathering and updating of water data. It is therefore helpful to assess the relationships between water availability, coverage, and access in a data-scarce environment represented by the study area.

This study relied on secondary data sourced from the National Water supply and Sanitation Baseline survey of 2017 facilitated by the Federal Ministry of Water Resources (FMWR), Federal Republic of Nigeria, Abuja. The FMWR is the main national coordinating body in the water sector in Nigeria (Emoabino and Alayande, 2007). Other government agencies not directly concerned with water resource development but carry out this responsibility in Nigeria include the Federal and State Ministries of Agriculture and Environment (Kelvin, 2015). The sampling method applied for data collection of the National Water Supply and Sanitation Baseline Survey was direct site visits to stakeholders and repositories of water information and administration of questionnaires in the 33 Local government areas in the study area.

3.2. Data Preparation and processing

3.2.1. Estimation of water demand

The average daily requirement of the household per capita was estimated based on the following assumptions (Shittu et al., 2015); Cooking (10 liters); Flushing of Toilet (20 liters); Washing and bathing (50 liters) and other needs (10 liters). This gives a total water demand of 90 liters per person per day. These values have a fair agreement of 80 l/d estimated in Table 1 by Idowu. and Martins (1998) as an average minimum water requirement for an average Nigerian to sustain a moderate living standard. The average number of persons in the households studied is seven (7). From Eq. (1), the estimated daily water requirement for the household equals 630 l/d (Shittu et al., 2015). The quantity of water required for activities within each of these classes is influenced mainly by variables such as climate and precipitation (MDG, 2015).

$$W = T * \mathrm{P} \quad (1)$$

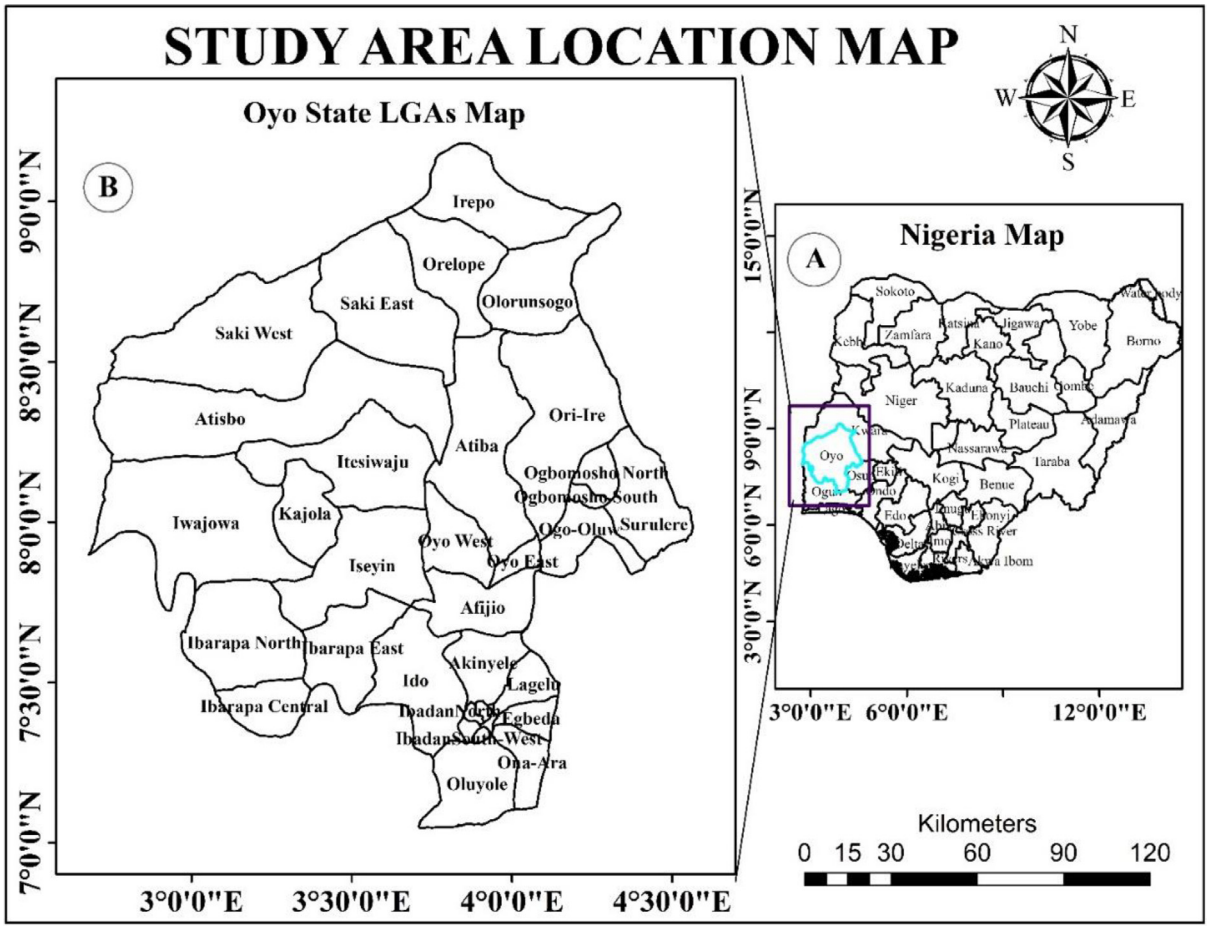


Fig. 1. Map of Oyo State showing the entire study area.

Where;

W = Water Demand/Day

T = Total Water Demand (liter/capita/day)

P = Population (Per capita)

3.2.2. Estimation of water availability

Water availability has to do with the nature, quantity, and quality of the water that is readily available for domestic, commercial, industrial, irrigational, institutional, recreational, and other usages for the benefit of people in a given community. The WHO World Health Organization (2004) and UNICEF (2005) had estimated that about 12% of the world's population consumes about 80% of the available water which implies that about 1.1 billion people are without access to safe water supplies (Ifabiyi and Ashaolu, 2013). In Nigeria, the consequences of the inadequacy of potable water supply in rural and poor urban communities have therefore been quite grievous (Christiana, 2017).

To determine the availability of water in each local government area, expression in Eq. (2) was used:

$$Wx = x1 + x2 + x3 + x4 + x5 + x6 \quad (2)$$

Where;

W_X = Total potable water available sources in each local government area (m^3/day)

x1 = water sourced from the connections to public water supply (m^3/day)

x2 = water sourced from hand-pumped boreholes (m^3/day) at $5m^3$/d per hole

x3 = water sourced from motorized boreholes (m^3/day) at $13m^3$/d per hole

x4 = water sourced from protected hand-dug well (m^3/day) at $3m^3$/d per well

x5 = water sourced from spring (m^3/day)

x6 = water sourced from rainwater harvesting (m^3/day)

3.2.3. Estimation of water coverage

Water coverage designates the area that is covered by the distribution systems for available water resources both in quality and quantity. In the study area, coverage does not guarantee access.

The Coverage was determined according to Eq. (3):

$$Wy = y1 + y2 + y3 \quad (3)$$

Where;

W_Y = Total sampled population that has coverage to public water supply in each of LGA, (%);

y1 = Sampled population covered with household connection from the nearby waterworks, (%);

y2 = Sampled population covered with motorized borehole, (%);

y3 = Sampled population covered with hand-pumped borehole, (%).

3.2.4. Estimation of access to potable water supply

Access to water is measured as a percentage of the total population with reasonable means of getting an adequate quantity of water that is safe for drinking and essential household activities (Ishaku et al., 2011). The UNICEF and WHO (UNICEF, 2008) defines it as the percentage of a population that uses drinking water from improved sources such as household connections, public standpipes, boreholes, protected wells, and springs.

Access to safe drinking water is a pre-condition for health and success in the fight against poverty, hunger, child death, and gender

Table 2
Summary of the major water schemes in Oyo State.

S/N	Water Scheme/Works	Lat (DD)	Long (DD)	Source of Raw Water	Type of Treatment	Name of Promoter	Installed Capacity (m^3/day)	Performance Level (%)	Delivered Quantities (m^3/day)
1	Asejire	7.3640	4.1266	River	Full	State Govt	104,000	52	54,080
2	Eleyele	7.4000	3.8747	River	Full	State Govt	27,240	10	2724
3	Oyo	7.8705	3.8908	River	Full	State Govt	8000	70	5600
4	Eruwa	7.5196	3.3843	River	Full	State Govt	8000	23	1840
5	Igboho	8.8092	3.7533	Lake	Full	State Govt	1000	28	280
6	Igbetti	8.7553	4.1620	Stream	Full	State Govt	1000	25	250
7	Kisi	9.0584	3.8435	Stream	Full	State Govt	7200	8	576
8	Saki, Oge	8.6856	3.3745	River	Full	State Govt	1380	16	220.8
9	Iseyin, Ajumoda	7.9664	3.5872	Spring	Full	State Govt	6400	7	448
10	Iseyin, Atori	7.9733	3.6036	Spring	Full	State Govt	900	70	630
11	Ogbomoso	8.1677	4.1989	River	Full	State Govt	6350	10	635

inequality (Lawal and Basorun, 2015) and to poverty reduction and that access to safe drinking water prevents the spread of water-borne and sanitation-related diseases (Ifabiyi and Ashaolu, 2013). It is central to the human rights and personal dignity of every human being and availability should be at least 20 liters of water per person per day from a source within one kilometer of the user's dwellings (WHO 1996). Long distances to and queues at the water points and transporting heavy water containers on heads are the main challenges facing rural dwellers in terms of water supply (UNICEF, 2005). However, water quality, whether it is used for drinking, irrigation, or recreational purposes, is very important for health in both developed and developing countries worldwide (Oyedotun, 2012), and inadequate water supply and lack of basic sanitation have resulted in grave economic and health consequences (United Nations Children and Education Fund 2021).

Eq. (4) was used to estimate the percentage of the sampled population with access to potable water supply:

$$Wz = z1 + z2 + z3 + z4 + z5 + z6 + z7 \quad (4)$$

Where;
W_Z = Sampled population with access to potable water supply in each LGA, (%)
z1 = Sampled population with access to household connection water supply, (%)
z2 = Sampled population with access to motorized borehole water supply, (%)
z3 = Sampled population with access to the hand-pumped borehole, (%)
z4 = Sampled population with access to protected hand-dug well, (%)
z5 = Sampled population with access to the rainwater source, (%)
z6 = Sampled population with access to stand-pipe water supply, (%)
z7 = Sampled population with access to the spring water source, (%)

3.2.5. Estimation of access to public water supply

The access to public water supply was estimated using Eq. 5:

$$Wp = p1 + p2 + p3 \quad (5)$$

Where;
W_p = Sampled population with access to public water supply in each LGA, (%)
p1 = Sampled population with access to household connection water supply, (%)
p2 = Sampled population with access to motorized borehole water supply, (%)
p3 = Sampled population with access to the hand-pumped borehole, (%)

3.3. Data analysis

The secondary data were analyzed using both the descriptive analysis and the group-difference (paired sample t-test) methods. For the descriptive analysis, data used covered information on the major waterworks (Schemes), water sources, and their nature. This is presented in charts and tables appropriately. For the paired t-test, the variables compared were coverage and access. To test the status of the statistical significance of the relationship between these two variables, *t-statistic* was used and the population parameter was symbolized as ρ. The null hypothesis states that there is no linear relationship between coverage and access to sustainable potable water supply) against the alternative hypothesis which states that there is a relationship between the variables. Again, this study analyzed the data by comparing the means of responses from the respondents using the t-test statistic for an independent sample. The significance level was set at 0.05 at a 95% confidence interval. Analyses were computed with the Statistical Packages for the Social Sciences (IBM SPSS) Statistics software version 25.0 for windows 10.

4. Results and discussions

4.1. Major Water Schemes in Oyo State

Table 2 shows the summary of the existing major waterworks/schemes, raw water sources, type of treatment, promoters, installed capacity, performance levels, and their respective delivered quantities in the State. From Table 2, the raw water sources were grouped into four major sources and the results are presented in Fig. 2. The river and lake were found to be the preponderate and the least raw water sources with 96.8% and 0.4% respectively as shown in Fig. 2.

In Fig. 3, both Oyo and Iseyin Atori Water Schemes have the highest performance level of 70% followed by Asejire Water Works with about 52%. Iseyin Water Scheme, Ajumoda has the least performance level of about 7%.

4.2. Classification of water sources and the percentages of the sampled population with access to each source

As shown in Fig. 4, groundwater is found as the major source of water supply in about 98% of all the LGAs in Oyo State. That is, groundwater such as protected dug wells, motorized and hand pump boreholes are the major water sources.

4.3. Coverage and access to public water supply in Oyo State

Coverage to public water supply and access to potable water supply in the study area were compared and the results are shown in Fig. 5. The results indicated that about 90% of all the LGAs have more access to potable water than coverage to the public water supply except for Afijio LGA which has the same percentage coverage and access. This implies that more than 90% of the population relies on private arrangements for their water supply rather than government sources.

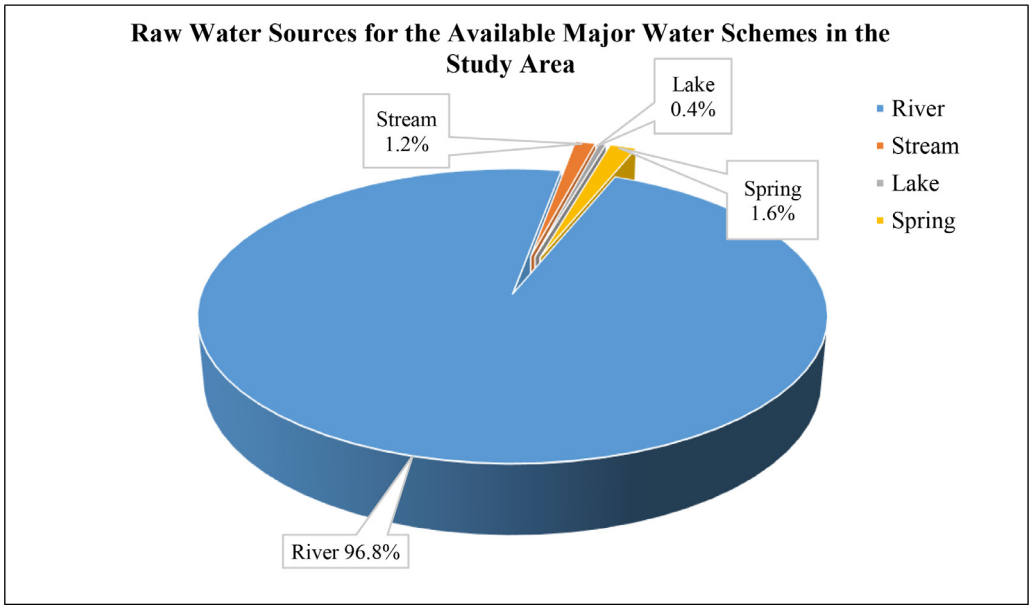


Fig. 2. Pie chart of raw water sources for the available major water schemes in Oyo State.

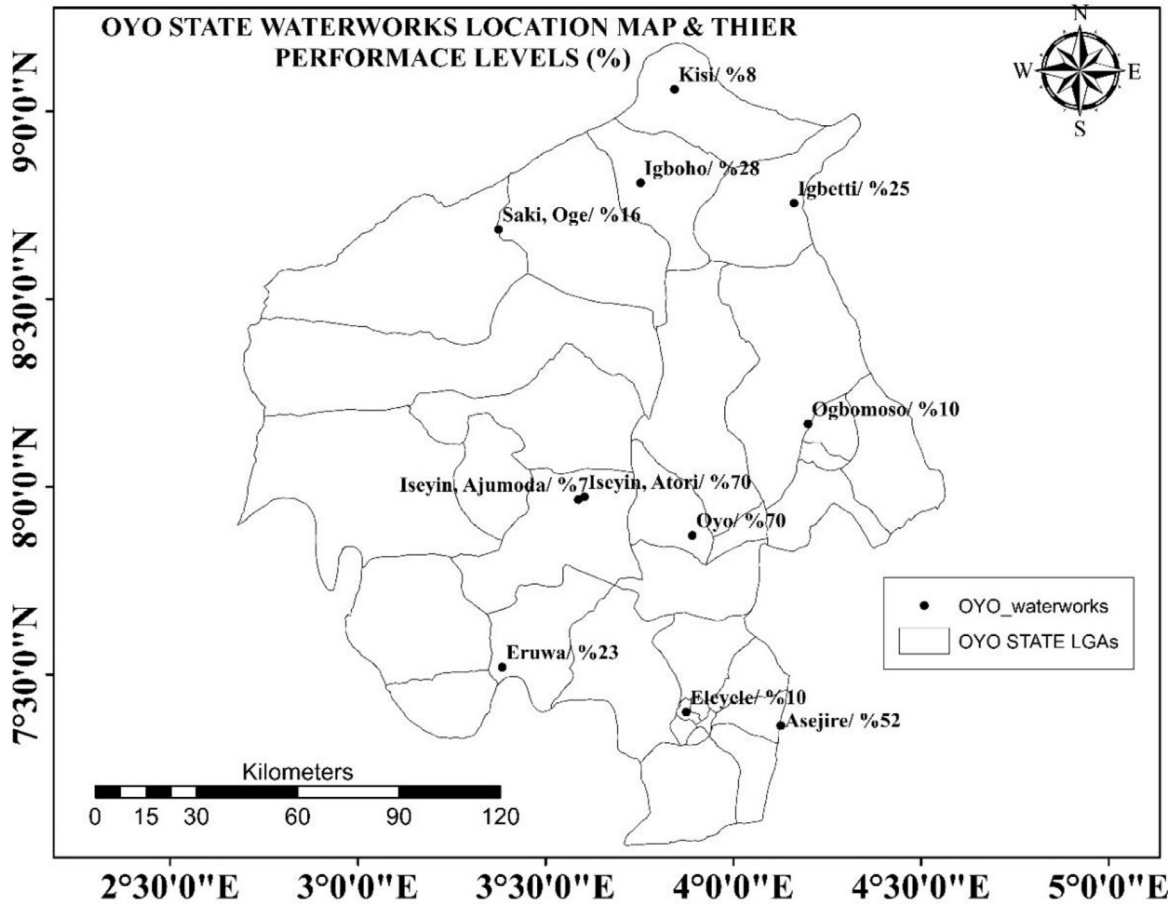


Fig. 3. A map showing Oyo State waterworks/schemes locations and their performance levels.

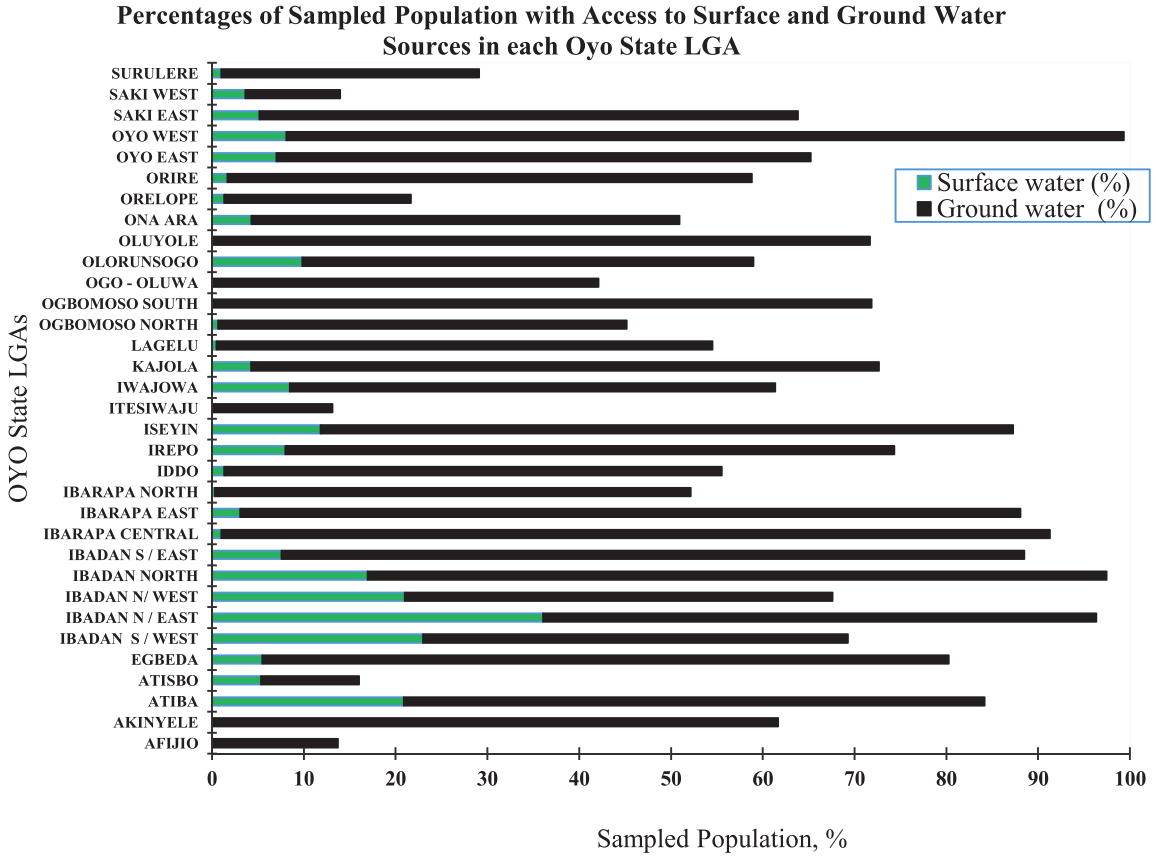


Fig. 4. Component Bar chart showing LGAs in Oyo state and their sampled populations with access to both surface and ground water sources.

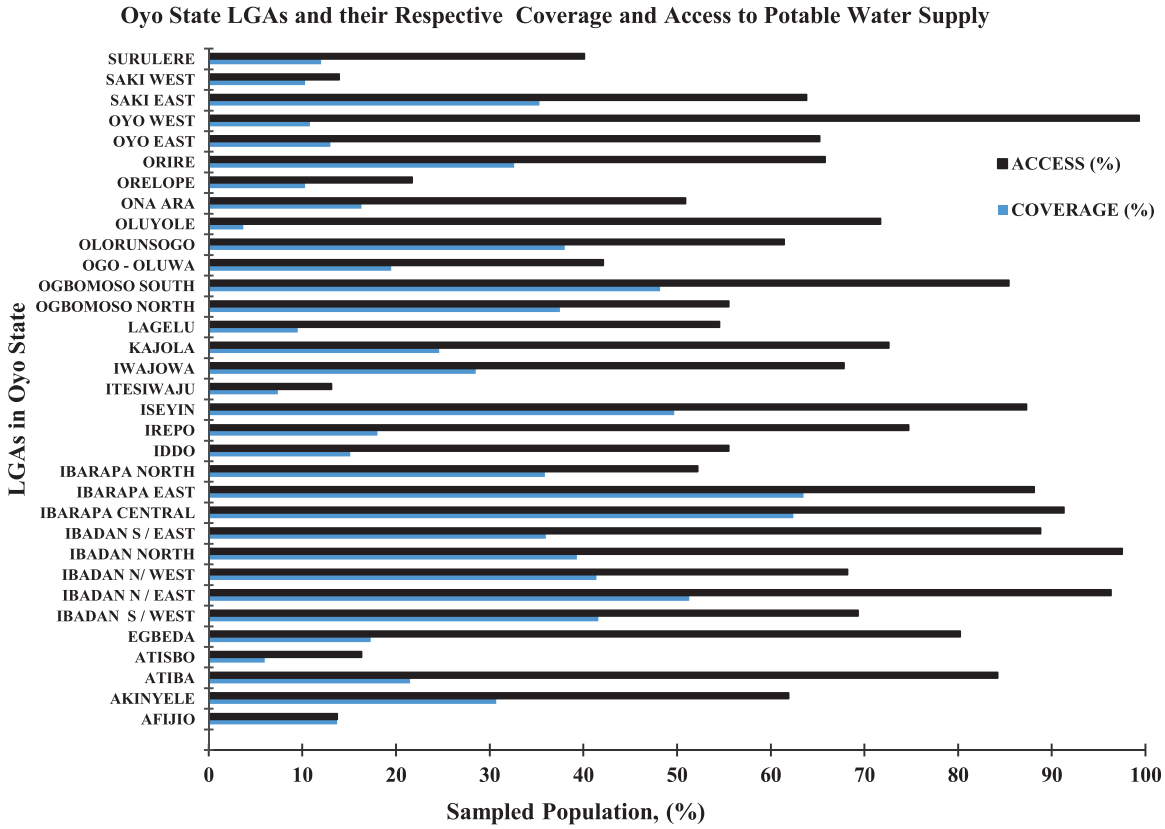


Fig. 5. Clustered bar chart showing lgas in Oyo State and their sampled populations with coverage and access to public water supply.

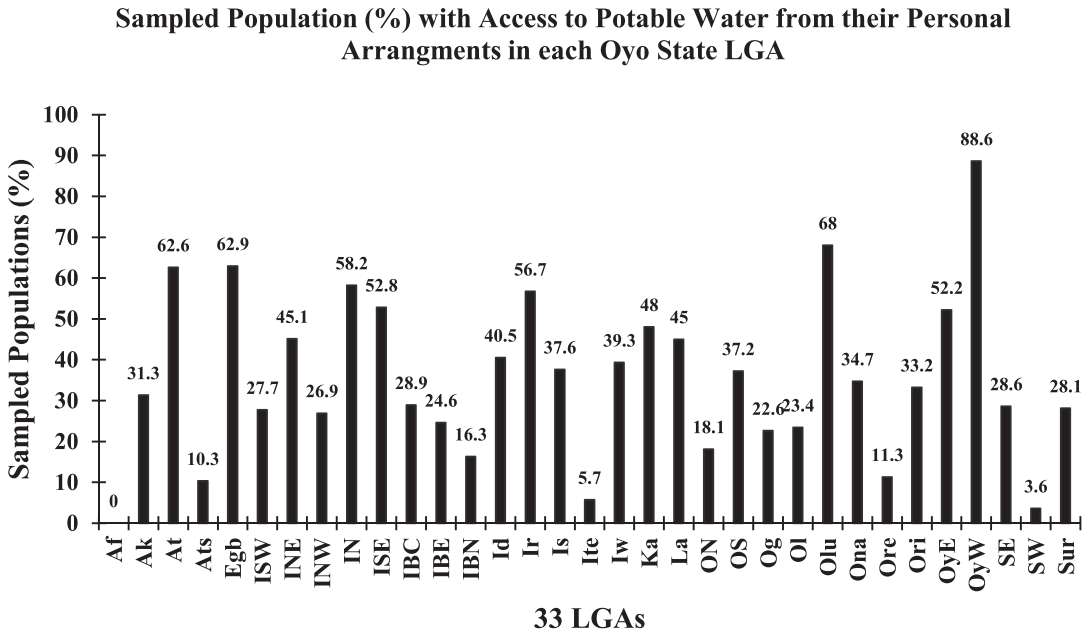


Fig. 6. Bar chart showing LGAs in Oyo State and their sampled populations that are not getting water from public water supply.

Table 3
Percentages of sampled population with coverage and access to potable water Supply.

LGAs	Sampled Population	Coverage (%)	Access (%)
Afijio	299	13.7	13.7
Akinyele	352	30.7	61.9
Atiba	297	21.5	84.2
Atisbo	300	6.0	16.3
Egbeda	329	17.3	80.2
Ibadan S / West	361	41.6	69.3
Ibadan N / East	355	51.3	96.3
Ibadan N/ West	324	41.4	68.2
Ibadan North	354	39.3	97.5
Ibadan S / East	356	36.0	88.8
Ibarapa Central	298	62.4	91.3
Ibarapa East	293	63.5	88.1
Ibarapa North	301	35.9	52.2
Iddo	299	15.1	55.5
Irepo	300	18.0	74.7
Iseyin	330	49.7	87.3
Itesiwaju	297	7.4	13.1
Iwajowa	295	28.5	67.8
Kajola	329	24.6	72.6
Lagelu	420	9.5	54.5
Ogbomoso North	299	37.5	55.5
Ogbomoso South	309	48.2	85.4
Ogo – Oluwa	297	19.5	42.1
Olorunsogo	295	38.0	61.4
Oluyole	300	3.7	71.7
Ona Ara	326	16.3	50.9
Orelope	300	10.3	21.7
Orire	301	32.6	65.8
Oyo East	299	13.0	65.2
Oyo West	297	10.8	99.3
Saki East	329	35.3	63.8
Saki West	330	10.3	13.9
Surulere	299	12.0	40.1

4.4. Estimation of coverage and access to public water supply and access to personal arrangement for water supply

Fig. 6 shows that there is more access to potable water than coverage to the public water supply and their mean percentages are presented in a bar chart. This shows that most access to safe water are not from public water distribution. The maximum and the minimum access are recorded in Oyo West and Afijio LGAs with about 90% and 1% respectively (Fig. 7).

4.4.1. Establishing Relationship between coverage and access to potable water source in Oyo State using paired t-statistics analysis method

Table 3 shows the data used for establishing a statistically significant relationship between the coverage and the access to potable water supply in the study area (i.e. columns 3 and 4 respectively). Tables 4 – 7 summarized the results of the analysis.

Investigation of normality of the two variables

Table 4 confirmed that the two variables (Coverage and Access to Public Water Supply in Oyo State) are approximately normally distributed for both Kolmogorov-Smirnov and Shapiro-Wilk *p-values* which is one of the major assumptions for the use of the paired *t*-test. Thus, the null hypothesis of the non-normality of these variables is rejected.

From the normal Q-Q plots shown in Fig. 8A and B for coverage and access to public water supply respectively, there is an absence of outliers and two variables have their data partially arranged along the lines of best fit. This also proved that the two variables are approximately normal. Thus, the suitability of the paired t-test analysis.

Paired-Samples t-test analysis

The results of the statistically significant differences between coverage and access to potable water supply in Oyo state are summarized in Table 5 where paired t-test was used using columns 3 and 4 in Table 3 as input data.

From Table 5, the means and the standard deviations for the two variables (coverage and access) are 27.3 and 62.7, 16.6 and 25.4 respectively. There exists a nearly strong relationship between Coverage and Access to Public Water Supply in Oyo State as their correlation coefficient was 0.606. The result of a paired sample one-tailed *t*-test were also significant: t (32) = 10.070; p = 0.000 (one-tailed test) where $p<0.05$. Since the relationship between these two variables is statistically significant, it follows that the null hypothesis of no significant relationship between the two variables is rejected with a mean increment of about 35.44 at a 95% confidence interval.

Table 4
Tests of normality.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Coverage to Public Water Supply (%)	0.136	33	.124	.937	33	.057
Access to Public Water Supply (%)	0.115	33	.200*	.924	33	.024

Table 5
Paired Samples Statistics.

Variables	Avg	Variance	N	r	df	t-Stat	Sig. one-tail	t_C one-tail	Sig. two-tail	t_C two-tail
Access to Potable Water Supply (%)	62.7	643.3	33	0.606	32	10.07	0.0000	1.6939	0.0000	2.0369
Coverage to Public Water Supply (%)	27.3	276.0	33							

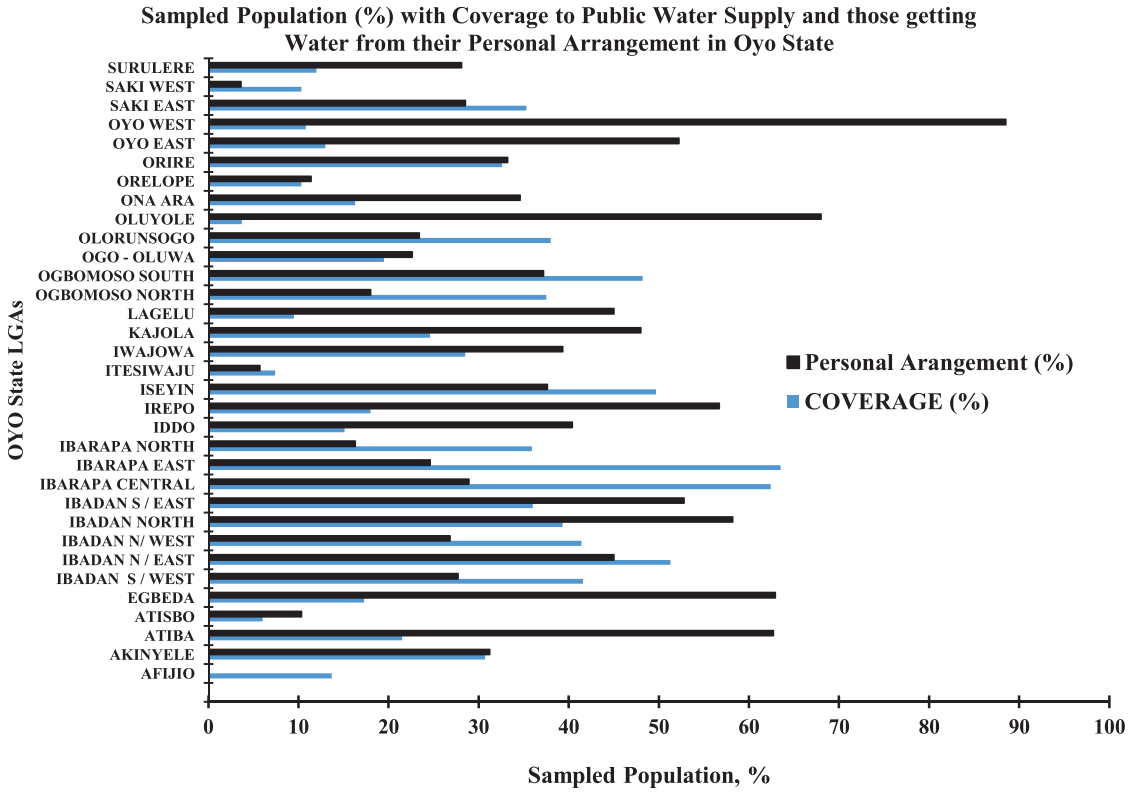


Fig. 7. Bar Chart showing LGAs in Oyo State and their sampled populations with coverage and those that are not getting water from public water supply.

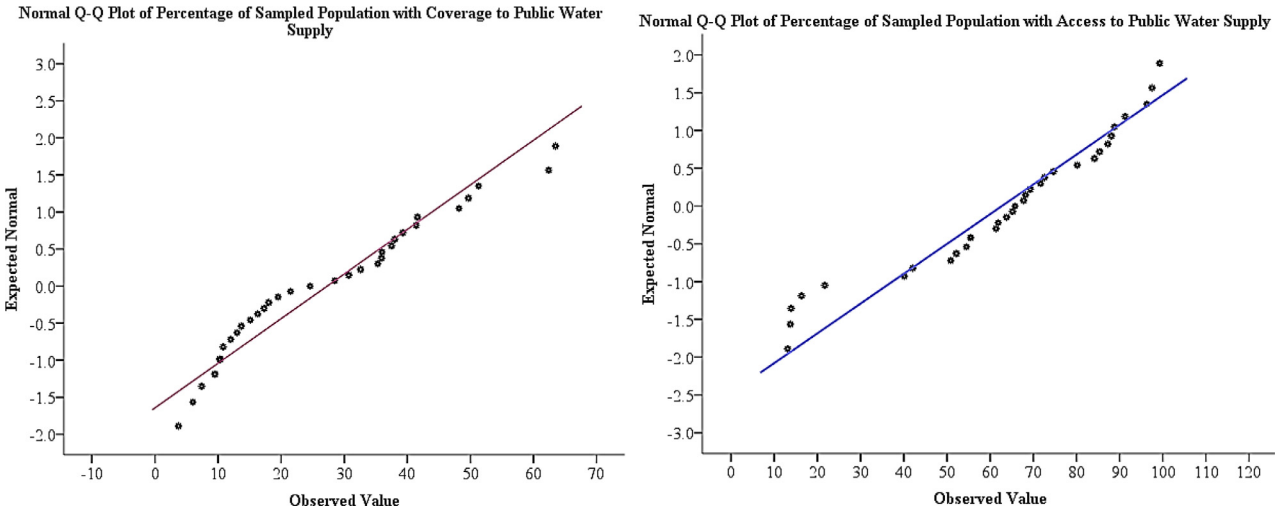


Fig. 8. A and 8B: Plots of expected normal against observed value for percentage of sampled population with coverage and access respectively to public water supply data.

Table 6
Regression model result.

Model	R	R^2	Adj. R^2	Change		
				F Change	df	Sig.
1	0.606[a]	0.367	0.347	6.12	19	0.024

a. Predictors: (Constant), Percentage of Sampled Population with Coverage to Public Water Supply.
Dependent Variable: Percentage of Sampled Population with Access to Public Water Supply.

4.4.2. Relationship equation development between coverage and access to public water source in Oyo State using regression analysis

The coverage and access to potable water supply data for all the LGAs were divided into two parts. The first part comprises nineteen (19) LGAs which were used for modeling while the remaining fourteen (14) LGAs were used for validation using the linear regression model in SPSS. The results are summarized in Tables 6 and 7.

From Table 6, the R-Square value explains how much movement of an independent variable is explained by the movement of a dependent variable. As the R-Square value equals 36.7% which is greater than 30%, it shows that the movement of an outcome (Access) variable is well explained by the movement in the predictor (Coverage) variable.

There is a linear relationship between Coverage and Access to Public Water Supply as shown in Table 7. Assuming this linear relationship is represented as in Eq. (6); then the slope of the linear relationship is obtained as; $a = 1.14$ while the intercept or the constant on the vertical axis is obtained as; $b = 34.17$

$$Y = aX + b \tag{6}$$

Where;
Y = Access to Potable Water Supply in Oyo State (Outcome Variable)
X = Coverage to Public Water Supply in Oyo State (Predictor Variable)
a = Slope of the straight line
b = Intercept or constant on the vertical axis

Hence, Eq. (7) is the regression equation that represents the linear relationship between Access and Coverage to Public Water Supply in Oyo State.

$$Y = 1.14X + 34.17 \tag{7}$$

This implies that it is possible to predict Access to Safe Water in Oyo State if the information on Water Facility Coverage is available.

4.4.3. Relationship equation validation

The validation of the generated relationship was done using 14 LGAs' data for coverage and access to potable water by calculating both the Nash Sutcliff Efficiency (NSE) and the Coefficient of Determination (r^2) which are among the statistical methods of model validation. Table 8 was obtained by predicting access to safe water in some selected Local Government Areas within the State by using their corresponding information on water facility coverage using Eq. (6).

Table 8 shows the results of the modeled access (%), validated by calculating the Nash-Sutcliff Efficiency (NSE) and the Coefficient of Determination (r^2) using Eqs. (8) and 9 respectively.

Table 8
Selected LGAs, their modeled percentage access using Eq. (6).0, and their measured percentage access.

LGAs	Measured Access (%)	Modeled Access (%)
Akinyele	61.9	69.2
Ibadan S / West	69.3	81.6
Ibadan N/ West	68.2	81.4
Ibarapa Central	91.3	105.3
Ibarapa East	88.1	106.6
Iddo	55.5	51.4
Iseyin	87.3	90.8
Iwajowa	67.8	66.7
Lagelu	54.5	45.0
Ogbomoso South	85.4	89.1
Ona Ara	50.9	52.8
Orire	65.8	71.3
Saki East	63.8	74.4
Surulere	40.1	47.9

$$NSE = 1 - \frac{\left[\left(\sum_{i=1}^{n} (\text{Measured Access} - \text{Modeled Access})\right)^2\right]}{\left[\sum_{i=1}^{n} \left(\text{Measured Access} - \overline{\text{Measured Access}}\right)\right]^2} \tag{8}$$

$$NSE = 1 - (1255.74/3092.62)$$

$$NSE = 0.60$$

$$r^2 = \left[\frac{\left(N\sum_{i=1}^{n}(xy)\right) - \left(\sum_{i=1}^{n} x\right) * \left(\sum_{i=1}^{n} y\right)}{\sqrt{\left[\left(N\sum_{i=1}^{n}(x)^2\right) - \left(N\sum_{i=1}^{n}(x)\right)^2\right] * \left[\left(N\sum_{i=1}^{n}(y)^2\right) - \left(N\sum_{i=1}^{n}(y)\right)^2\right]}}\right]^2 \tag{9}$$

here;
x = measured access (%)
y = modeled access (%) r^2 = coefficient of determination $r^2 = (0.941)^2$ $r^2 = 0.885$

The result of the validation (NSE = 60% and r^2 = 88.5%) as estimated above indicates that the modeled equation (Eq. (6)) for predicting access to the potable water supply is a fair representation of the relationship between the two variables. Thus, it is capable of predicting the access to potable water supply in all the LGAs in Oyo State.

5. Conclusions

This study found that water availability for public water supply in the study area is inadequate. Most consumers rely on individual groundwater sources for their access to potable water. The study also revealed that less than 30% of the sampled population is covered by the existing public water supply distribution and access was estimated at 63%. In 1990, the baseline figure of people with access to the potable water supply was estimated as *40%* and the MDG target was to halve the percentage without access to potable water by the year 2015 to

Table 7
Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Beta	Std. Error	Beta		
1	(Constant)	34.17	6.942		2.8997	0.00997
	Percentage of Sampled Population with Coverage to Public Water Supply	1.14	0.218	0.606	2.4739	0.02421

[a]. Dependent Variable: Percentage of Sampled Population with Access to Potable Water Supply.

achieve *70%* access to potable (MDG, 2015). However, results from this study show that the MDG was not met.

To meet SDG 6.1, funding for water supply study and infrastructure will have to be raised considerably. The study area, as in many developing countries did not meet the MDG. This is a major threat to achieving the SDG as funding continues to dwindle. The models created in this study can help reduce the time, effort, and fundings required for data gathering and analysis. For the study area, it should be possible to predict Access to potable water provided that information on water supply facility coverage is known.

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Data availability

The datasets analyzed during the current study are available in the supplementary file attached to this submission.

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Declaration of Competing Interest

The authors declared no conflict of interest in this research paper.

Supplementary materials

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