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Research article

ASSESSMENT OF PUBLIC WATER SUPPLY AVAILABILITY AND UTILIZATION FOR SUSTAINABLE URBAN GROWTH AND MANAGEMENT IN CALABAR SOUTH LOCAL GOVERNMENT AREA, CROSS RIVER STATE, NIGERIA

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ABSTRACT

This study assesses public water availability and utilisation for sustainable urban growth and management in Calabar South Local Government Area. The study examines the extent of public water supply, patterns of utilization, challenges affecting access to potable water, and implications for sustainable urban development in the area. Calabar South Local Government Area was stratified into 13 ethnic residential settlements. Three hundred and ninety-six (396) questionnaires were systematically administered using 1.0 percent of the total number of houses per ethnic settlement. A descriptive survey research design was adopted using both primary and secondary data sources. Primary data were collected through questionnaires, interviews, and field observations, while secondary data were obtained from journals, textbooks, and government publications. Data collected were analyzed using descriptive statistical methods such as frequency tables and percentages. Findings indicate that irregular water supply, inadequate infrastructure, rapid population growth, and poor management practices significantly affected public water availability and utilization. The study concludes that efficient public water provision is essential for sustainable urban growth and recommends improved investment in water infrastructure, proper maintenance, and effective urban water management strategies.

KEYWORDS

Public Water Supply, Water Utilization, Sustainable Urban Growth, Urban Management, Water Infrastructure, Calabar South.

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INTRODUCTION

Water is one of the most essential natural resources required for human survival, environmental sustainability, and socio-economic development. It plays a significant role in domestic, industrial, agricultural, and commercial activities, thereby contributing to the overall growth and management of urban centers. Rapid urbanization in many developing countries has increased pressure on existing urban infrastructure and public utilities, particularly water supply systems. In Nigeria, urban centers continue to experience significant population growth resulting from rural-urban migration, natural population increase, and spatial expansion. This rapid urban growth has created enormous challenges in the provision and management of public water infrastructure, especially in urban local government areas. (Aderibigbe, Awoyemi & Osagbemi, 2008). Public water supply is a critical component of sustainable urban management because it supports public health, sanitation, environmental quality, economic productivity, and social well-being (United Nations, 2021). Where public water systems are inadequate, residents often resort to alternative sources such as boreholes, streams, rainwater harvesting, and water vendors, many of which may be unsafe or unsustainable.

Public water availability refers to the extent to which safe, reliable, and accessible water is provided to the population through government or publicly regulated systems. Water availability is a critical component of urban infrastructure because it directly influences public health, sanitation, economic productivity, and environmental sustainability. According to the World Health Organization, access to potable water is fundamental to human survival and sustainable development. In many developing countries, however, rapid urbanization has outpaced the provision of water infrastructure, thereby creating significant water shortages in urban areas. Urban water availability involves three major dimensions: water quantity, water quality, and water delivery systems. Cities experiencing rapid population growth often face challenges in maintaining these three dimensions due to increasing demand and infrastructural deficiencies. Studies have shown that urban growth places pressure on freshwater resources, leading to poor service delivery and unequal water distribution among residents (Oyebode, 2026).

Sustainable urban growth refers to the orderly physical, economic, social, and environmental development of urban centres in ways that meet present needs without compromising future generations. Water supply is one of the most essential components of sustainable urban management because urban productivity, environmental quality, and public health depend largely on access to safe water. Urban growth in many developing countries has the pressure on public water infrastructure. In Nigeria, poor governance, inadequate investment, weak institutional coordination has negatively affected sustainable water management systems. Oyebode et al. (2026) maintained that effective urban water management requires sustainable governance structures, proper planning, and continuous infrastructural investment. Sustainable urban growth and management involve the effective planning, development, and maintenance of urban infrastructure and services in ways that meet present needs without compromising the ability of future generations to meet their own needs.

Water utilization refers to the various ways households, institutions, and industries use available water resources for domestic, commercial, industrial and sanitation purposes. Domestic water use remains the dominant form of utilization in most Nigerian urban centres, including cooking, washing, bathing, and cleaning activities. Studies on urban water utilization in Nigeria indicate that inadequate public water supply has forced many households to rely on alternative water sources such as private boreholes, water vendors, wells, and rainwater harvesting systems. The decline in piped public water has contributed significantly to the growth of self-supply systems in Nigerian cities. (Shuaibu, Hassan & Abubakar, 2025).

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The development of public water supply systems in Nigeria can be traced to the colonial period when basic urban infrastructure was established in major administrative and commercial centers such as Calabar, Lagos, and Enugu. Colonial authorities introduced piped water schemes primarily to serve European residential quarters, government offices, military establishments, and commercial districts. These early water supply systems laid the foundation for modern urban water infrastructure in Nigeria. However, the facilities were designed to serve relatively small populations and have become increasingly inadequate in meeting the demands of rapidly growing urban centers (Ayoade, 1988; Akpabio, 2012). Following Nigeria's independence, responsibility for public water supply was transferred to the state governments through the establishment of Water Boards and Water Corporations. In Cross River State, the Cross River State Water Board Limited became the principal agency responsible for water production, treatment, distribution, and maintenance of public water infrastructure. The Water Board was established to ensure that residents of Calabar and other urban centers in the state had access to safe and potable water for domestic, commercial, and institutional uses (Akpabio, 2012).

Balogun, Sojobi, and Galkaye (2017) observed that rapid population growth, poor operational efficiency, leakages and low reticulation coverage are major causes of inadequate public water supply in Nigeria urban areas. The authors further noted that increasing urbanization without corresponding infrastructural expansion creates a widening gap between water demand and supply. Fatunmibi (2023) argued that poor

access to potable water contributes to sanitation problems and increases prevalence of waterborne diseases in many Nigerian communities. The study emphasized the importance of Sustainable Development Goal 6 (SDG 6), which focuses on ensuring access to clean water and sanitation for all. Several studies have also revealed that sustainable water management depends on community participation, maintenance culture, financial sustainability, and efficient policy implementation. For instance, studies carried out by Ali (2025) identified community participation and infrastructure maintenance as critical success factors for sustainable water supply projects in Nigeria.

Globally, sustainable water management strategies now emphasize integrated water resources management, water conservation, infrastructure rehabilitation, environmentally sustainable water reuse systems. Scholars have argued that water reuse technologies and alternative supply systems can help improve resilience in rapidly urbanizing cities (Erifeta, & Erifeta 2025) and (Adeniran, Daniell & Pittock, 2021). Urban centres in Nigeria face numerous challenges associated with water availability and utilization. These include aging infrastructure, poor maintenance, inadequate funding, rapid population growth, electricity shortages, leakages, poor governance, and urban sprawl. The growing dependence on private boreholes in Nigerian cities demonstrate the declining efficiency of water systems. Studies indicate that public piped water in Nigeria urban declined significantly between 1990 and 2015, while dependence on self-supply systems increased rapidly (Shuaibu, Hassan, & Abubakar 2025). In addition, urban expansion often creates informal settlements lacking access to adequate water infrastructure. Poor water supply in such areas contributes to environmental degradation, poor sanitation, flooding, and public health risks. Urban growth without corresponding infrastructural development therefore undermines sustainable urban management. (McDonald, Douglas, Revenga, Hale, Grimm, Growall, & Fekete, 2011). Also, Adeniran, Daniell, and Pittock (2021) emphasized that water infrastructure development is essential for sustainable urban development because it supports sanitation, health, environmental quality, and economic growth. The study further argued that investment in water infrastructure remains inadequate in many developing nations, including Nigeria.

In many Nigerian cities, public water supply systems are characterized by inadequate infrastructure, poor maintenance, erratic power supply, aging pipelines, insufficient funding, and ineffective management practices. These challenges have limited access to potable water and increased the vulnerability of urban residents to waterborne diseases and environmental hazards (Ocheri, Odoma & Umar, 2014). Consequently, urban households spend considerable income and time sourcing water from alternative means, thereby affecting productivity and quality of life. Several empirical studies have been conducted on public water supply and urban management in Nigeria and other developing countries. Aderibigbe, Awoyemi, and Osagbemi (2008) examined water availability adequacy in Ilorin metropolis and found that most households lacked regular access to potable water due to infrastructural deficiencies and poor management practices. The study recommended increased government investment in water infrastructure.

Balogun et al. (2017) investigated public water supply challenges in Lagos state and discovered that rapid population growth and inadequate operational capacity contributed significantly to water shortages in urban communities. Oyeboode et al. (2026) reviewed urban water management practices in Nigeria and concluded that sustainable urban water systems require integrated governance, effective policy implementation, and infrastructural rehabilitation. Fatunmibi (2023) also established that inadequate access to potable water contribute to major public health challenges and poor sanitations in Nigeria.

The Cross River State Water Board performs several important functions, including the development of water supply schemes, operation of water treatment plants, maintenance of pipelines and distribution networks, installation of water connections, revenue collection, and monitoring of water quality. Through these activities, the Board contributes significantly to public health improvement, environmental sanitation, and urban development. Despite these responsibilities, the Water Board has faced numerous challenges that have affected effective service delivery in Calabar. These challenges include aging infrastructure, inadequate funding, population growth, vandalism of water facilities, irregular power supply, and insufficient maintenance of water distribution networks. Consequently, many residents of

Calabar South and other parts of the metropolis depend on private boreholes, water vendors, and other alternative sources to meet their daily water needs.

According to Akpabio (2012), inadequate investment and institutional weakness have constrained the performance of urban water utilities in many Nigerian cities, including Calabar South. Similarly, Awuah and Bijimi (2024) observed that effective urban water supply in Nigeria requires strong collaboration among government agencies, water utilities, development partners, communities, and water users. The inadequacy of public water supply in Calabar South has implications for sustainable growth and management. Poor access to potable water contributes to environmental sanitation problems, indiscriminate waste disposal, public health risks, and pressure on groundwater resources. Furthermore, ineffective water distribution systems hinder urban productivity and undermine efforts toward achieving sustainable development goals related to clean water and sustainable cities (United Nations Development Programme, 2020). Despite these studies, limited research has specifically examined public water availability and utilization in relation to sustainable urban growth and management in Calabar South Local Government Area. It is against this background that this study seeks to assess public water availability, and utilization for sustainable urban growth and management in Calabar Government South Local Government Area, Cross River State. The study aims to examine the extent of public water availability, identify the challenges affecting water utilization, and evaluate the implications of water supply on sustainable urban development and management in the area.

METHODOLOGY

The Study Area

The study was conducted in Calabar South Local Government Area. Calabar South is one of the two Local Government Areas that make up the Calabar metropolis in Cross River State. The Local Government Area lies within the coastal region of southern Nigeria and shares boundaries with Calabar Municipality to the North, the Atlantic coastal zone to the south, and Great Qua and Calabar rivers to the east and west respectively (See Fig. 1)

Calabar South experiences a tropical climate characterized by high rainfall, humidity, and relatively high temperatures throughout the year. The area is predominantly urban with increasing population growth resulting from rural-urban migration, commercial activities, educational development, and administrative functions. Calabar South Local Government Area, located in Cross River State, is a densely populated urban areas in the State. The area has witnessed rapid physical and demographic growth over the years due to increasing commercial activities, educational institutions, and administrative functions. Despite this growth, public water supply in the area remains inadequate and inconsistent. Many households experience irregular water distribution, forcing residents to depend heavily on private boreholes, sachet water, and water vendors to meet their daily needs.

According to the National Population Commission, the population of Calabar South was 191,630 in 2006 (NPC, 2006). But recent projections estimate the population of Calabar South at about 368,000 (naijadetails.com. 2026), based on the projected figure of 799 houses per year, the study area is estimated to have 42,354 houses in 2025 (Edide, 2025)

Despite its urban status, Calabar South faces challenges relating to inadequate public infrastructure and social services, particularly public water supply. Many residents depend on alternative water sources such as boreholes, wells, rainwater harvesting, and water vendors due to irregular or insufficient public water distribution. These conditions make the area suitable for assessing public water availability and utilization for sustainable urban growth and management

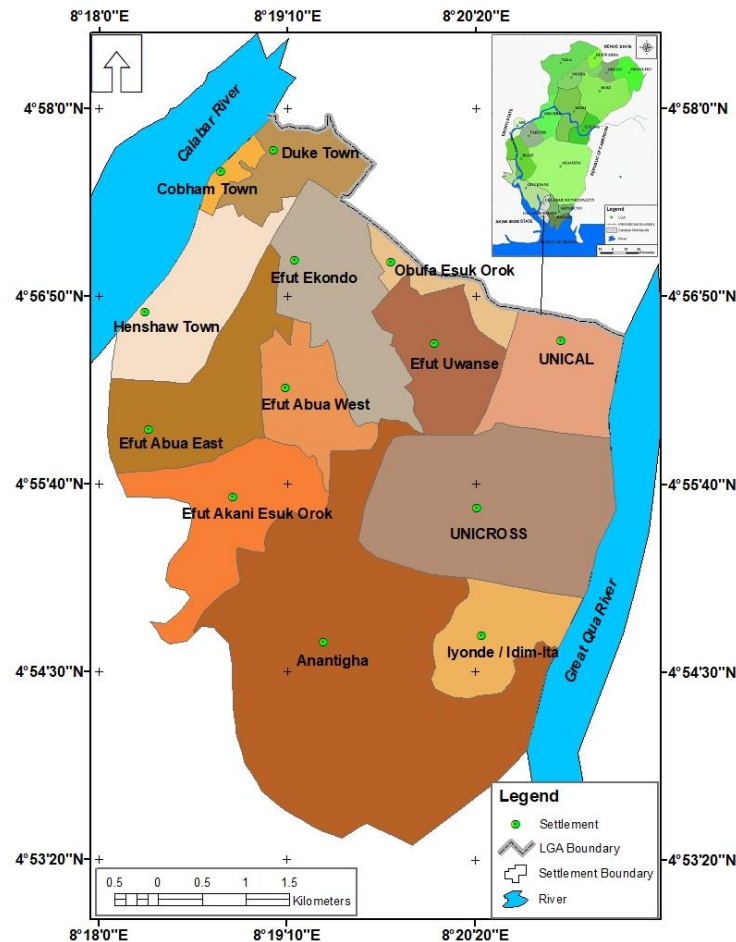


Fig. 1: Study area in context of Cross River State

Source: Department of Urban and Regional Planning, University of Calabar

Types and sources of Data

The study utilized both primary and secondary data in order to obtain comprehensive information on the public water availability and utilization for sustainable development in Calabar South Local Government Area.

A combination of both the primary and secondary data were used for this study. Primary data were collected directly from the field by the researcher through the following methods: administration of questionnaires, oral interviews and field observation. The questionnaires focused on issues such as: availability of water supply, frequency of water access, sources of water by households, challenges affecting water supply, and the effects of inadequate water supply on urban living.

The secondary data were obtained from already existing materials and published sources such as: textbooks, academic journals, conference papers, government publications, internet materials and previous research work relevant to the study.

Sample Size and Sampling Techniques

Sampling Size

The study adopted the proportionate sampling method to determine the sample size for the study area with total housing population of 39,957 houses within the 13 ethnic settlements as at 2022, at a 5percent level of precision (see table 1). A sample size of 1% of population of 39,957 houses was used in the study. According to Krejcie and Morgan (1970), a population approximately, 40,000 would require a sample size of about 380 respondents. Therefore, a sample of 396 houses exceeds this requirement and statistically acceptable

Table 1: Number of houses within ethnic settlements in Calabar South between 1972 and 2022

S/N	Ethnic Settlements	Number of Houses											
		1972	%	1982	%	1992	%	2002	%	2012	%	2022	%
01	Anantigha	22	0.64	267	1.91	2358	7.7	2485	7.8	3171	9.9	4227	10.6
02	Duke Town	374	10.9	388	2.77	2183	7.1	2320	7.3	2577	8.1	2664	6.7
03	Cobham Town	118	3.45	276	1.97	610	1.9	634	1.9	645	2.0	679	1.7
04	Henshaw Town	341	9.96	570	4.1	2420	7.9	2497	7.8	2989	9.3	3065	7.7
05	Efut Ekondo	1019	29.6	3778	26.99	6567	21.4	6691	20.9	6893	21.5	7392	18.5
06	Efut Abua West	678	19.8	897	6.4	3866	12.6	3987	12.5	4501	14.0	4559	11.4
07	Efut Abua East	354	10.3	1967	14.05	3326	10.8	3467	10.8	3998	12.5	4550	11.4
08	Efut Akani Esuk	52	1.52	2359	16.85	2848	9.3	2986	9.3	3198	10.0	3433	8.6
09	Crutech (Unicross)	9	0.26	37	0.24	388	1.3	221	0.7	379	1.2	822	2.1
10	Unical	13	0.38	46	0.33	774	2.5	954	2.7	1004	3.1	1199	3.0
11	Efut Uwanse	280	8.2	2760	19.72	3762	12.3	3968	12.4	4769	14.9	5170	12.9
12	Iyonde	-	-	12	0.09	17	0.05	128	0.4	247	0.8	274	0.7
13	Obufa Esuk	165	4.82	642	4.6	1542	5.0	1659	5.2	1872	5.9	1923	4.8
	Total	3,425		13,999		30,661		31,997		36,243		39,957	

Source: Adapted from Edide, 2025

This produced a total sample size of 396 households. Subsequently, proportionate allocation was used to determine the sample size for each settlement. For instance, for the Anantigha ethnic settlement, with 4,227 houses, the proportional-allocation formula yielded approximately 42 households selected for questionnaire administration (see table 2)

Table 2: Number of houses within ethnic settlements in 2022

S/N	Ethnic Settlements	No. of houses	Sampled size
01	Anantigha	4227	42
02	Duke Town	2664	26
03	Cobham Town	679	7
04	Henshaw Town	3065	30

05	Efut Ekondo	7392	73
06	Efut Abua West	4559	45
07	Efut Abua East	4550	45
08	Efut Akani Esuk	3433	34
09	Crutech (Unicross)	822	8
10	Unical	1199	12
11	Efut Uwanse	5170	51
12	Iyonde	274	3
13	Obufa Esuk	1923	19
	Total	39,957	396

Source: Researcher's compilation, 2026

The target population for the study comprised of households within the 13 ethnic settlements and a total of 39,957 houses as at 2022, in Calabar South Local Government Area. Due to large population size and time constraints, a sample size of approximately 396 households was selected based on Krejcie and Morgan (1970), formula size determination. The sample size was considered adequate for representing the views of residents across different ethnic communities within the study area and for achieving reliable statistical analysis.

Sampling Techniques

The study adopted a combination of stratified sampling and systematic random sampling techniques. Calabar South was first divided into different ethnic settlements to ensure adequate representation of various parts of the Local Government Area. This helped to capture variations in water availability and utilization across different ethnic settlements. Within each selected community, households were selected systematically. In this method, the researcher selected households at regular intervals along streets and residential clusters. For example, every fifth or tenth residential house was selected depending on the housing density within each settlement. Where more than one household existed in a building, one household was randomly selected for questionnaire administration. The combination of these sampling techniques ensured fairness, reduced bias, and enhanced the reliability and representativeness of the data collected for the study.

RESULTS AND DISCUSSION

Table 1 shows that 182 respondents (47.4%) experienced irregular public supply and 56 (14.6%) reported no public supply. Thus, 62.0% lacked regular access, compared with 146 respondents (38.0%) who reported availability. The distribution indicates a substantial reliability deficit rather than a marginal service interruption.

Table 1. Reported availability of public water supply (n = 384)

Response	Frequency	Percentage (%)
Available	146	38.0
Not Regularly Available	182	47.4
Not Available	56	14.6
Total	384	100

Table 2 shows that private boreholes were the principal source for 156 households (40.6%). Public taps or boreholes served 104 households (27.1%), while 82 (21.4%) depended mainly on vendors and 42 (10.9%) relied on rainwater or wells. The combined 72.9% dependence on non-public sources demonstrates the extent to which households compensate for limited public provision.

Table 2. Principal household water source (n = 384)

Response	Frequency	Percentage (%)
Public Tap/Borehole	104	27.1
Private Borehole	156	40.6
Water Vendors	82	21.4
Rainwater/Wells	42	10.9
Total	384	100

As shown in Table 3, only 52 respondents (13.5%) received public water daily. Supply was weekly for 108 households (28.1%), occasional for 174 (45.3%) and entirely absent for 50 (13.1%). The concentration in the occasional and never categories confirms that service reliability is the central operational weakness.

Table 3. Frequency of public water supply (n = 384)

Frequency	Frequency Count	Percentage (%)
Daily	52	13.5
Weekly	108	28.1
Occasionally	174	45.3
Never	50	13.1
Total	384	100

Table 4. Association between public water availability and sustainable urban growth

Variables	Calculated Chi-square	Critical Chi-square	Df	Decision	p-value
Public Water Availability and Sustainable Urban Growth	18.42	9.49	4	Reject H0	< .001

The association between public water availability and sustainable urban growth was statistically significant, $\chi^2(4, n = 384) = 18.42, p < .001$. H01 was therefore rejected. Reliable water access is empirically connected to the conditions required for household welfare, sanitation and orderly urban development.

Table 5. Association between public water utilisation and urban management

Variables	Calculated Chi-square	Critical Chi-square	Df	Decision	p-value
Public Water Availability and Urban Management	16.87	9.49	4	Reject H0	.002

Public water utilisation was significantly associated with urban management, $\chi^2(4, n = 384) = 16.87, p = .002$. H02 was rejected. The result supports the view that water-service performance affects sanitation management, residential functionality and the capacity of urban institutions to support population growth.

Table 6. Association between water infrastructure and dependence on alternative sources

Variables	Calculated Chi-square	Critical Chi-square	Df	Decision	p-value
Water Infrastructure and Alternative Water Dependence	21.56	9.49	4	Reject H0	< .001

Water-infrastructure adequacy was significantly associated with household dependence on alternative sources, $\chi^2(4, n = 384) = 21.56, p < .001$. H03 was rejected. This result is consistent with the descriptive evidence that private boreholes and vendors substitute for unreliable public supply.

Integrated empirical interpretation

The six tables present a consistent empirical pattern. Public supply is both insufficient and irregular, and households respond by shifting to privately financed sources. The finding that fewer than two in five households reported public-water availability, combined with the dominance of private boreholes, indicates that the burden of securing water has moved from the public utility to individual households.

This substitution has planning consequences. Household boreholes may improve short-term access, but uncoordinated extraction can increase pressure on groundwater, while vendor dependence raises affordability and quality-control concerns. The results therefore connect service reliability with environmental management, public health and the equitable distribution of urban infrastructure.

The inferential results reinforce the descriptive findings. All three null hypotheses were rejected at the 5% level. Because the survey is cross-sectional, the tests establish association rather than causation; nevertheless, the convergence of household-source patterns and statistically significant relationships provides a strong basis for prioritising water infrastructure in urban-management decisions.

CONCLUSION AND POLICY IMPLICATIONS

Public water provision in Calabar South does not presently meet the requirements of a rapidly growing urban population. Irregular service affects 47.4% of surveyed households, and a further 14.6% report no availability. Consequently, private boreholes, water vendors, rainwater and wells have become essential substitutes. The statistically significant relationships between water availability, urban growth, urban management and dependence on alternative sources show that water-service reform is central to sustainable development in the area.

The Cross River State water authorities should rehabilitate pumping, treatment and distribution infrastructure; extend reticulation to underserved settlements; establish preventive-maintenance schedules; and publish measurable service standards for supply frequency and water quality. Urban-development approvals should be coordinated with projected water demand so that new growth does not outpace network capacity.

Until reliable public coverage is restored, private boreholes and water vendors require registration, periodic quality testing and enforceable abstraction and sanitation standards. Community water schemes and rainwater harvesting can supplement supply, but they should be integrated into a monitored urban water-security programme rather than treated as permanent substitutes for effective public provision.

Study limitations

The findings are based on cross-sectional household reports and therefore do not measure seasonal changes in network output or establish causal effects. Future research should combine household surveys with utility production records, water-quality tests, geospatial service-coverage analysis and repeated dry- and wet-season observations.

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Data availability. The data supporting the findings are available from the corresponding author on reasonable request, subject to ethical and institutional restrictions.

Author contributions. All listed authors contributed to the conception or design of the work, interpretation of evidence, critical revision, and approval of the submitted version. The authors should confirm their individual contributions before submission.

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