



32

ASSESSMENT OF DOMESTIC WATER SUPPLY PATTERNS IN GOMBE METROPOLIS, NIGERIA

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ABSTRACT

Inadequate domestic water services pose significant challenges in developing nations due to population growth, urbanization, and improved living standards. Gombe Metropolis, experiencing rapid urban development and population expansion, serves as a pertinent in the study area. This paper examines the domestic water supply dynamics within Gombe Metropolis, Nigeria, with a focus on its associated challenges and patterns. Multi-stage sampling approach were utilized, the research identifies diverse water sources employed for household purposes in the region. Findings reveal that a mere 15.25% of households have access to piped bore water, while a substantial 39% depend on a combination of public and private boreholes, underscoring substantial private investments in water infrastructure. Socio-economic and demographic factors, including income, education, occupation, and family size, emerged as key determinants of household water access, exacerbating disparities in the study area's water supply. This suggests an inequitable distribution of water supply sources within the metropolis. The conclusion of the study is that there is a need for targeted interventions to ensure equal access to clean water across all areas of the city. The study recommended that the government prioritize investment in infrastructure to improve water distribution systems, particularly in underserved areas and raise awareness and educate residents about water conservation practices to reduce overall water consumption and further alleviate strain on the city's water resources.

Keywords: Assessment, Domestic water, Gombe, Metropolis, Supply Pattern

1.1 INTRODUCTION

Water, as an essential natural resource within the ecosystem, is vital for sustaining life and serves a multitude of purposes, including domestic, industrial, agricultural, and transportation needs (Turyasingura et al., 2023). Of these, domestic water supply, which encompasses the provision of water for drinking, food preparation, and hygiene, is paramount for human survival. Without access to an adequate supply of clean water, life cannot be sustained for more than a few days, and insufficient water resources often lead to the rapid spread of diseases (Prüss-Ustün et al., 2016). In the context of domestic use, water sources can vary greatly, ranging from streams, springs, hand-dug wells, boreholes with handpumps, rainwater collection systems, to piped water supplies with taps, house connections, and reliance on water vendors (Abdullahi et al., 2020). Households rely on water for a range of purposes, including drinking, cooking, personal and clothing hygiene,



cleaning, animal care, gardening, and even commercial activities. The availability and suitability of water sources can fluctuate with the seasons, further complicating access (Howard et al., 2020).

Inadequate access to clean water supplies not only threatens human health but also contributes to poverty through various economic burdens, including the costs of treating water-related illnesses, household expenditure on acquiring water, and the significant time and energy spent on water collection (Hutton, 2012). Recognizing the fundamental importance of sufficient water supply for human well-being and development, the United Nations General Assembly acknowledged the human right to water in 2010 (Brown et al., 2016).

Target 6.1 of the Sustainable Development Goals (SDGs) underscores the urgency of achieving universal and equitable access to safe and affordable drinking water by 2030. This target is measured by the "population using safely managed drinking water services," defined as access to an "improved water source that is located on-premises, available when needed, and free from fecal and priority chemical contamination" (WHO UNICEF, 2017).

While various studies have investigated domestic water supply patterns in both developed and developing countries, including Nigeria (Abdullahi et al., 2020; Wang et al., 2012; Thompson et al., 2002; Aberilla et al., 2020; Oyesanmi et al., 2017; Musa et al., 2013), it is noteworthy that limited research has been conducted within the context of Gombe Metropolis. This research gap underscores the significance of this study, which aims to comprehensively assess domestic water supply patterns in Gombe Metropolis, a rapidly growing state capital located in the northeastern region of Nigeria.

The specific objectives of this research are to assess the socio-economic and demographic factors influencing household access to clean water supply, investigate the various sources of water supply utilized for domestic services in Gombe Metropolis and examine the factors affecting domestic water supply in the study area.

1.2 Study area

The study area is Gombe Metropolis in Gombe State, located between latitudes 10°15'N and 10°19'N and longitudes 11°07'E and 11°15'E. It is bounded by Kwami LGA to the north, Akko LGA to the Southwest and Yamaltu Deba LGA to the east with the altitude of 500 meters above the mean sea level and occupies a total area of about 54 km² (Maina, et al., 2017). It covers an area of approximately 54 square kilometers and experiences a distinct Sudan savannah climate with dry and wet seasons. The study area is situated in Gombe State in the North Eastern part of Nigeria. The geology includes Cretaceous sandstones overlaid by tertiary and quaternary deposits. The study area is situated in Gombe State in the North Eastern part of Nigeria.

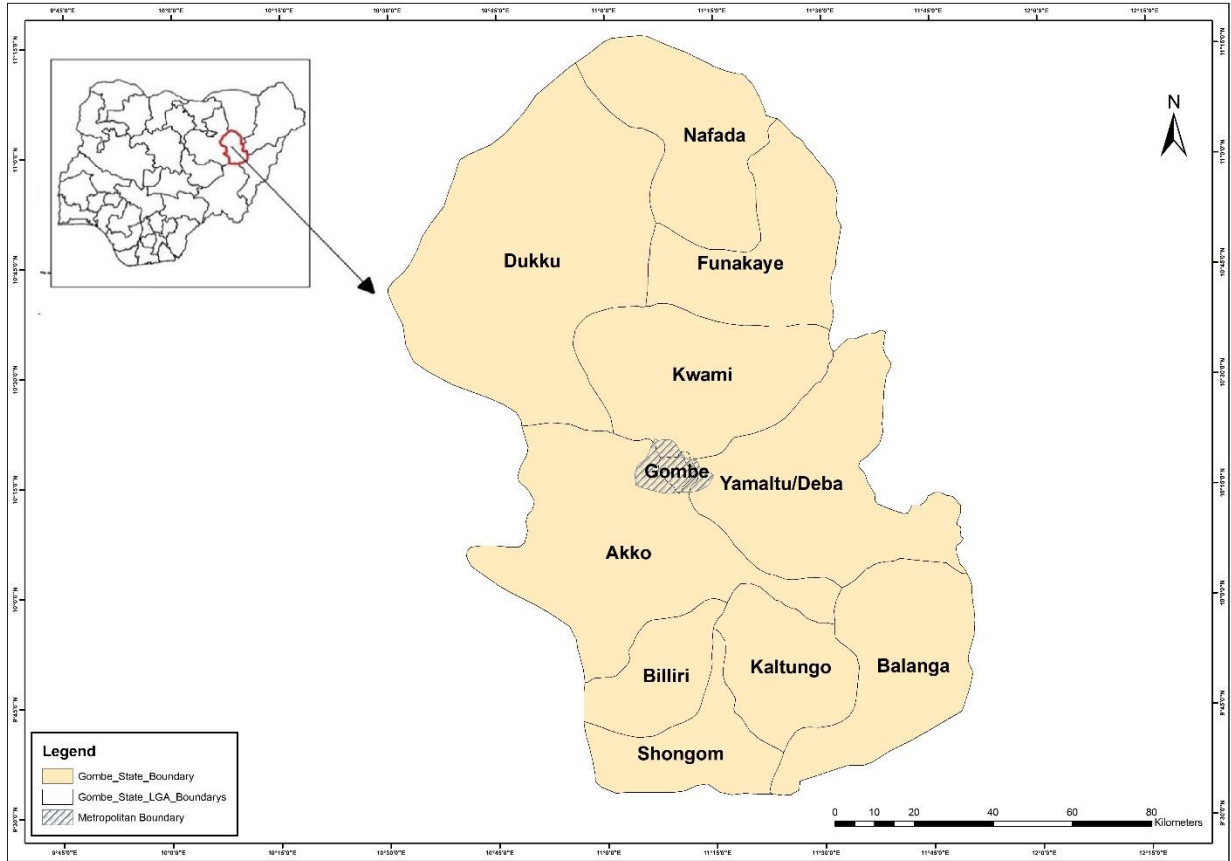
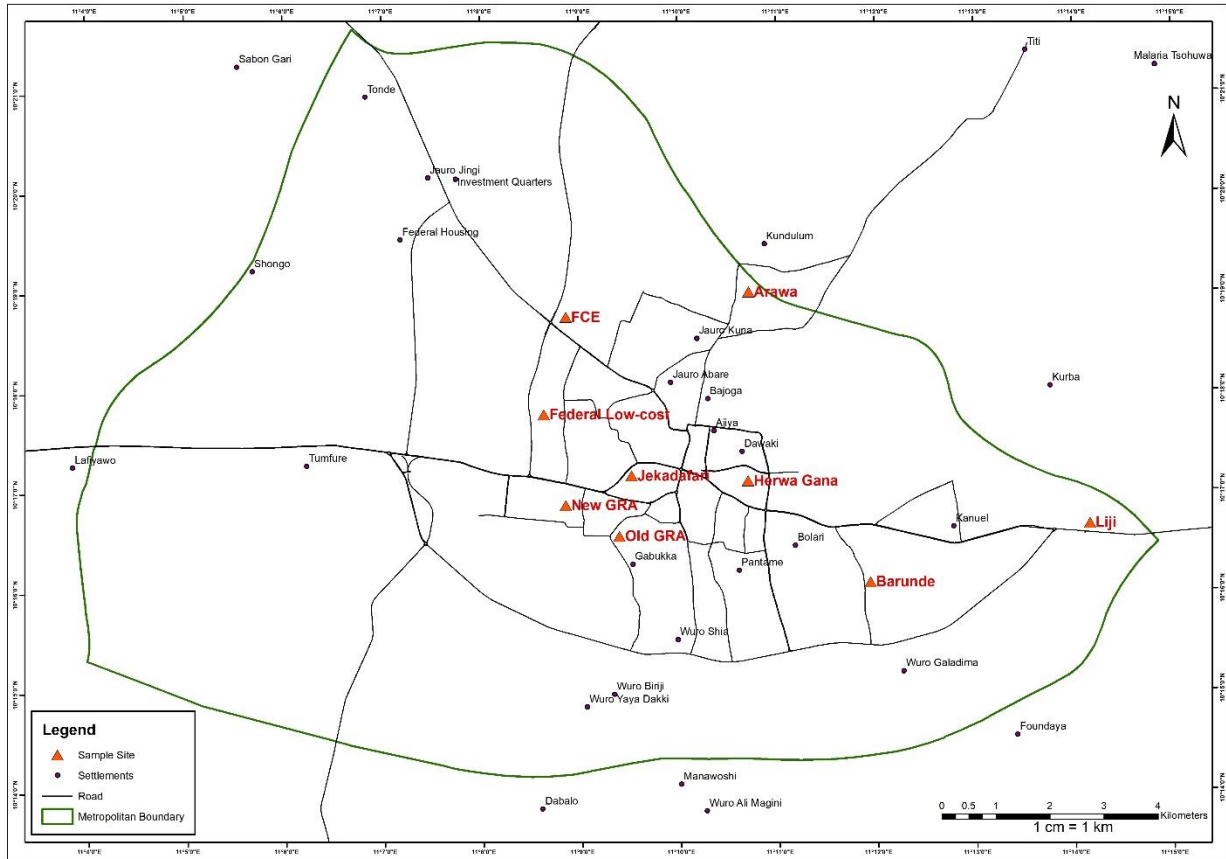


Figure 1: Gombe State showing Gombe Metropolis
Source: Gombe State Geographic Information System (GOGIS)



1.3 METHODOLOGY

The research focuses on assessing domestic water supply patterns in Gombe Metropolis, Nigeria. A multi-stage sampling approach was utilized. In the first stage, the metropolis was divided into different population zones such as low, medium and high density.

Systematic sampling was then employed at the second stage of the survey, where every tenth household within the selected communities was chosen for the household survey. This approach ensured that the sample was both representative and systematic. The study used the Gombe state's mean household size for urban populations, which is eight persons per household. The total sample population size was calculated by dividing the population of nine wards by this mean. The study used the Yamane formula for sample calculation- $N/(1 + N(e)^2)$. The population size is 29,624, and the margin of error is 0.052, resulting in a household sample size of 400. Hence, 400 sets of questionnaires were administered.

Responses from the systematically sampled households were collected and analyzed using mean, standard deviation, frequencies and percentages to understand various water sources, access and challenges within the metropolis.

1.4 RESULTS AND DISCUSSION

1.4.1 Socio-economic and demographic factors influencing household access to water supply

Household access to water supply is influenced by a variety of socio-economic and demographic factors. This is presented in Table 1. The presented data on socio-economic and demographic factors influencing household access to water supply in the study area provides valuable insights



into the characteristics and distribution of households based on income, education, occupation, and family size.

Table 1: Socio-economic and demographic factors influencing household access to water supply (n=400)

Characteristics	Number	Percentage
Income Level (₦)		
Less than 20,000	109	27.25
20,000 - 40,000	136	34.00
41,00 - 60,000	98	24.50
Above 60,000	57	14.25
Education Level		
Informal	91	22.75
Primary	113	28.25
Secondary	127	31.75
Tertiary	69	17.25
Occupation		
Civil Servants	87	21.75
Farming	47	11.75
Trading	81	20.25
Artisans	64	16.00
Unemployed	121	30.25
Family Size		
Less than 5	114	28.50
5-10	113	28.25
11-15	98	24.50
Above 15	75	18.75

Source: Fieldwork 2023

The data in Table 1 indicates that a significant number of households in the study area have incomes below 20,000 Naira (27.25%) and between 20,000 and 40,000 Naira (34%). This suggests that many households in the area may have difficulty accessing and affording reliable water supply services. It indicates a potential need for more affordable and accessible water supply options for low-income households. This finding is consistent with the research of Jha et al. (2013).

A significant proportion of households have primary education (28.25%) and secondary education (31.75%). The implication is that households with higher education levels have better awareness of water-related issues, hygiene practices, and the importance of clean water. Educational campaigns and programs can target these households to promote water conservation and proper water use.

The data indicates a significant number of unemployed individuals (30.25%). High unemployment rates can impact household income and, consequently, their ability to access reliable water supply services. Addressing unemployment and promoting income-generating activities in the study area could improve overall water access.

The data indicates a fairly even distribution of family sizes, with households having less than 5 members (28.5%), 5-10 members (28.25%), and 11-15 members (24.5%). Household size can impact water consumption. Having an understanding of the distribution of family sizes can assist water supply planners in estimating demand and designing systems that effectively cater to different household sizes. Lin, Broere, and Cui (2022) support the findings of this study.

1.4.2 Various sources of water supply utilized for domestic services in Gombe Metropolis

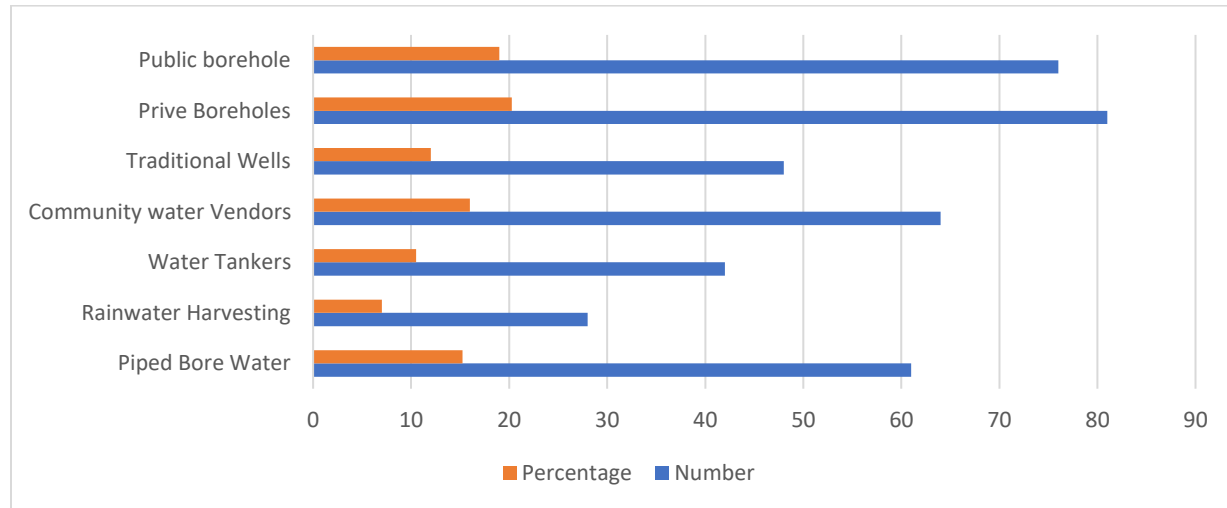


Figure 1: Sources of water supply I Gombe Metropolis

Source: Fieldwork, 2023

The data in figure 1, provides information on various sources of water supply utilized for domestic services in Gombe Metropolis provides valuable insights into the water supply patterns and preferences of households in the study area.

Piped bore water is one of the water supply sources utilized by households in the study area. This source indicates that some residents have access to a more reliable and centralized water supply system, likely in urban or developed areas of the metropolis. The relatively low percentage (15.25%) suggests that while some households have access to piped bore water, a significant portion of the population relies on other sources.

Rainwater harvesting is practiced by a portion of households in Gombe Metropolis. This source may be more prevalent in areas with sufficient rainfall and where infrastructure for harvesting rainwater is available. The relatively low percentage (7%) suggests that not all households are engaged in rainwater harvesting, and it may be influenced by factors such as climate conditions and infrastructure.

Water tankers play a role in supplying water to households, particularly during water shortages or in areas with unreliable access to other sources. The use of water tankers indicates challenges in the regular and consistent supply of water through conventional sources, possibly due to infrastructure limitations or seasonal variations.



Community water vendors provide a source of water supply for households. This may be a common practice in areas where piped water supply is limited, and communal sources are relied upon. The relatively high percentage (16%) suggests a significant reliance on community water vendors, possibly due to challenges in accessing other sources.

Traditional wells are still utilized by a portion of households in the study area. These wells are mostly hand-dug and represent a traditional water source. The percentage (12%) suggests that while traditional wells are used, they are not the primary source for a majority of households.

Private boreholes are a significant source of water supply in the study area. This indicates that a substantial number of households have invested in private water infrastructure for their domestic needs. The relatively high percentage (20.25%) suggests that many households have chosen to secure their water supply independently.

Public boreholes represent a common source of water supply accessible to the community. They are typically managed by local authorities or organizations. The percentage (19%) suggests that public boreholes play a crucial role in providing water supply to a significant portion of the population.

1.4.3 Factors affecting domestic water supply in the study area.

Table 3: Challenges of Water Supply in Gombe Metropolis

Challenges	SA	A	N	D	SD	(Σfx)	\bar{x}
Insufficient Infrastructure	99	86	61	83	71	1259	3.15
Unequal Distribution of Water Resources	88	115	98	47	52	1340	3.35
Seasonal Water Scarcity	69	83	62	82	104	1131	2.83
High Water Wastage	71	85	60	82	102	1141	2.85
Inadequate Government Investment	60	88	116	47	89	1183	2.96
Pollution of Water Sources	103	83	62	82	70	1267	3.17
Lack of Awareness on Water Conservation	140	75	66	55	64	1372	3.43
Inadequate Access to Clean Water Sources	135	62	62	72	72	1325	3.31

Source: Fieldwork, 2023. Note: SA= strongly agree, A=agree, SD=strongly disagree, D=disagree, II= impact index, R= ranking

confirms In Table 3, the average rating of 3.15 suggests that respondents generally have a slightly negative opinion about the impact of insufficient infrastructure on water supply. They somewhat agree that this is a challenge. Additionally, the average rating of 3.35 indicates that respondents tend to agree that unequal distribution of water resources is a significant challenge in the city. With an average rating of 2.83, respondents are leaning towards disagreement regarding seasonal water scarcity, suggesting that some do not view this issue as a major challenge. Similarly, the average rating of 2.85 suggests that respondents are leaning towards disagreement about high water wastage. The average rating of 2.96 indicates that respondents somewhat agree that inadequate government investment is a challenge in water supply. On the other hand, respondents, on average, tend to agree that pollution of water sources is a significant challenge, as indicated by the average rating of 3.17. The highest average rating among the challenges (3.43) suggests that respondents strongly agree that there is a lack of awareness on water conservation, indicating a need for



education and awareness programs. Furthermore, respondents, on average, tend to agree that inadequate access to clean water sources is a significant challenge, as indicated by the average rating of 3.31. Kafi et al. (2017) supports this conclusion.

1.5. CONCLUSION

The data analysis of socio-economic and demographic factors affecting household access to water supply in Gombe Metropolis reveals that 61.25% of households have incomes below 40,000 Naira, indicating financial constraints. Education levels are balanced, with many having primary or secondary education. However, a high percentage of unemployed individuals, reaching 30.25%, can negatively impact household income and water supply services. The distribution of family sizes is balanced, aiding water supply planners in estimating demand effectively. Piped bore water is accessible to some residents, but not the primary source for most. Rainwater harvesting is practiced but not universally adopted, and water tankers are used. Community water vendors play a significant role in supplying water, while traditional wells are used but not as primary sources due to concerns about water quality. Insufficient infrastructure, unequal distribution of water resources, seasonal water scarcity, high water waste, inadequate government investment, and pollution of water sources are significant challenges.

1.6. RECOMMENDATIONS

Based on the findings of the study, the following suggestions are made for both private and public sector:

- i. Targeted interventions for low-income households are needed to improve affordability.
- ii. Educational campaigns should promote water-related awareness and hygiene practices.
- iii. Addressing unemployment can enhance household income and water access.
- iv. Equitable distribution of water resources is crucial for universal access.
- v. Infrastructure improvements and investments are essential for reliability.
- vi. Collaboration between the public and private sectors can expand access to clean water sources.



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