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Research Article

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Assessment of Safe-drinking Water in Auchi, Nigeria

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Abstract Rapid urbanization, environmental constraints, climate change and the inability of public utilities to cope with increasing demand affect the water supply system. This is evident in the Auchi region, as about 70% of Auchi households have no access to adequate domestic water sources. The study assesses the accessibility of safe drinking in Auchi and its influence on residents' socio-economic status on water consumption. The results showed that the portable water has a low coverage in Auchi and its environs. The study also revealed that Akepke and Iyekhei had the lowest access to safe water supplies at $P<0.05$. The dwellers around these clans walk an average distance of 1.5 km to and fro to gather water from either borehole points or designated water vendors. However, Utsogun, Igbei, and Aiboste are less water stressed with an average return trip time of 50 minutes to gather 20 litres of water. The complex situation has further affected the socio-economic balancing of people due to the productive time spent and high financial expenditure incurred in procuring this essential utility. Due to the increasing population of Auchi, it is therefore projected that 60% of the inhabitants might face accessing safe-drinking water by 2050s. In conclusion, it is generally recommended that governments at every level need to step up investment in water resources programmes by involving stakeholders in corporate and private organizations.

Keywords Domestic water use, Accessibility, Water resources, Water vendor, Auchi, Socio-economic

1. Introduction

As a unique natural resource, water plays a vital role in human welfare and survival [1]. It constitutes an essential element of life. An adequate supply of safe and clean water is the crucial precondition for sustaining human life, maintaining an ecosystem that supports all life, and achieving sustainable development [2]. This inevitable resource is a great treasure for the socio-economic and political development of every region. It is the most sought-after social good and ranks very high in many communities' developmental preferences [3]. The crucial role of adequate water quantity for human welfare and health has been explained in several studies [1-5]. Irrespective of its importance, a global paucity of adequate and safe drinking water has been established [1, 4-5]. However, tremendous attention has not been directed towards water management issues globally, which adversely affects people's livelihood, mostly in developing countries. This has inevitably aroused considerable interest globally, especially in developing countries, including Nigeria, as almost 1 billion people in developing countries lack access to such supply [5].

Water security is an increasing concern and an imperative critical need for sustainable development in Nigerian urban centres, particularly as Nigeria is already facing severe water scarcity due to conflict and drought [6]. Since 1990, there has been little change (29%) in access to water in Nigeria. Therefore, WHO and UNICEF [7] suggest that increased access to safe water in rural areas by 23 percent (from 43% to 66%), and in urban areas by 10 percent from (81% to 91%) would help to achieve the Post-2015 Development targets of access to 50

litres per capita per day of safe drinking water. Against this projection, Nigeria still lags in the provision of safe water as 27% of the rural population and 16% of the urban population use unimproved sources of drinking water for households [7]. It is increasingly evident that not much has been achieved with the increasing water scarcity concerns in Nigeria. However, low rates of capital investment, difficulties in appropriately developing local water resources, and weak institutions mandated to manage water supplies contribute significantly to low coverage, affordability, and accessibility of water supply in Auchi and its environs [8]. The water utility investments have not kept pace with the growing population and further complicate the already stressed condition. People rely on other sources of supply, such as streams and rivers, water sachets, pools from vendors, among others that are often highly contaminated or, in most cases, inadequate to meet the hygiene requirements [9].

As urban areas and populations expand, demand for water, energy, and other resources also grow because more people use them. The increase in demand and water use and other resources within the environment continues to stress water resources and establish water security as key priority to achieve the Post-2015 development target (SDG 6) on household water (Centre for International Governance Innovation [10]. Hence, this study focuses on the coverage and distribution of safe-drinking water in Auchi and its environs and develop some integrated water resource strategic measures to improve water provision, accessibility, and distribution.

2. Research Methodology

2.1 *The Study Area*

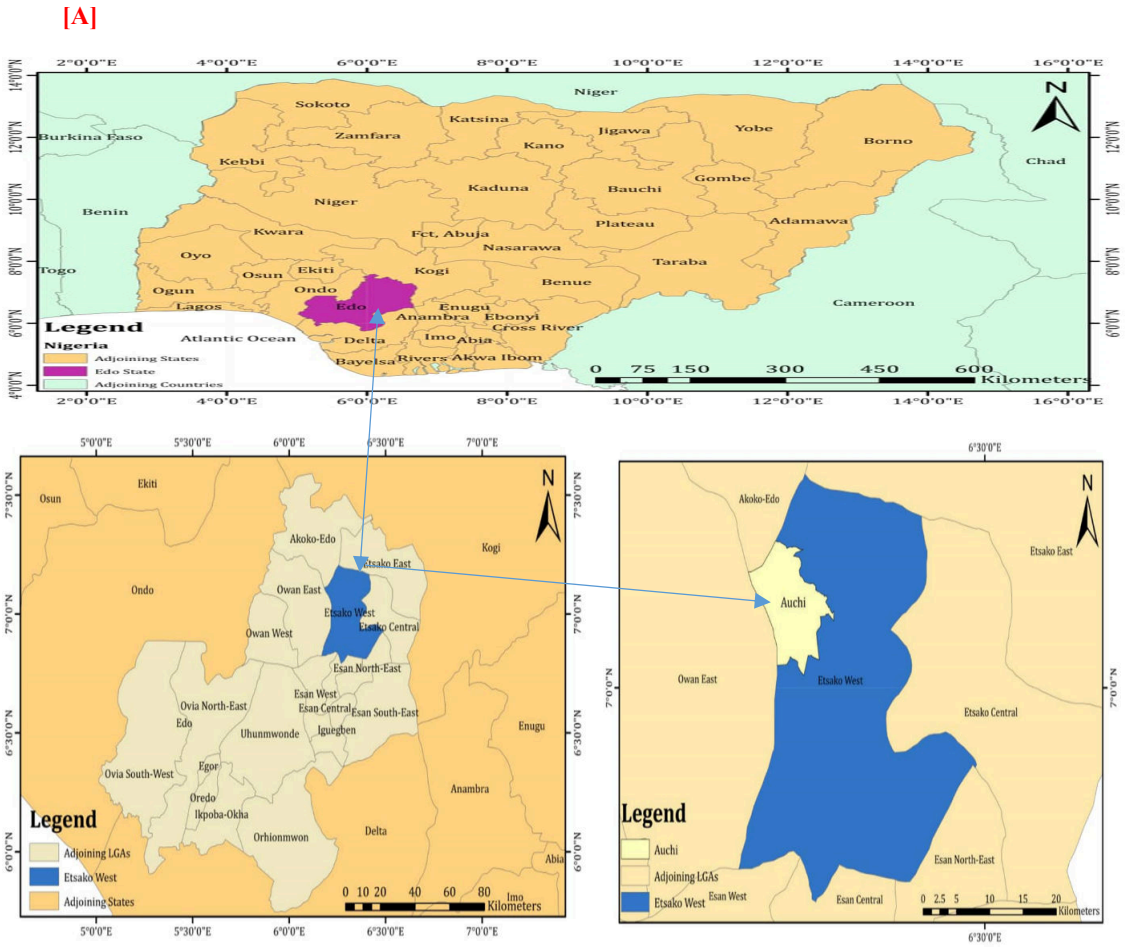

Figure 1: Map of Nigeria Showing Edo State (a), Map of Edo State showing Etsako West (b). Map of Etsako West Showing Auchi(c).

Auchi is a pre-colonial traditional urban center and one of the largest settlements (both in terms of population and spatial distribution) in Edo State, Nigeria, as shown in Fig. 1a, 1b, and 1c, respectively. It grew into a town of repute about 500 years ago during the early part of the 15th century AD, before Oba Ewuare. The Great of ancient Benin Kingdom [11]. It consists of five widely separated traditional communities located at Usogun, Akpekpe, Aibotse, Igbei, and Iyekhei, which have fused into a large community presently known as Auchi under the administration of Otaru of Auchi.

The town is located at about 136km North-East of Benin-city, the Edo state's capital, and it is about 330km to Abuja, which is the Federal Capital Territory. It lies at the fringe of the southern rainforest and northern savanna grassland of Nigeria. It lies within the coordinates of latitude 70 04'N and 70 54'N of the Equator and longitude 5036' E and 60 24'E of the Greenwich meridian [12]. It shares a common boundary with Iyuku/Imekhe, Jattu, and South Ibie at the East, at the north by Ikpeshi/Igbigele, and at the west; by Iviaro and Warrake and the South by Aviele, Agbede, and Egeuno. At the same time, South-Ibie and Jattu are coalescing with Auchi to form one continuous urban forum. It covers an area that spans about 346,316 km^2 with elevation ranging mainly between 320 and 420m above sea level.

2.2 Primary Sources of Data

This research's primary data was sourced mainly through the questionnaire's administration, focus group discussions, interviews, and local reports investigation.

Questionnaire: For this study, three sets of questionnaires were designed to collect research data. The first set of questionnaire was designed for respondents in the targeted population. This questionnaire was used to obtain relevant data on their socio-economic characteristics, ownership and available water sources, strategies employed to source water, quantity and quality of water used, and causes and problems associated with water scarcity.

2.3 Secondary Sources of Data:

Substantial numbers of literature were obtained from published and unpublished sources from organizations relevant to this research. Some of these include official publications and semi-official publications issued by boards and ministries such as the National Board of Statistics on National Integrated Survey of Household (NISH), National Integrated Survey of Establishments (NISE), Federal Ministry of Environment and Water Resources, Water Corporation/Board of Edo State, Etsako West Local Government Council and National Population Commission (NPC especially). Also, reviewed research publications, documentation of relevant reports submitted by research workers, institutions, and organizations such as UNICEF, UN-WATER, UN-HABITAT, UNEP, UNF/UNFIP, MDG, USAID, PRB, Water Aid, World Bank, WHO and vital legal documents on water management issues were appraised.

2.4 Research Population

Akinbamijo [13] defines a research population as an audience to which the research is directed. Based on this assumption, the focused audience for this study was the entire residents of Auchi. Burns and Grove [14] define eligibility criteria as "a list of characteristics required for membership in the target population." The criteria for inclusion of respondents for this study are: water users, private water suppliers, and others that make up informal sectors and public agents. Auchi town has an estimated population of 98,294 (2017) as projected from the 1991 figure of 42,610 (Nigerian Population and Housing Census, 1991) set at a growth rate of 3.4% percent using the formula in Eq. (1):

$$P_t = P_o\left[1 + \frac{r}{100}\right]n \quad (1)$$

Where;

Po = Projected Population,
Pt = Population of the base year,
r = Rate of population growth (3.4)
n = 25 years

2.5 Method of Data Analysis

The analysis of data from samples constitutes a significant proportion of contemporary research in the social sciences. Relevant data were collected from respondents to achieve the set objectives for the study. The set objectives and responses for this study are shown in Table 1.

Table 1: Research Objectives, Data Type, Source and Method of Analysis

S/N	Research Objectives	Method of Data Collection	Method of Analysis/Statistical Used	Respondents Source of Data	Expected Outcome	Variables Scale of Measurements for each objective. (Determinant of analytical method)
1.	Identify the socio-economic characteristics of households in the study area	Questionnaire survey	SPSS/correlation bivariate /two tailed significant test /Pearson and Chi-square	All respondents	Determine the socio-economic characteristics of household with respect to the rate of water demand and use.	Interval/ and Nominal scale
2.	Assess the reliability of existing water sources in Auchi	Questionnaire survey	Regression model Regression coefficient and model analysis of variance (ANOVA)	All respondents	Identify the existing trends of domestic water sources	Interval and Nominal scale
3.	Examine the level of accessibility of various water source in the study	Questionnaire survey	Multiple regression analysis / analysis of variance (ANOVA) SPSS/ Spearman rho test of correlation	All respondents	Develop factors contributing water accessibly to meet a sustained vital need of water supply	Nominal and Interval scale Interval and Interval scale
4.	Examine the level of water-related water-risks to people in	Questionnaire survey	SPSS/ Regression analysis model analysis of variance (ANOVA)	All respondents	Identify per capita consumption of water, its effects on socio-economy of residents.	Interval scale
5.	Auchi and; Assess the efficiency of water sources in meeting the demand of people in Auchi.			All respondents	Improve the frame that enhance availability and efficiency to solve the problem of inadequacy	

3. Results and Discussion

3.1 *House Size Distribution*

Economic status of households tends to determine the family size for several reasons, including the need for larger family size through multiple marriages, children serving as security for parents during old age, kinship structure, and the extended family system. However, the enormous household has a greater demand for water for adequate hygiene. The study examined the respondents' household size to understand their water demand and behavioural disposition of the water used in their residents in Auchi. Table 2 and Fig. 2a present the result of the household size profile of the respondents. It revealed houses with between five and eight persons were the highest with 50.7%, followed by houses of less than five residents, with 34.8%, houses with between 8 persons and 12 persons with 12.8% and 13 residents above was 1.7%. The result indicates (76%) of the houses were less than five occupants, while the (almost 2%) were those with more than nine residents and above. Furthermore, household size determines the quantity of water consumed in the household. The result is in line with Momoh [12] observation that household size is a significant determinant in water demand. Considering the current low level of water provision in Auchi, it then means that less water is available per person in the household. It also indicates that households would gather water more frequently and from various sources with varying quantities. According to Akintola *et al.* [15], many inhabitants who have no access to municipal water supply have no choice but to use whatever sources of water available, no matter the quality.

Table 2: Household Size

	Frequency	**Percent %**
1- 4 Person's	244	34.8
5-8 Persons	356	50.7
9-12 Persons	90	12.8
13 Person's & Above	12	1.7
Total	**702**	**100.0**

Source: Author's Fieldwork, 2018

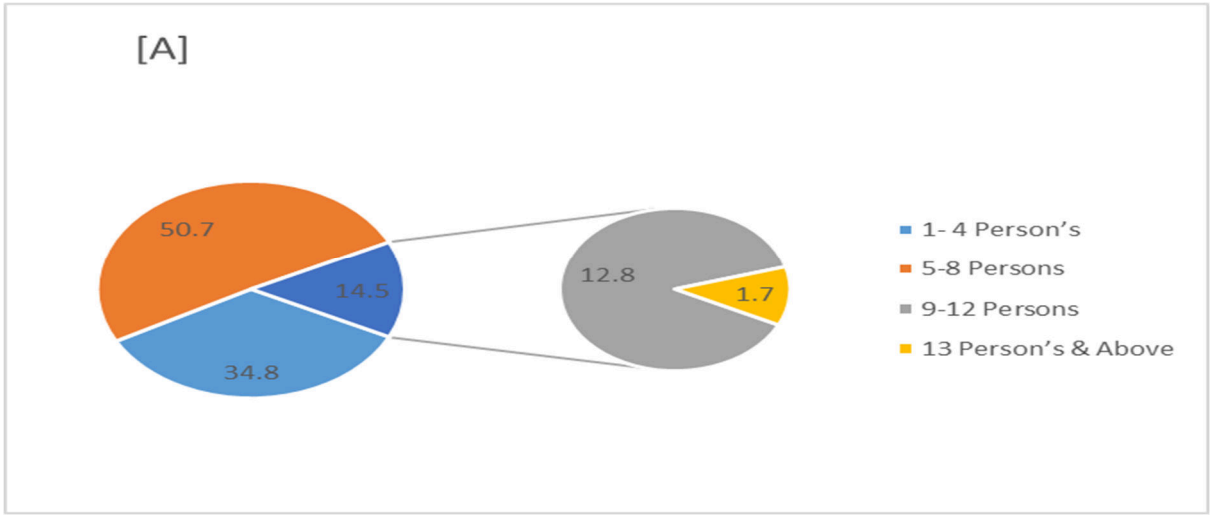

Figure 2a: Household size distribution in Auchi

3.2. *Patronage and Water Preference*

Available water sources and their geographical locations influence demand responsive to the source and allow the community to make informed choices about their sources' affordability. The result in Table 3 shows seven

different sources of water supply. Emphasis was given to multiple-source water supply systems to sustain efficient water use for domestic and productive demands. However, private water vendors serve a significant percentage (39.2%) urban resident. Also, there is no water access and patronage equity. Only 35.9% of households have access to clean boreholes water due to affordability. This water source supplied safe drinking water to households. It linked the source to income-generating activities such as economic development. Private water vendors perform better than public utility from an equity perspective. Most often, the urban poor cannot afford their private solutions to water scarcity. Therefore, their dependence on vendors should not translate into lower-income households being further exploited. The natural water sources in the area, such as rivers, are seasonal, and residents do not have adequate water access. This source during the dry season only 7.9% depends on stream/river water. Groundwater storage tanks are designed as effective alternative storage units for water sourced through other sources, such as rainfall harvesting, an extension of pipes from neighbors or family boreholes. It has recently become an essential option to obtain rainwater usage capacity to ameliorate Auchi's situation. The formal providers, especially the government utilities or private companies officially contracted by the government to distribute networked water, could not be accessed by residents in the area.

Also, the factors that influence household respondents to prefer various water sources of their choice ensure adequate water accessibility. The result in Table 3 shows that respondents (41.0%) choose alternative rather than preferred sources for water use because of the inability to access their preferred source. This result indicates that convenience, distance traveled, and time spent queuing to collect water from identified sources are very high. Also, the amount of effort expended in acquiring the needed quantity, the cost of buying/transporting water from source to the consumer, and water treatment necessary to meet potable water standards are components of household preference for water use. However, this investigation also reveals seasonal variations and their effects on Auchi's water sources' reliability and preference. These results emphasize that a household's perception of water quality and its proximity to an improved water source influenced its decisions to gather water. Results further indicate that open water sources were attractive to some households because they were completely free of any finance charges. In contrast, some other households collected water from such sources to meet other needs such as cleaning and washing, among other domestic uses.

3.2.1 *Underground Water Extraction*

Borehole water serves as the primary source of drinking water provided within walking distance of households in Auchi. Continuous increase in the number of boreholes results from the government's inability to take the lead in water quality issues, supply and expand pipe-borne water infrastructure and distribution networks. The influence of communal and non-governmental organizations in providing potable water/public supply has not been successful in Auchi. Groundwater was seen as a significant resource for household qualitative water uses. Hence, the high-income household believed that a self-supplied borehole is more hygienic because there is less exposure between discharge points to points of usage. Also, the service standard, such as quality, pressure, and reliability are essential. In most cases, some boreholes were commercialized at a high price of ₦ 1.00 per litre. This is in line with the WHO [15] observation that urban dwellers will prefer a regular water supply source, even if it may be costlier.

Furthermore, the study revealed that the recent development pattern and institutional arrangements for providing free borehole water services to people through; commercial banks operating in Auchi, NGOs such as Rotaract International, International Organizations, and Social clubs. Also, few individuals' most especially commercial buildings such as hotels, hospitals, service stations, and religious organizations, allow the people to collect water at provided public standpipes to assist the deprived dwellers. People in the category are a fast-growing proportion and exceed numbers around places like; Akpekpe, Iyekhe, and Igbe quarters in Auchi. The study also enumerated the number of boreholes and their functionality and identified the agency that sponsored water schemes. A total of 224 boreholes of different types were identified, mostly owned by different stakeholders in the study area. Despite all efforts, some of the boreholes were in a state of disrepair. This implies no follow-ups in repairs and maintenance by sponsored agencies after the boreholes were delivered to the beneficiary communities.

Table 3: Patronage and Reason for Water Preference of Water Source

	Frequency	Percent %
Pipe Borne Water	1	0.1
Hand dug wells	0	0.0
Boreholes	252	35.9
River/Stream	35	4.9
Harvested Rain Water	136	19.4
Water Vendors	275	39.2
Others Specify	3	0.4
Total	**702**	**100.0**
No Alternative/Means/Source	288	41.0
Always Available- regularity	237	33.8
Close To The House	57	8.1
Good For Drinking	81	11.5
Not Expensive	39	5.6
Total	**702**	**100.0**

Source: Author's Fieldwork, 2018

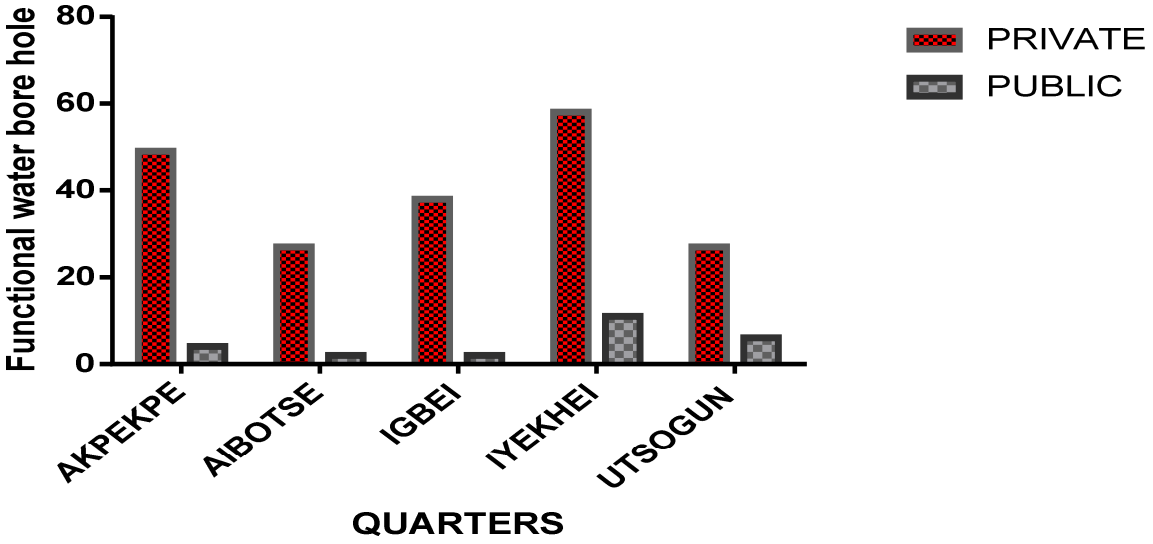

Figure 2b: Functional boreholes in Auchi

To measure the health and non-health impacts of improving water access, Sule, Umoru & Oyathelemi [8] & Oyati, Chukuwendu, Oyathelemi & Osiyoku [17] assessed the drinking water quality and health impacts of selected boreholes in Auchi. These studies observed that boreholes in the area are usually very deep, attaining minimum depths of 197m. This makes pumping very expensive, preventing the full development and use of all groundwater resources. Households connected to a borehole had consistently better drinking water quality than those relying on other sources. However, the groundwater sources are depleted too rapidly through excessive exploitation. Aquifers that may take thousands or millions of years to fill are depleting through over-pumping. This reduces available water resources and borehole yields, resulting in serious side effects, such as saline intrusion. It is essential to substantially slow down water withdrawal from the underground source to prevent earthquakes and reduce the high cost of pumping.

4. Conclusion

Water resource problems are mounting and can constrain human well-being, including those related to economic development. In Auchi today, the study shows that current practices in water resources management have led to severe challenges in meeting future human, economic, and environmental water requirements. To achieve water security, Auchi and its environs must have reliable and sustainable access to acceptable water quality and

quality. Therefore, a systematic and holistic investigation of domestic water security was carried out to provide a current database on the household's socio-economic characteristics. In the course of investigating and proffering solutions to the practical constraints to water provision in the area, the study anchored on the contemporary concepts on social services provision, some of which include; water security concept, governance in water management concept, Integrated Water Resource Management (IWRM), and Green Economy concepts. Research findings indicate the significant challenge of poor access to an improved water source, insufficient infrastructure to cope with additional demand for both water supply and household treatment, and safe storage in urban Auchi. This facilitates the entire population's access to a dependable and provision of water from multiple sources to improve household resilience to scarcity at a manageable cost.

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