

Investigating the Multidimensional Drivers of Public Water Supply Inequality in Makurdi town, Nigeria

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Abstract- Literature suggests that inequality in public water supply undermine health, livelihoods and socio-economic development in towns and cities. The study set out to investigate the factors responsible for public water supply inequality in Makurdi town, Benue State Nigeria. Purposive sampling technique was used to select a sample of 399 public water supply workers from four (4) water agencies in the study area. The structured questionnaire and interview were employed to collect data for the study. Data collected was analyzed using Principal Component Analysis. The result yielded eight-dimensional public water supply inequality triggering factors in Makurdi town. The factor accounted for 80.718% of the total variance. The factors include; governance and management deficiencies, socio-economic disparities, policy and resource constraints, operational and policy implementation challenges, urbanization and consumption patterns, workforce and infrastructure maintenance issues, funding and infrastructure barriers, and environmental and topographic factors. The study concluded that these factors are a threat to health, and socio-economic well-being of urban residents. The study recommended a holistic approach involving network expansion rehabilitation and maintainers, effective governance framework, investing in vulnerable communities among others to reduce inequality for sustainable and inclusive public water supply.

Keywords: Public Water Supply, Water Supply Inequality, Drivers, Governance, Makurdi, Nigeria.

I. INTRODUCTION

Access to clean public water supply is fundamental to the socio-economic development of cities, yet public water supply worldwide often exhibit significant inequalities. According to Akoteyon (2019), this disparity arises from a complex interplay of multiple drivers, which can be broadly categorized into economic, social, geographical, political and environmental dimensions.

Historically, public water supply has evolved as essential public services aimed at safeguarding public health, and supporting social and economic development. However, as urbanization and

population growth increases, particularly in developing countries many public water supply systems struggle to keep pace. Consequently, many households, particularly in marginalized neighborhoods face challenges accessing clean public water supply leading to public water supply inequality with severe implications for health, social and economic well-being.

Despite global efforts to address public water supply inequality in cities, inequality in public water supply continue to increase leading to adverse health outcomes, social unrest, and economic challenges. According to Ukpai (2022) the challenges of public water supply in cities is largely due to the absent of information that identifies these drivers responsible for public water supply in a place for deliberate policy plan and action that will address the challenges. Research by Akoteyon (2019), Obisesan and Ozabor (2016), have argued that, the drivers responsible for public water supply inequality in urban areas are not the same in space and they differ from one locality to another and cannot be generalize to represent drivers responsible for public water supply inequality in all urban scenarios and locations. To address these challenges research must be context and spatial specific in terms of geographic location to address the challenges facing urban public water supply inequality in cities.

Despite the existence of numerous studies on drivers responsible for public water supply inequality, there remains a geographic gap in identifying the drivers responsible for public water supply inequality in Makurdi town. This study investigates the drivers responsible for public water supply inequality in Makurdi town.

II. LITERATURE REVIEW

There is a consensus among scholars that no single factor can fully account for inequality in the distribution of public water supply in urban areas.

Several factors combine to impact the inequality in public water supply. The factors include, population growth, socio-economic conditions, poor funding, corruption, political and infrastructural development, water supply policies, historical and power relations and colonial policies.

Population Growth

The increase in urban population have contributed to inequality in the distribution of public water supply. According to Ngumbela, (2021), Population growth in many developing countries have outstrip water supply capacity, leading to reduced availability, reliability and quality supply because of weak infrastructure or poor governance. Twomey and Krurger (2021), have identified, increase demand, pressure on infrastructure, urbanization and unplanned settlements, resource depletion, as major effects of population growth on public water supply in cities. The more the population growth, the more water needed for drinking, cooking, sanitation and industrial activities, resulting to more infrastructure pressure on existing pipelines, treatment plants, and reservoirs which may breakdown more frequently due to excessive use.

similarly, population growth often leads to urban sprawl and informal settlements which may lack proper water supply infrastructure, making it difficult to provide reliable public water supply in cities, thereby creating public water supply inequality. This has also led to financial and management challenges in providing public water supply in urban areas, thereby reducing service quality in cities by rationing public water supply for urban residents.

socio-economic condition of the people

Chitunge (2020), have argued that the socio-economic conditions of individuals and communities is also one of the major factors that significantly influence access to public water supply, thereby creating public water supply inequality. Urban residents' access to public water supply is affected by socio-economic conditions in the following ways;

- i. Income level: the income level of households affects access to public water supply, higher income households are more likely to afford connection fees, service charges, and ongoing utility bills. In contrast, low-income households may struggle to pay these costs, thereby limiting their access to public water supply in cities.

- ii. Geographic location: socio-economic status often correlates with geographic location. Poorer neighborhoods often found in urban slums may lack infrastructure and investment resulting in inadequate or no access to public water supply systems.
- iii. Educational attainment: education can impact awareness about water rights, usage, and maintenance. Individuals with higher education levels may better understand how to advocate for their water needs and navigate bureaucratic processes to access public services like water supply
- iv. Government policy and investment: governments in wealthier societies may prioritize water infrastructure development in affluent areas, leaving poorer areas underserved. This disparity in investment can lead to public water supply inequality in cities.
- v. Social inequality and discrimination: marginalized groups may face systemic barriers to accessing public water supply services due to discrimination based on ethnicity, gender, or other socio-demographic characteristics.
- vi. Community organization and advocacy: neighborhoods with strong organization and advocacy capabilities can often negotiate better access to public resources, including public water supply. Socio-economic status can affect the ability of a neighborhood to mobilize and demand services.
- vii. Health status: poor health can limit individuals' capacity to advocate for their needs affecting their access to public water supply. Conversely, access to clean public water supply can improve health outcomes, further linking socio-economic status with water supply access.
- viii. Infrastructure quality: wealthier neighborhoods typically have more reliable and higher quality public water infrastructure, whereas poorer areas may deal with aged or inadequate systems that result in intermittent or compromised service.

In summary, socio-economic conditions create a complex interplay of factors that can hinder or enhance access to public water supply, leading to significant disparities in public water availability and quality across different neighborhoods. Addressing these disparities often requires holistic approaches that consider economic, social and political dimensions.

Poor funding

Adequate provision of public water supply services required finance, which are not readily available or poorly deployed in cities resulting to poor funding and inequality in the distribution of public water supply services by the respective governments. Since the initial and routine maintenance cost of establishing these services are high, most government concentrate in providing water to a few within urban areas where they can benefit from economies of scale that reduce the unit costs of network infrastructure services and enjoy better cost recovery (Ohwo 2019). As a result, some areas within the urban center receive public water services than less agglomerated areas, such as less densely populated peri-urban areas, (World Bank Group 2013).

Corruption

Corruption has also exacerbated public water supply inequality in urban areas. Corruption levels in most countries is high and budget released for the provision of public water supply are either outright embezzled or mismanaged, this had led to shortfalls in public water supply services in urban areas, (Ledant, 2013). Although the scope of corruption varies substantially across the sector and among different cities and governance system, an estimate by World Bank suggests that 20% to 40% of water sector finances are being lost to dishonest corrupt practices. In a similar vein Ohwo, (2010) asserts that corruption was one of the major reasons why the Warri urban water Board in Nigeria was moribund, as moneys budgeted for its maintenance and facilities provision do not get to the actual purpose the fund were meant for.

Historical development and colonial policies

A study in Lilongwe the capital of Malawi by Rusca et al (2017), assert that unequal access to public water supply is tied to historical socio-political dynamics and power relations. Similarly, Boakye-Ansah et al (2016) opined that intra-urban inequality in the distribution of public water supply are rooted in policies that promote uneven infrastructural development. Also, the inequality in the distribution of public water supply that exist in developing countries of West Africa are attributed to colonial policies, such as provision of public water supply to Government Reserved Areas (GRA) living other part of the city to provide water for themselves, (Hungerford and Smiley 2016).

Weak institutional arrangement and management

Obadiah (2011), on the challenges and problems of providing public water supply in Lafia town, Nasarawa State identified weak institutional arrangement as one the major problem with the Nasarawa State Water Board. According to his findings, the State Water Board have a Board of Directors and General Manager controlled by the State Ministry of Water Resources. The General Manager is appointed by the State Governor. Senior staff are frequently transferred from the State Water Board to State government departments and vice versa, resulting in managerial instability which affect service provision. Generally, the management of public water supply in urban areas of Nigeria is often poor, resulting to inequality in the distribution of public water supply and sometimes in the complete collapse of the system, which leads users to alternative sources that comes at a cost.

Lack of clearly defined water policy

According to Ochungo, et al (2019), lack of clearly defined water supply policies has also contributed to the disparities in access to public water supply in urban areas, of developing countries. Some countries like, Nigeria lack a national public water supply policy, and as a result there is an uncoordinated and inequitable provision of public water in many urban areas of the country, resulting to inequality in the distribution of public water supply between residents within the same urban area. Hence, Akpabio (2012) described Nigeria public water supply policies as an ad-hoc mechanism prompted by international pressure and response to emergencies, as well as political efforts by successive leaders to justify existence and perceived performance. It is therefore not surprising that the colonial policy of providing public water supply in some selected areas at the detriment of other areas still dominates the policy scene in developing countries like Nigeria, (Ohwo, 2019).

Management Problem

Owolabi (2004) identified management problems as one of the major factors responsible for public water supply in cities. He identified some of these management problems as;

- i. Inadequate data on operation and management
- ii. Insufficient and inefficient use of fund
- iii. Poor management of public water supply facilities
- iv. Inappropriate public water system design

- v. Unsustainable policies, legal frameworks and overlapping responsibilities, and
- vi. Political interference.

According to Akintola and Areola (1980), the inequality in the distribution of public water supply in Ibadan can be attributed to low capital investment by government to water corporation. Owolabi (2004) observed that the major challenge of management in public water supply in cities of Nigeria is that government is solely responsible for public water supply to the populace. This often led to total dependence on large scale water supply system which are very expensive to install and maintain, which always lead to inadequate supply of public water supply.

Lebeka et al (2021) also attributed the inequality in the distribution of public water supply to poor management systems which affects public water supply the following ways:

- i. Inefficient resource allocation: poor management leads to inadequate distribution of public water supply, often favoring certain areas over others. This can create supply shortages in underserved communities while resources are wasted in others
- ii. Infrastructure decay: without effective management, maintenance of public water supply infrastructure can be neglected. Aging pipes and treatment facilities can lead to frequent leaks, contamination, and service interruptions, reducing overall access to clean water.
- iii. Inadequate planning and investment: lack of strategic planning can result in insufficient investment in water infrastructure, especially in growing urban areas. This can cause mismatches between supply and demand, leaving many residents without reliable access to public water supply.
- iv. Insufficient community engagement: failure to involve local communities in water management and decision-making can lead to disconnects and the services provided. Local knowledge and input are crucial for effective and equitable access.
- v. Lack of emergency preparedness: poor management systems may not prioritize resilience or emergency preparedness for water supply systems. In times of crisis, such as natural disasters, vulnerable communities may face severe water shortages.

- vi. Regulatory failures: the absence of robust regulatory frameworks can lead to poor enforcement of water quality and access standards, affecting the reliability and safety of public water supply.

According to Adom and Simatele (2020), factors responsible for public water supply inequality can be summarized and grouped into four dimensions, namely the physical inequality of water in the natural environment, the economic dimension, the geospatial inequality dimension of inequality, and the social relation dimension. The physical dimension of inequality of water in the natural environment is based on the fact that water is not enough to meet all demands or that there are inadequate natural water resources to meet the demands of the population. The economic inequality in the distribution of public water supply revolves around the lack of economic means to access public water resources available to all people, (Makaya et al 2020). For example, failure to invest in or repair water infrastructure or lack of human capacity can lead to inequality in public water supply, even in cases where freshwater is abundantly available (Chitonge 2020). The geospatial inequality in public water supply in cities has much to do with the historical background of cities in West Africa. Colonial planning has contributed to many urban areas not having access to public water supply. The city centers were provided with public water infrastructure living the outskirt with enormous backlog which till today is affecting their access to public water supply.

The fourth order inequality in the distribution of public water supply arises from social relations between different people. This population struggle to access public water supply in cities and urban areas because they have low income as they live in poor neighborhoods; they may be refugees, foreigners, or a combination of all these factors, (Martin 2020).

III. METHODOLOGY

3.1 Study Area

Makurdi town is located between latitude $7^{\circ}37'$ and $7^{\circ}47'$ North and longitude $8^{\circ}27'$ and $8^{\circ}40'$ East (see Figure 1). Makurdi is the Capital of Benue state with a population of about 297,398 National Population Census (2006). And an estimated population of 472,000 in 2024 (United Nation Population, 2024). The town is located within Makurdi Local

Government Area with eleven (11) council wards namely; Clark/Market, Wadata/Ankpa, North Bank I & II, Wailomayo, Fiidi, Modern Market, Bar, Agan, Mbalagh and Central/South Mission Council Ward, (see figure 1). Makurdi town is divided by the river Benue with neighborhoods on both banks of the river. Makurdi town has undergone rapid development with new neighborhoods covering Council wards like Wailomayo, Wadata/Ankpa, Central/South Mission, Clark/Market, as shown in (figure 1) and the remaining council wards are completely outside the urban space.

Makurdi town has joined other urban centres in the country in sustaining itself through formal and informal activities which urban centers in developing countries are usually associated with, the bulk of its residents are employed in the civil service structure comprising of the Federal, State and Local Government establishments while a few of its population are employed in the banking, insurance, industries and few private outfits. Majority of its population depends on informal activities such as trading, commercial motorcycling, taxi driving, while at the outskirts of the town, a number of people

are involved in urban agricultural as a source of livelihood.

Public water supply plays a significant role in shaping the daily lives of residents and the economic dynamics of the town. The primary source of public water supply in Makurdi town comes from River Benue, which flows through the town. Water is drawn from the river, treated and then distributed to residents through the Makurdi Water works. In addition to this source of water supply, alternative sources like boreholes, water vendors and wells are used by residents especially in areas where the public water system is less accessible.

One of the main challenges facing public water supply in Makurdi town is irregularity of supply. Residents often experience disruption in service due to outdated infrastructure, inadequate water treatment capacity, and power supply affecting pumping stations, (Tyonum, 2024). The water distribution network in Makurdi is not fully comprehensive, leading to some areas experiencing low pressure or no access to treated water. Residents in these areas often rely on alternative sources like private boreholes, hand-dug wells or even purchasing water from private vendors.

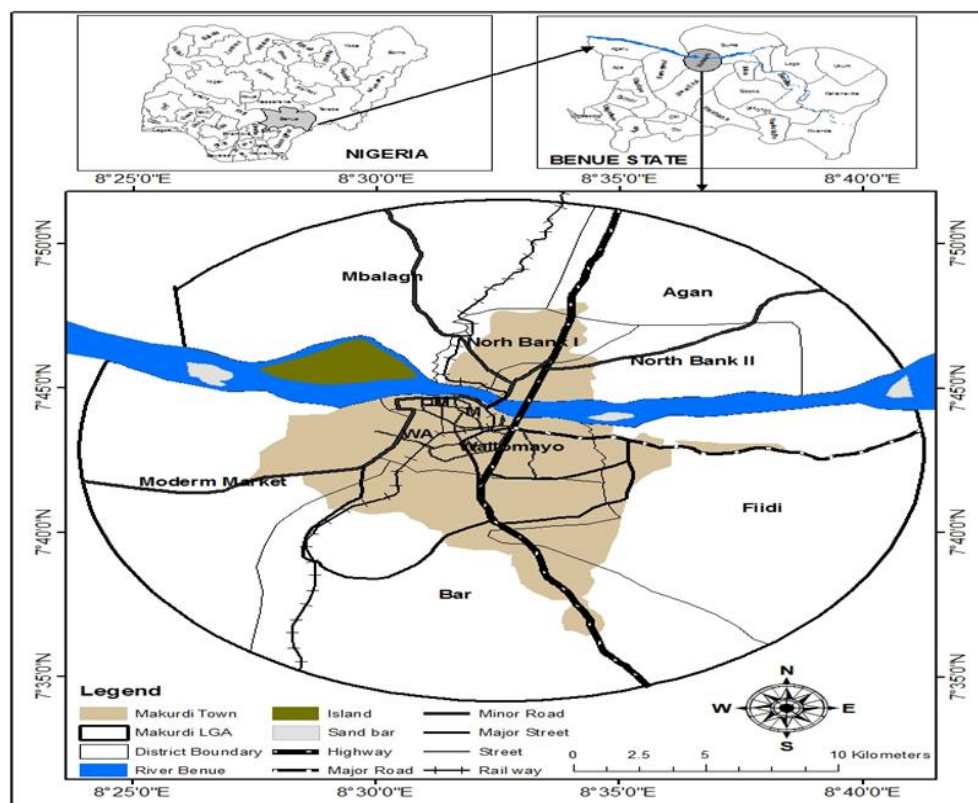


Fig 1: Makurdi LGA showing Council wards and contiguous built-up areas.

Source: Benue State Ministry of Lands and Survey

3.2 Sample size, Data collected and Data analysis

A purposive sampling technique was used to select a sample of 399 public water supply workers from four (4) water agencies responsible for public water supply in the study area. A structured questionnaire and interview were employed to collect data from officials of public water supply agencies and other stakeholder (water vendors, water tankers drivers and community leaders) in the study area. Data on 30 variables suspected to be factors responsible for public water supply inequality were collected, and the Principal Component Analysis was used to analyze and reduce the number of variables to smaller components that are very important and accounted for the factors responsible for public water supply inequality in Makurdi town.

IV. RESULTS

In an attempt to determine the drivers responsible for public water supply inequality in Makurdi town, a total of 30 perceived drivers identified during the

reconnaissance survey in the study area were used in an effort to reduce the large size of the data and determine appropriate score for further analysis. The option of the Principal Component Analysis was considered appropriate. With the help of SPSS 22.0, data from the 399 copies of the questionnaire were entered and analyzed, and the data is presented in table 1, from table 1, the factor analysis procedure with alpha varimax rotation applied to data yielded eight-dimensional public water supply inequality triggering factors in Makurdi town. The eight factors which together accounted for 80.718% of the total variance in the 30 original variables can be regarded as major public water supply inequality triggering factors in Makurdi town. These factors are governance and management deficiencies, socio-economic disparities, policy and resource constraints, operational and policy implementation challenges, urbanization and consumption patterns, workforce and infrastructure maintenance issues, funding and infrastructure barriers, and environmental and topographic influences.

Table 1: Factors responsible for public water supply inequality (Rotation factor Matrix)

S/n	Variables	F1	F2	F3	F4	F5	F6	F7	F8
1	Water consumption practices	-.053	.465	.033	.153	.813	.073	.048	.026
2	Inadequate funding	-.006	.246	.070	-.045	-.061	.107	-.700	-.033
3	Lack of management capacity	.768	-.126	-.179	.217	.051	-.460	-.016	.033
4	Poor governance	.690	-.118	.362	-.467	.122	.164	-.006	.027
5	Unsustainable water policies	-.053	-.348	.679	.554	.008	-.010	-.025	-.013
6	Urban spatial growth	-.074	.490	.025	.178	.788	.088	.070	-.006
7	Inadequate data on operation	.776	-.110	-.198	.179	.086	-.458	.019	.001
8	Inappropriate public water system design	.787	-.118	-.186	.159	.087	-.438	-.013	-.009
9	Political interference	.695	-.130	.405	-.430	.090	.192	-.007	-.024
10	Poor management of water facilities	.771	-.043	-.350	.397	.007	.060	-.028	.036
11	Infrastructure development	.085	.282	.039	.076	-.086	.013	.234	-.568
12	Socio-economic condition of the people	.223	.814	.272	.109	-.237	-.107	-.047	-.045
13	corruption	.700	-.131	.389	-.438	.077	.182	.025	-.014
14	Historical development & colonial policies	-.054	-.376	.665	.554	.029	.013	-.014	-.016
15	Income level	.198	.820	.264	.108	-.290	-.086	-.058	-.024
16	High rate of billing	.253	.806	.281	.121	-.254	-.066	-.061	-.027
17	Poor road network	.016	.238	.222	.028	-.217	.011	.425	.273

18	Marching ground & youth restiveness	.130	.147	.138	-.024	-.221	.100	.367	-.328
19	Poor welfare for water utilities workers	.491	.040	-.392	.479	-.096	.506	-.027	-.042
20	Inadequate manpower	.771	-.118	-.207	.206	.099	-.442	-.011	.025
21	Settlement pattern	-.077	.484	.088	.156	.798	.044	.034	.003
22	Education level	.213	.811	.262	.130	-.266	-.115	-.022	-.032
23	Political affiliation	.710	-.128	.374	-.404	.099	.200	-.008	-.007
24	Ethnic & religion background	.719	-.083	.375	-.430	.107	.164	-.021	-.022
25	Damage water utilities	.497	.045	-.387	.468	-.089	.527	.006	.066
26	Topography of the area	.080	.204	.120	.031	-.124	.037	.374	.613
27	Leakages and losses in distribution	.512	-.014	-.378	.431	-.125	.550	.012	.007
28	Climate change and variability	.024	.249	.185	.019	-.096	.040	-.327	.378
29	Limited freshwater resources	-.069	-.377	.652	.567	.032	-.016	-.033	-.033
30	Competing demands	-.068	-.366	.657	.564	-.004	.008	-.014	-.015
	Eigenvalue	6.480	4.324	3.627	3.281	2.439	1.890	1.132	1.043
	Percentage variance	14.968	13.436	13.061	11.940	10.536	9.172	3.925	3.681
	Cumulative percentage	14.968	28.403	41.465	53.405	63.940	73.113	77.038	80.718

Source: Author field work 2024

Factor 1: Governance and management deficiencies

This factor is defined by variable number 3(lack of management capacity), variable number 4(poor governance), variable number 7(inadequate data on operation and management), variable number 8(inappropriate public water system design), variable number 9(political interference), variable number 10(poor management of water facilities) variable number 13(corruption). All the variables show high loading on the component with each scoring above 500 on the component, with the highest leading .787 and .776. the factor contributed a total eigenvalue of 6.480 and accounted for 14.968% of the total variance, and is without doubt the must important factor responsible for public water supply inequality in the study area.

The planning, construction and management of public water system, infrastructure or facilities in the study area do not meet the needs of households. The design of public water supply has inadequate water treatment plants and storage facilities, poorly design system and management deficiencies are responsible for public water supply in Makurdi town. Interview with water agencies in the study area revealed that,

the poorly designed public water system is responsible for public water supply inequality in Makurdi. The leakage and water loss are as a result of inefficient piping, poor materials and bad joint connections which often result to leaks, causing large volumes of water to be lost before reaching consumers. Also, according to research sources, the poor water system design has resulted to breakdown of the reticulation system, increasing operational and maintenance expenses.

On lack of data on operation and management, interview with water agencies revealed that, it is difficult for water agencies without accurate data on population, water demand, and consumption patterns, to design public water system that can meet the current and future needs of the people. Also missing data on water flow, pressure, and leakage prevents early detection of faults, leading to prolonged outages and waste. This lack of data has made it hard for water agencies to prioritize areas needing urgent infrastructure upgrades that will reduce the inequality in public water supply.

On management of public water supply, the study identified weak institutional arrangement and management as the major problem with the Makurdi Water Board. According to findings, Board have a Board of Directors and General Manager controlled by the State Ministry of Water Resources. The General Manager is appointed by the State Governor. Senior staff are frequently transferred from the State Water Board to State government departments and vice versa, resulting in managerial instability which affect service provision. Also, political interference also contributed in to the instability in the management of public water facilities. This have made management of public water supply in Makurdi very poor, resulting to inequality in the distribution of public water supply and sometimes in the complete collapse of the system, which leads users to alternative sources. This finding on poor water management and government interference agrees with the finding of Obadiah (2011), on the challenges and problems of providing public water supply in Lafia town, Nasarawa State Nigeria.

On corruption, interview sources reported high level corruption in public water supply agencies that results to misallocation of funds designated for public water supply projects, leading to incomplete projects or sub-standard quality thereby creating public water supply inequality in Makurdi town.

Factor 2: socio-economic factor

This factor is defined by variable number 12(socio-economic condition of the people in an area), variable number 15(income level), variable number 16(high rate of billing), and variable number 22(education status). All the variables show high loading on the component with score above 500 and with highest loading of .820 and .814. the factor contributed a total eigenvalue of 4.324 and accounted for 13.436% of the total variance and is without doubt, the second most important factor responsible for public water supply inequality in Makurdi town.

The socio-economic condition of people with low income, low level of education and resident in informal settlements have also contributed to public water supply inequality services in Makurdi town. This factor can better be understood when low- or no-income population are to pay for services they can't afford. The public water supply institution needs resources to manage and maintain public water supply, but due to poor return on investment from

consumers who lack the income to pay for water services, it becomes hard and difficult for the management of these facilities to provide, maintain and sustain the provision of public water services. According to sources from the interview with water agencies. Neighborhoods like Wurukum are known for making illegal connections that sometimes cause system imbalances and water losses. Also, people living in informal neighborhoods cannot get attention to receive water infrastructure because of their low status in the society, and the unplanned nature of their environment. The findings of this study agree with the study of Adom et al 2023 in South Africa who identified factors responsible for public water supply inequality to include household income, social status and resident neighborhood. The implies that the high level of poverty in the study area is one of the reasons for inequality in public water supply. Deliberate efforts and policies should be targeted at making public water supply accessible to low-income earners.

Factor 3: Policy and historical constraints

This factor is defined by variable number 5(unsustainable water policy), variable number 14(historical development and colonial policies). All the variables show high loading on the component with score of above 500 and with highest loading of .679 and .665. the factor contributed a total eigenvalue of 3.627 and accounted for 13.061 of the total variances and is without doubt, the third must important factor responsible for public water supply inequality in the study area.

Interview with government agencies revealed that one of the major factors responsible for public water supply inequality is the absence of a well-defined policy for public water supply. Makurdi town lack a well-defined public water supply policy, and as a result there is an uncoordinated and inequitable provision of public water in many neighborhoods within the town, resulting to inequality in the distribution of public water supply between residents within the same urban area. Hence, Akpabio (2012) described Nigeria public water supply policies as an ad-hoc mechanism prompted by international pressure and response to emergencies, as well as political efforts by successive leaders to justify existence and perceived performance as can be seen with past administrations and their efforts to make public water supply available in Makurdi and its environment. It is therefore not surprising that the

colonial policy of providing public water supply in some selected areas at the detriment of other areas still dominates the policy scene, in many urban areas within the study area and the country at large.

Factor 4: Policy implementation and management challenges

This factor is defined by variable number 5(unsustainable water policy), variable number 14(historical development and colonial policies). All the variables show high loading on the component with score above 500 and with highest loading of .554 and .554. the factor contributed a total eigenvalue of 3.281 and accounted for 11.940% of the total variances, and is the fourth most important factor responsible for public water supply inequality in Makurdi town.

According to interview sources water agencies in the study area are yet to adopt and implement global best policies guiding public water supply such as; (a)direct subsidies for low-income households or discounts on public water bills for the economically disadvantage households to improve affordability, (b) implement policies for investment in water infrastructure that allocates funding for development and maintenance of public water supply infrastructure in underserved neighborhoods to ensure equitable access to public water supply, (c) implement policy on community involvement and stakeholder engagement that conduct regular public consultation, participation in decision making processes related to water management to ensure that policies on public water supply reflect local needs and priorities, (d) yet to enact laws to protect the water rights of marginalized communities and ensure secure access to public water supply, and (e) yet to implement emergency response plans to address public water supply interruptions by human and natural disaster with a focus on vulnerable population, and as a result the town keeps suffering from public water supply inequality.

Factor 5: Urbanization and consumption pattern

This factor is defined by variable number 1(water consumption practices), variable number 6(urban spatial growth), and variable number 21 settlement pattern. All the variables show high loading on the component with score of above 500 with highest loading of .813 and .798. The factor contributed a total eigenvalue of 2.439 and accounted for 10.536% of the total variances and is without doubt the fifth

important factor responsible for public water supply inequality in Makurdi town.

Urbanization or spatial growth according to interview sources is one of the factors responsible for public water supply inequality in Makurdi town. This finding agrees with the findings of Owolabi (2004) who look at the increasing population, urbanization and climate factors in Lagos and implications on water demand and supply.

The growing population and infrastructure development in Makurdi town is increasingly putting pressure on the limited public water supply utilities which were constructed more than forty years ago and this have resulted to water supply inequality within the city. The growing trend of urbanization have concentrated in Makurdi town, increasing the demand for public water supply and putting pressure on water infrastructure within the city. The public water distribution system in Makurdi was designed to provide public water supply to a smaller population and settlements located around the heart of the city, but due to urbanization or spatial growth of settlement without water infrastructure development, Makurdi is experiencing inequality in the distribution of public water supply.

The other variable which loaded on this factor is water consumption practices. bad water consumption practices such as leakage and breakages in household plumbing and distribution systems contributes to water loss, reducing overall supply in the study area. Also, the growth of informal settlements has led to unregulated water consumption practices thereby exacerbating public water supply inequality in Makurdi town.

Factor 6: Workforce and infrastructure maintenance issues

This factor is defined by variable number 5(poor welfare for water utilities workers), and variable number 25(damage water utilities). All the variables show high loading on the component with score of .527 and .506. the factor contributed a total eigenvalue of 1.890 and accounted for 9.172% of the total variance, and it is the sixth most important factor responsible for public water supply inequality in Makurdi town.

The welfare of public water supply workers is very important to the overall maintenance of water

facilities, management and efficiency of public water supply systems. Poor welfare conditions can lead to several negative impact on workforce and infrastructure maintenance of water institutions resulting to inequality in public water supply.

Interview sources in public water utilities identified decreased morale and productivity as one of the reasons for poor public water supply in the study area. Workers face poor welfare conditions such as inadequate pay, lack of benefits, or unsafe working environments. These issues delay maintenance, repairs, and improvements of public water supply, thereby resulting to inequality in the supply of public water. Also frequent staff changes, inadequate training and skill development were also identified as reasons affecting public water supply in Makurdi town.

Factor 7: Funding constraints and infrastructure barriers

This factor is defined by variable number 2(inadequate funding). The factor contributed a total eigenvalue of 1.132 and accounted for 3.925% of the total variance and is the seventh factor responsible for public water supply inequality in the study area.

The people in the study area have poor access to public water supply due to poor funding of water infrastructure such as storage tanks and pipes. By the World Health Organization (WHO) standards, the approved lifespan of water pipes is five years. Sadly, according to interview sources from water agencies, majority of these pipes have never been replaced since they were laid decades ago because of poor funding. Also because of poor funding the outward expansion of Makurdi town have not received any attention in the provision of water infrastructure and water utilities such as water distribution lines in the expended areas resulting to public water supply inequality in the affected areas. Households living in sprawl areas walk long distance in search of water supply.

Old and poorly maintained water pipes as a result of inadequate funding have led to significant water losses through leaks, reducing the availability of public water supply in neighborhoods like High level, Wurukum, North bank and Wadata. These neighborhoods are connected to public water supply, but due to poor maintainers of pipes in these areas they no longer have access to public water supply as

a result of broken pipes. This finding agrees with the findings of Obisesan and Ozabor (2016).

Factor 8: Environmental and Topographical factor.

This factor is defined by variable number 26(topography of the area). The component show high loading with score of .613. the factor contributed a total eigenvalue of 1.043 and accounted for 3.681% of the total variance and is the eighth factor responsible for public water supply inequality in Makurdi town.

The topography of Makurdi town also contribute to public water supply inequality. Makurdi is situated on the bank of the river Benue which serves as a primary source of public water. The elevation of different areas in relation to the river affects how public water can be pumped and distributed. Lower-lying neighborhoods on the southern bank of the river gets better supply access to public water supply because of high pressure in supply then their counterparts on the northern bank of the river with low pressure because of the high elevation. The topography also impacts drainage pattern within the town resulting to public water supply challenges. Interview sources revealed that, lower-lying neighborhoods public water supply sources are contaminated, and water infrastructure damaged when they is heavy rainfall or flooding leading to costly repairs and service interruptions that results to public water supply inequality.

V. CONCLUSION AND RECOMMENDATION

The study concluded that, public water supply inequality in Makurdi town is multifaceted and is driven by factors like, governance and management issues, socio-economic factors, policy and historical constraints, policy implementation and management challenges, urbanization and consumption patterns, workforce and infrastructure maintenance issues, funding and infrastructure barriers, and environmental and topographic factors. These factors are a threat to equitable public water supply, health, socio-economic well-being of urban residents. The study recommended a holistic approach involving network expansion rehabilitation and maintainers, effective governance framework, investing in vulnerable communities among others to reduce inequality for sustainable and inclusive public water supply in Makurdi town.

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