Spatial Distribution Pattern of Public Water Access in Makurdi, Nigeria

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Abstract

Water is explicitly linked with economic progress and developmental trajectories of most countries and regions of the world. However, despite its significant contribution to quality of life, public health and socio-economic development, water scarcity has continuously remained one of the most excruciating problems around the globe. In view of the disproportionate nature of water scarcity, both in space and time, this study examined the spatial distribution pattern of public water access in neighbourhoods of Makurdi, Benue State, Nigeria. By utilizing cluster sampling technique, data on household water sources, water stress features (duration of supply, time and distance) and challenges were obtained through questionnaire administered on 378 households in 13 neighbourhoods in the study area. The data were analyzed using descriptive (frequency and percentage) and inferential statistics (independent T-Test). Findings from the study revealed that households in the study area are characterized by low level of access to public water supply (0.35) and rely on other informal non-network water sources to augment improved water source. The empirical findings also indicated that access to public water supply vary among the neighbourhoods in the study area (t=30.83; df=12; and Sig=<.001). The primary challenge to equitable distribution and access to public water in Makurdi are political factor (3.34) and economic factor (3.18). As a recommendation, the government should invest more in the provision of public water supply infrastructure in Makurdi to help increase daily duration of water access in the study area within reasonable time and distance.

Keywords: Access; Public Water Supply; Neighbourhoods, Spatial Distribution

1.0 INTRODUCTION

Water is a basic requirement of all living beings. It is fundamental for sustaining lives as well as economies. Hence, providing water to all communities and populations is one of the global goals of sustainable development (United Nations 2015). Access to safe water supply is important for human health and well-being (WHO, 2008). But the provision of clean drinking water remains a key incomplete development objective (World Water Assessment Programme (WWAP), 2015). Like all other resources, the distribution of water is not equitable amongst the various sections of the population (Calow and Mason 2014). Inequality in access to water is one of the major reasons behind the water crisis around the world (UNDP, 2006). In 2015, only 58% of the global population had access to piped water on their premises (WHO/UNICEF, 2015).

Access to water, sanitation, and hygiene (WASH) has increased significantly in recent years, as recent official estimates show (Joint Monitoring Programme (JMP), 2017). However, progress has been uneven, and available data highlight inequalities among and within countries. Inequalities exist not only between rural and urban areas, poor and rich, but also between vulnerable groups and the general population. Addressing and eliminating these inequalities have become central concerns in the Sustainable Development Goals (SDGs) era, with a dedicated goal on "reducing inequality within and amongst countries" (SDG 10), as well as across most SDGs, including for example "ensuring availability and sustainable management of water and sanitation for all" (SDG 6).

Regarding access to water, many advances were reported by UN in the MDGs, and 147 out of 215 countries achieved the goal (UNICEF and WHO, 2015). However, the monitoring carried out using the average national coverage conceals inequalities in access to water due to social or economic discrimination. This is shown by several works, which identified the following: a) inequality between rich and poor (UNICEF and WHO, 2019); b) increase in coverage accompanied by an increase in inequality between rural and urban areas (WHO and UNICEF, 2014); c) different coverage rates

between national averages and informal settlements or other special communities (Dos Santos *et al.,* 2017; Adams, 2017, 2018) gender and class inequality (Truelove, 2011).

In recent years, much attention has been directed towards assessing the level of water access in many countries and regions of the world with respect to Agenda 2030 of the SDGs (WHO/UNICEF, 2015; United Nations 2017; WHO/UNICEF, 2017). These studies reported consistent progress in access to water across the globe, while neglecting the internal disparities (distribution) in water access. The academic literature also shows relevant efforts to propose and validate instruments and mechanisms for assessing distribution in water access (Wang *et al.,* 2018; Luh *et al.,* 2013; Bain *et al.,* 2014; Pullan *et al.,* 2014; Yu *et al.,* 2014; Flores-Baquero *et al.,* 2017; GinéGarriga and Pérez-Foguet, 2019; Ezbakhe and Pérez-Foguet, 2018), but they have not been implemented at lower scale (household, ward, district, LGA or State) and have only been tested in specific case studies.

Extant review of literature also shows that access to water has been viewed from a unidimensional aspect. That is, access to water has been relegated only to connectivity to water supply mains in most studies (Malakar et al., 2017; Luh *et al.,* 2013; Bain *et al.,* 2014; Pullan *et al.,* 2014;). Going by the SDGs concept of access to water, access to water supply in the real sense of the matter goes beyond household connectivity to public water supply main. For access to water to be established, it must be available (connectivity), within reasonable distance and time and should be affordable. Therefore, for effective policy formulation and planning for improved water distribution and access, water access must be measured using multi-dimensional indicators. However, studies on water access that proceed in a multi-dimensional way are limited in Nigeria and particularly in Makurdi.

Even in the face of global progress in water access, the story remains bleak in Nigeria. More than half of the population is affected by lack of access to safe drinking water and poor sanitation (Galadima, *et al.,* 2011). According to the WorldBank, (2010), water production facilities in Nigeria are "rarely operated to full capacity due to broken down equipment, or lack of power to fuel the pumping". Equipment and pipes are poorly maintained, leading to intermittent supply of pipe borne water in Nigeria. In Makurdi for example, studies by Chia and Ndulue, (2018); Ibaishwa and Abaagu, (2018); Aho *et al.* (2016); and Akali *et al. (*2014) was focused on problems of domestic water supply, gender issues in access to water, sanitation and hygiene, and determinant of residential per capita water demand.

Although the findings of these studies (Chia and Ndulue, 2018; Ibaishwa and Abaagu, 2018; Aho *et al.* 2016; and Akali *et al.* 2014) provides ample information on water access and demand in Makurdi, the result does not reflect the true situation of water access in Makurdi. This is because of the over simplicity of the concept of water access to connectivity to public water supply alone, while neglecting issues on quality, regularity, and affordability. The studies also failed to present a true picture of the distribution pattern of water access due to the aggregation of the result. It is imperative to provide the spatial variation (distribution pattern) in water access in Makurdi town; this will go a long way to improve policy formulation in the right direction. Therefore, this study examined the distribution and access to pipe-borne water in Makurdi town across different neighbourhood densities and socioeconomic class through the multidimensional approach. Hence, the following objectives were evolved from the research questions in other to achieve the aim of the study:

i. Assess the socioeconomic attributes of the households in Makurdi

ii. Determine the level of household water access in Makurdi

iii. Assess the factors impeding access to water in Makurdi

In lieu of this, the study also hypothesized that:

Ho= There is no statistically significant variation in the pattern of public water access in neighbourhoods of Makurdi

Ha= There is statistically significant variation in the pattern of public water access in neighbourhoods of Makurdi

2.0 STUDY AREA AND METHODOLOGY

2.1 Study Area

Makurdi is the capital city of Benue state in northcentral Nigeria. Makurdi lies between Latitude 7° 44N and Longitude 8° 54N. It is located within the flood plain of lower River Benue valley. The physiographic characteristics span between 73-167 m above sea level. Due to the general low relief, sizeable portions of Makurdi are water logged and flooded during heavy rainstorms (Ameto, 2012). This is reflected in the general rise in the level of ground water in wells during wet season. The drainage system is dominated by River Benue which traverses the town into Makurdi North and South banks.

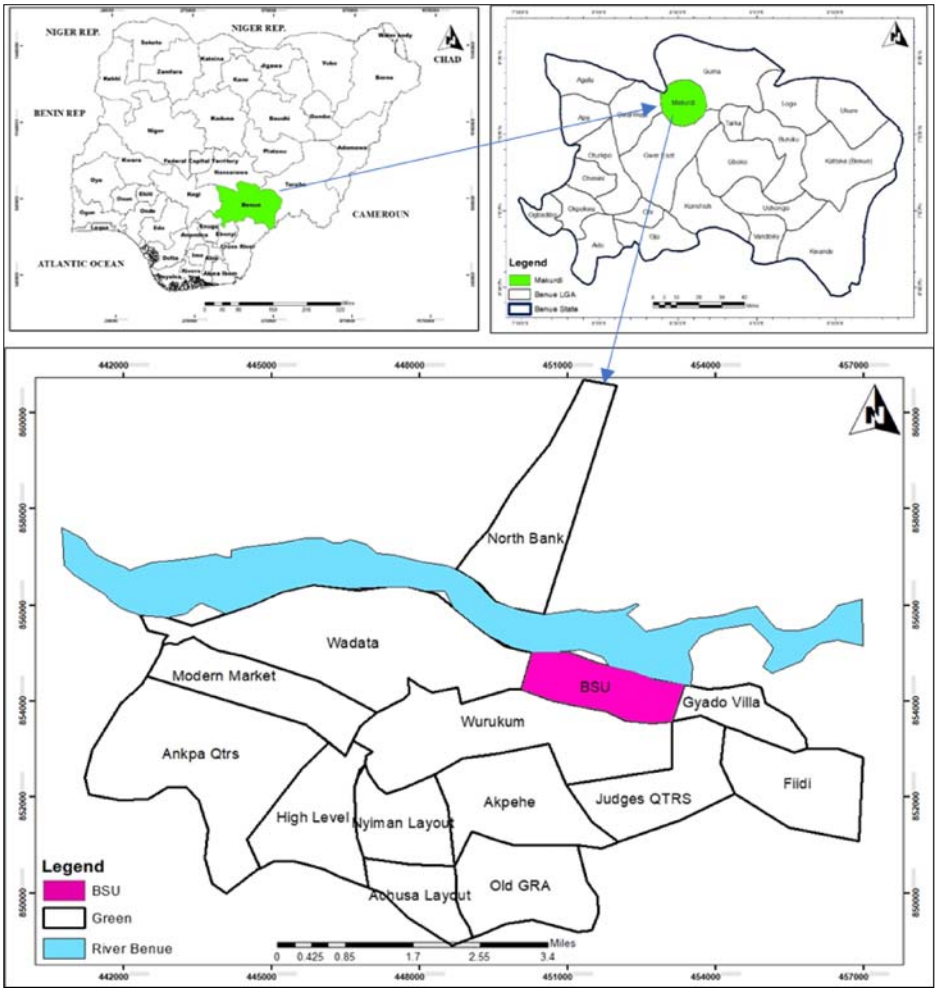

Figure 1: Neighbourhoods Map of Makurdi, Benue State

2.2 Methodology

The study adopts the survey and descriptive research design approach. The data were sourced from primary sources using survey and questionnaire. The data was gathered using a cross sectional approach; that is the data were collected within the same period of time. A total of 378 questionnaires was administered on households across thirteen (13) neighborhoods in Makurdi metropolis. The data collected was subjected to descriptive and inferential analytical techniques and the result were presented in Tables, Charts and maps.

3.0 RESULTS AND DISCUSSION

3.1 Socioeconomic Attributes of Respondents

The study revealed that majority of the respondents were between the age bracket of 36-45 years (31%), respondents between the age bracket of 26-35 years accounted for 30%, while respondents within the age bracket of 46-55 years accounted for 21%. Majority of the respondents were married (64%), while female respondents accounted for 63% and male 37% (Table 1). The population is relative literate as majority of the respondents had attained ND/NCE (31%) and HND/B.Sc. (27%). Table 1 also shows that 34% of the respondents had a household size of 34%, while 27% had a household size of 3-4 and 16% for 7-8 household size.

Table 1: Socioeconomic Attribute of Respondents

Item	Frequency	Percentage
Gender		
Male	240	63%
Female	138	37%
Total	**378**	**100%**
Marital Status		
Single	72	19%
Widow(er)	35	9%
Separated	26	7%
Married	245	65%
Total	**378**	**100%**
Education Attainment		
No formal education	37	10%
Primary	14	3%
Secondary	72	19%
ND/NCE	117	31%
HND/B.Sc.	101	27%
Postgraduate	37	10%
Total	**378**	**100%**
Household Size		
1	24	6%
2	39	10%
3-4	101	26%
5-6	127	34%
Above 6	87	24%
Total	**378**	**100%**
Occupation		
Unemployed	110	29%
Retiree	40	11%
Trader	103	27%
Artisan	11	3%
Civil servant	50	13%
Farmer	27	7%
Others	37	10%
Total	**378**	**100%**

3.2 Household Water Access to Public Water Supply

The level of household access to public water supply was examined using four key indicators; availability of public water infrastructure, duration of water supply, time spent collecting water, and distance travelled to collect water. The cumulative effect of the fur indicators was used to determine level o water access in the neighborhoods. Table 2 shows the distribution of household access to public water supply in the thirteen neighbourhoods in Makurdi. The result shows that availability of public water infrastructures in the neighbourhoods varies from one neighbourhood to the other. For example, 70% of the households in Nyiman layout had access to public water infrastructure, while 60% of the households in neighbourhoods in Old GRA and Wurukum had access to public water infrastructure.

However, in other neighbourhoods, less than 50% of the households had access to public water infrastructure

Table 2: Household Access to Public Water Supply

	YES	
Neighbourhood	**Frequency**	**Percent**
Gyado Villa	4	14%
High Level	6	20%
Ankpa Quarters	5	26%
Achusa	8	27%
Akpehe	13	45%
North Bank	9	30%
Old GRA	18	60%
Wurukum	18	60%
Wadata	14	47%
Morden Market	8	26%
Fiidi	12	40%
Judges Quarters	7	23%
Nyiman Layout	21	70%
Total	**143**	**37%**

Duration of water access is categorized into four, 1-2 hours, 3-4 hours, 5-8 hours, 9-12 hours, and 13-16 hours. Table 3 shows that majority of the households (49%) enjoy 1-2 hours of water access, 26% enjoy 3-4 hours of water access, while 18% enjoy 5-8 hours of daily water access. The implication is that 97% of the household only expect water supply for less than 8 hours per day, while about 50% of the households rely on 1-2 hours of water access from public water source. The study also revealed that 3% of the households enjoy 9-12 hours of water access, while 4% of the households enjoy 13-16 hours of daily water access (Table 3). The foregoing analysis revealed the poor level of public water access in Makurdi, where more than three quarter of the households had less than four hours of access to public water.

Table 3: Duration of Access to Public Water Supply

Neighbourhood	**1-2**	**3-4**	**5-8**	**9-12**	**13-16**
Gyado Villa	11	1	0	0	0
High Level	1	1	1	0	0
Ankpa Quarters	0	0	8	0	0
Achusa	1	2	0	0	1
Akpehe	3	3	5	2	2
North Bank	11	2	0	0	0
Old Gra	12	2	0	1	0
Wurukum	2	6	1	1	1
Wadata	10	4	0	0	0
Morden Market	13	1	0	0	0
Fiidi	1	3	1	0	0
Judges Quarters	0	5	7	0	0
Nyiman Layout	3	6	1	0	2
Total	**70 (49%)**	**37 (26%)**	**26 (18%)**	**4 (3%)**	**6 (4%)**

The study also assessed the time spent by household members when collecting water. The time spent for water collection (to and fro) is presented in Table 4. The result shows that 43% of the respondents spend 30 minutes or less collecting water, 22% spend 46-60 minutes collecting water, while 20% of the respondents spend 31-45 minutes collecting water. In addition, 16% of the respondents reported that they send above 60 minutes collecting water. The foregoing analysis reveals that about 53% spend more than 30 minutes to collects water which is the minimum standard according to the WHO (2006).

Table 4: Minimum Time Spent for Water Collection

Neighbourhood	< 30 Minutes	30-45 Minutes	46-60 Minutes	Above 60 Minutes
Gyado Villa	18	4	4	3
High Level	14	9	4	3
Ankpa Quarters	10	6	2	1
Achusa	15	4	7	4
Akpehe	19	2	6	2
North Bank	10	8	6	6
Old GRA	13	5	8	4
Wurukum	12	3	4	11
Wadata	7	4	6	13
Morden Market	8	6	12	5
Fiidi	9	7	13	1
Judges Quarters	14	8	3	5
Nyiman Layout	12	9	7	2
Total	**161 (43%)**	**75 (20%)**	**82 (22%)**	**60 (16%)**

The minimum distance travelled in search of water by the respondents is presented in Table 5. The result shows that 58% of the respondents travel for less than 400 metres in search of water, while on the other hand, 28% of the respondents travel for 401-800 metres in search of water. Table 4.19 also reveals that 11% of the respondents travel for 801-1200 metres daily in search of water, while 3% of the respondents travel for over 1200 metres in search of water on daily basis. This shows that a significant proportion of the households have access to water within reasonable travel limit of 400 metres as prescribed by the WHO (2006). Although, about 42% of the households travel for more than 400 metres daily in search of water. The spatial distribution pattern of the indicators across the neighbourhoods is depicted in Figure 2-5.

Table 5: Minimum Distance Travelled to Water Source

Neighbourhood	< 400M	401-800M	801-1200M	> 1200M
Gyado Villa	21	1	5	2
High Level	18	9	3	0
Ankpa Quarters	16	2	0	1
Achusa	14	8	7	1
Akpehe	19	5	5	0
North Bank	13	13	4	0
Old GRA	24	6	0	0
Wurukum	18	9	2	1
Wadata	10	15	4	1
Morden Market	11	14	5	1
Fiidi	13	10	3	4
Judges Quarters	19	8	3	0
Nyiman Layout	22	7	0	1
Total	**218 (58%)**	**107 (28%)**	**41 (11%)**	**12 (3%)**

3.2.1 Household Water Access Index and Neighbourhood Distribution Pattern

The spatial distribution pattern of access to public water supply in Makurdi is presented in Table 6. The result shows that only four neighbourhoods had a fair level of access to public water supply in Makurdi, while others had low access to public water supply. The neighbourhoods with fair level of access are Akpehe (0.48), Nyiman Layout (0.48), Old GRA (0.47), and Ankpa Qtrs (0.41). Table 6 also shows the performance of the neighbourhoods by indicators. The neighbourhoods performed fairly well in respect to time spent collecting water (0.43) and distance travelled to water source (0.53). However, the low

level of access experienced in the neighbourhoods is occasioned by the very low duration of water access (0.03), and availability of public water infrastructure (0.38).

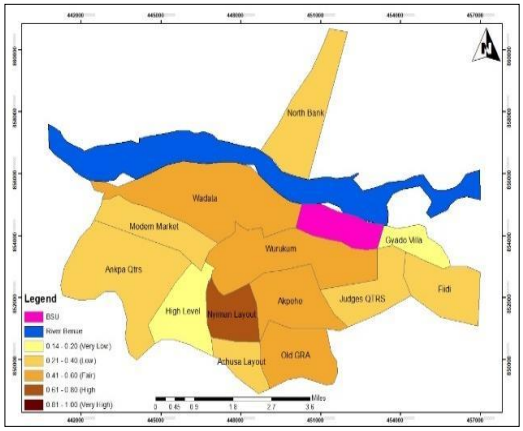

Figure 2: Public Water Infrastructure Availability

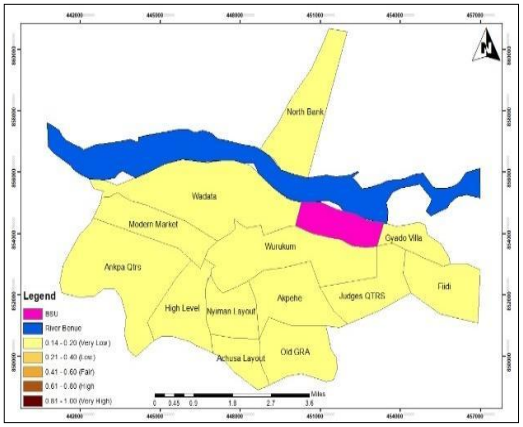

Figure 3: Duration of Daily Public Water Access

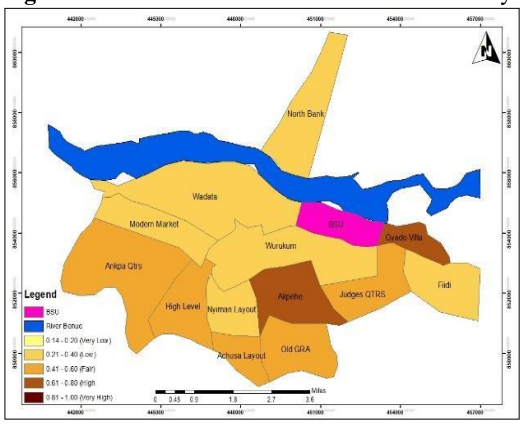

Figure 4: Time Taken to get Public Water

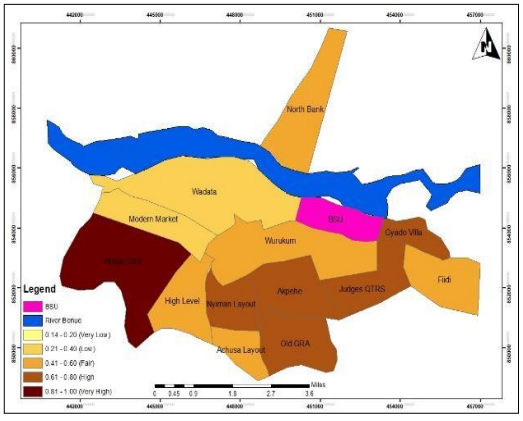

Figure 5: Distance Travelled to get Public Water

Table 6: Household Water Access Index for Neighbourhoods in Makurdi

Neighbourhood	Avail	Duration	Time Spent	Distance Travelled	AGG	Remark
Achusa Layout	0.27	0.03	0.5	0.47	0.32	Low
Akpehe	0.45	0.14	0.66	0.66	0.48	Fair
Ankpa Qtrs	0.26	0	0.53	0.84	0.41	Fair
Fiidi	0.4	0	0.3	0.43	0.28	Low
Gyado Villa	0.14	0	0.62	0.72	0.37	Low
High Level	0.2	0	0.47	0.6	0.32	Low
Judges QTRS	0.23	0	0.47	0.63	0.33	Low
Modern Market	0.26	0	0.26	0.35	0.22	Low
North Bank	0.3	0	0.33	0.43	0.27	Low
Nyiman Layout	0.7	0.07	0.4	0.73	0.48	Fair
Old GRA	0.6	0.03	0.43	0.8	0.47	Fair
Wadata	**0.37**	0	0.23	0.33	0.23	Low
Wurukum	0.47	0.07	0.4	0.6	0.39	Low
Total	**0.38**	**0.03**	**0.43**	**0.58**	**0.35**	**Low**
	Low	**Very Low**	**Fair**	**Fair**		

Note: 0.00-0.20= Very low; 0.21-0.40=Low; 0.41-0.60=Fair; 0.61-0.80= High; 0.81-1.00=Very High

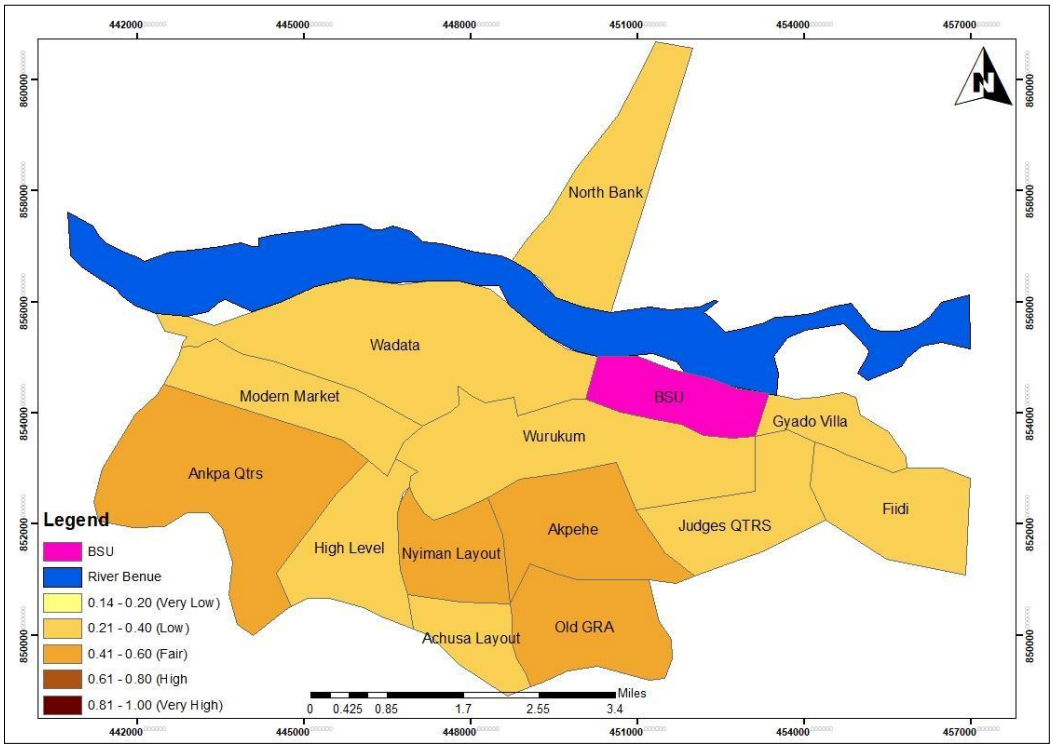

Figure 6: Spatial Distribution Pattern of Public Water Access in Makurdi

Test of hypothesis

One sample T-test was employed as analytical tool to test the study hypothesis. The study hypothesized that there is no significant difference in the level of water access across neighbourhoods in Makurdi. Table 4.27 shows the result of the One Sample T-test. The result recorded a t-value of 30.83, degree of freedom of 12, and a p-value of <.001. Since the p-value is less than 0.05 at 95% confidence level, there is significant difference in the level of water access across the neighbourhoods in Makurdi. Hence, the null hypothesis was rejected while the alternative hypothesis was accepted.

Table 7: One Sample T-test of Water Access in Makurdi

				95% Confidence Interval of the Difference	
	t	df	p-value (2-tailed)	Mean Difference	Lower limit	Upper limit
WAI	30.83	12	<.001	0.57	0.53	0.61

WAI= Water Access Index

3.3 Challenges to Public Water Access in Makurdi

The study also assessed the factors militating against effective access to public water supply in Makurdi. The factors were categorised into four-dimension, physical factors, economic, social, and political factors. The result of the analysis is presented in Table 8. Political factor was identified as the primary factor affecting access to public water in Makurdi with a weighted mean score of 3.34. Economic factor ranked second with a weighted mean score of 3.18, this factor covers cost of water infrastructure installation and cost of water, and income of household among others. Social and Physical factor ranked third and fourth with a mean score of 3.05 and 3.02 respectively.

Table 8: Factors Affecting Access to Public Water Supply in Makurdi

Challenges	Weighted Sum	Weighted Mean	Rank
Physical	1143	3.02	4th
Economic factor	1203	3.18	2nd
Social Factor	1153	3.05	3rd
Political Factor	1264	3.34	1st

4.0 Conclusion and Recommendations

This research has employed the multidimensional approach to estimate access to public water supply in Makurdi, Benue State, Nigeria. This is with the view to provide empirical evidence on water access situation of the neighbourhoods in Makurdi and to provide guidelines towards addressing the issue of water access. In view of this, the study was able to provide a vivid experience of the neighbourhoods in respect to public water supply as well as identify areas that require urgent attention in order to achieve water access for all.

Going by the findings of the study, spatial difference can be observed in access to public water supply of households across the various neighbourhoods in Makurdi. The study revealed that access to public water is significantly low in all the neighbourhoods, except in Ankpa Qtrs, Akpehe, Old GRA, and Nyiman layout where access to public water supply is fair. The study also reported that there is significant variation in the spatial pattern of water access. A further significant highlight of this study is the attention paid to each dimension of water access ranging from availability, duration, distance, and time spent to access public water supply. Each dimension of water assess was investigated thoroughly in order to understand the dynamics of water access level in the study area.

Empirical investigation on access to public water supply in Makurdi is a requisite tool for that can be used by authorities in charge of public water provision. This will avail them with the requisite information required for the development of a holistic policy, laws and guideline that will ensure the achievement of water access for all. Aside the issue of access reported extensively in this study, the study also highlights the differentials in the level of public water coverage in the study area. Only 37% of the households sampled had access to public water. This limited water coverage in the study is at variance to the Sustainable Development Goal (SDG) 6.1 which requires extending improved public water coverage by 100%. The implication of this is that un-served households residing in these neighbourhoods lack equitable access and quality water supply, thereby shifting the burden of providing safe drinking and domestic water to the households.

References

Adams, E. A. (2018). Intra-urban inequalities in water access among households in Malawi's informal settlements: Toward pro-poor urban water policies in Africa. *Environmental Development*, *26*, 34-42.

Aho, M. I., Akpen, G. D., & Ivuwe, P. (2016). Determinants of residential per capita water demand of makurdi metropolis. *Nigerian Journal of Technology*, *35*(2), 424-431.

Bain, R., Wright, J., Yang, H., Gundry, S., Pedley, S., & Bartram, J. (2014). 16. Improved but not necessarily safe: Water access and the Millennium Development Goals. *Global Water: Issues and Insights*, *89*.

Calow, R., & Mason, N. (2014). The real water crisis: inequality in a fast-changing world. *Overseas Development Institute Framing Paper, London*.

Chia, V. D., & Ndulue, E. L. (2018). The contending issues of domestic water supply in Makurdi metropolis, Benue State, Nigeria. Civil & Environ. Res., 6(9), 89–96.

Dos Santos, S., Adams, E. A., Neville, G., Wada, Y., De Sherbinin, A., Bernhardt, E. M., & Adamo, S. B. (2017). Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment*, *607*, 497-508.

Ezbakhe, F., & Perez-Foguet, A. (2018). Multi-criteria decision analysis under uncertainty: two approaches to incorporating data uncertainty into water, sanitation and hygiene planning. *Water resources management*, *32*(15), 5169-5182.Flores-Baquero *et al.,* 2017;

Galadima, A., Garba, Z. N., Leke, L., Almustapha, M. N., & Adam, I. K. (2011). Domestic water pollution among local communities in Nigeria-causes and consequences. *European journal of scientific research*, *52*(4), 592-603.

Giné-Garriga, R., & Pérez-Foguet, A. (2019, May). Monitoring and targeting the sanitation poor: A multidimensional approach. In *Natural Resources Forum* (Vol. 43, No. 2, pp. 82-94). Oxford, UK: Blackwell Publishing Ltd.

Ibaishwa, R. L., & Abaagu, A. M. (2018, July). Gender Access to Rural Water Supply, Sanitation and Hygiene in Rural Communities in Benue State, Nigeria. In *PAUWES Research-2-Practice Forum*.