IJAAR PUBLISHING®

International Journal of Advanced Academic Research | ISSN: 2488-9849
Vol. 10, Issue 6 (June, 2024) | www.ijaar.org

EVALUATION OF THE PERFORMANCE OF THE GREATER MAKURDI WATER WORKS IN BENUE STATE

BY

TPL. EMMANUEL TERESE TYONUM

DEPARTMENT OF ESTATE MANAGEMENT AND VALUATION
SCHOOL OF ENVIRONMENTAL STUDIES,
BENUE STATE POLYTECHNIC, UGBOKOLO.
tyonumemmnauel@gmail.com, 2348032740738

ABSTRACT

The study evaluated the performance of the Greater Makurdi Water Works in Benue State. It was guided by five specific objectives. These objectives include determining the quantity of water required for the metropolis, evaluating the geographical coverage of the Greater Makurdi Metropolis Water Supply Scheme, analyzing the volume of daily water supply, examining the relationship between population growth and water supply, and identifying challenges impeding the water supply capacity of the scheme. Through a comprehensive analysis, the study reveals several key findings. The study finds that the daily water requirement for Makurdi metropolis stands at 31,796,280 liters as of 2017. However, only a limited number of areas within the metropolis receive water from the Greater Makurdi Water Works scheme, leaving significant portions, such as Kanshio, Wurukum, Gyado Villa, and North Bank, without access to the water distribution network. Additionally, the daily water supply falls short of the metropolis's requirement, with per capita water access grossly inadequate compared to national standards. Moreover, the study highlights a weak correlation between population growth and water supply expansion in Makurdi metropolis, indicating a concerning trend of diminishing per capita availability over time. Furthermore, the study identifies significant challenges, including financial constraints and poor power supply, hindering the scheme's ability to meet water supply targets. Based on these findings, the study concludes that the Greater Makurdi Water Works scheme supplies water below the metropolis's requirement and recommends several measures to address the identified issues. These recommendations include expanding water distribution to underserved areas, honoring agreements with the government, enhancing funding, improving power supply infrastructure, and prioritizing adequate funding for the scheme to meet the population's water needs effectively. These recommendations are crucial for ensuring equitable access to clean and reliable water for the residents of Makurdi metropolis and its environs.

Keywords: Evaluation, Greater Makurdi Water Works, Daily water supply, Population growth, Water supply capacity and Challenges

Tyonum, E. T. (2024). Evaluation of the Performance of the Greater Makurdi Water Works in Benue State. *International Journal of Advanced Academic Research. 10*(6), 40-55. DOI: 10.5281/zenodo.12627183

Introduction

In Benue State, particularly in the urban centers of Makurdi, Otukpo, and Katsina-Ala, access to public water supply remains a challenge. Despite the establishment of the Greater Water Works by the administration of Governor Gabriel Towua Suswan in 2007, commissioned in 2012, many residents still face inadequate and unreliable water supply. This situation forces them to rely on unsafe supplementary sources such as streams, hand-dug wells, and ponds. This underscores the urgent need for an evaluation of the performance of these water works to address the persistent water supply challenges faced by the communities (Aliyu & Dankani, 2016).

According to the National Water Policy, the responsibility for urban and semi-urban water supply delivery lies with the State Governments, while the Federal Government provides overall policy frameworks, coordination, and regulation. State agencies, established through edicts, are tasked with water supply management within their jurisdictions. The fundamental functions of water utilities like the Greater Makurdi, Otukpo, and Katsina-Ala water works include the construction, operation, and maintenance of water supply systems (Sani, 2006; Ajibike, 2013).

In Nigeria, the efficiency of water supply systems is influenced by various factors, including urban planning and financial sustainability. Proper urban planning is crucial for the efficient operation of water supply systems and ensuring consumer satisfaction. However, challenges such as weak institutional arrangements, political interference in tariff setting, and inadequate legal frameworks hinder the effectiveness of water utilities (Obadiah, 2011; Bernard & Eugene, 2006). This is mostly seen in the areas of quantity of water requirement, extent of geographical coverage, volume/quantity of daily water supply and reticulation and extent of water distribution.

Understanding quantity of water requirements is fundamental for assessing the adequacy of the existing infrastructure and planning for future expansions or upgrades to meet growing demands (Ademiluyi et al., 2019).It is crucial to recognize the pivotal role that understanding the quantity of water requirements plays in urban development and infrastructure planning (Ademiluyi et al., 2019). Adequate water supply is essential for sustaining urban growth and ensuring the well-being of communities. By assessing the current and projected water demands of urban areas such as Makurdi, Otukpo, and Katsina-Ala, planners can gauge the sufficiency of existing water infrastructure and anticipate future needs. This assessment involves analyzing factors such as population growth, industrial development, and residential expansion to estimate the volume of water required to meet various demands.

Moreover, these understanding forms the basis for strategic planning initiatives aimed at enhancing water supply infrastructure (Ademiluyi et al., 2019). By identifying potential deficiencies and areas of strain within the existing system, planners can prioritize infrastructure upgrades, expansions, and maintenance interventions. Additionally, integrating considerations for future population growth and urban development into water infrastructure planning facilitates sustainable and resilient urban growth, ultimately contributing to the overall livability and prosperity of the communities served by the Greater Makurdi, Otukpo, and Katsina-Ala water works.

Mapping the extent of coverage provides crucial insights into the areas served by the water supply systems in Makurdi, Otukpo, and Katsina-Ala, thereby highlighting gaps where access to clean water may be lacking (Okonkwo et al., 2020). This spatial analysis allows

planners to identify underserved communities and prioritize interventions to extend water service coverage. By pinpointing areas with limited access to clean water, policymakers and stakeholders can develop targeted strategies to improve overall accessibility and ensure equitable distribution of water resources within urban centers. Furthermore, mapping the coverage of water supply networks enables planners to devise efficient and cost-effective interventions to address access disparities (Okonkwo et al., 2020). By identifying areas with limited coverage or inadequate infrastructure, planners can prioritize the allocation of resources for infrastructure upgrades, expansion of distribution networks, or establishment of new water supply points. This targeted approach maximizes the impact of interventions, ensuring that limited resources are utilized effectively to improve access to clean water for all residents, particularly those in marginalized or underserved communities. In essence, mapping the extent of coverage not only serves as a diagnostic tool to identify areas lacking access to clean water but also facilitates the design and implementation of targeted interventions to improve overall accessibility and equity in water supply services within urban areas.

Also, understanding variations in water supply is essential for proactive management and optimization of water distribution systems (Olatunji et al., 2021). By analyzing fluctuations in supply, planners and water utility managers can identify trends, patterns, and potential challenges affecting the reliability and adequacy of water distribution. This understanding allows for the development of proactive strategies to address issues such as water scarcity, pressure variations, and distribution network inefficiencies. In addition, proactive management based on a comprehensive understanding of supply variations enables water utilities to optimize their distribution systems for improved efficiency and performance (Olatunji et al., 2021). By identifying areas with high demand or vulnerable to supply disruptions, managers can implement measures such as demand management, pressure regulation, and infrastructure upgrades to enhance system resilience and reliability. Additionally, real-time monitoring and data analysis enable swift responses to emerging issues, minimizing the impact of supply disruptions and ensuring continuous access to clean water for consumers.

Rapid urbanization and population growth exert significant pressure on water resources and infrastructure, highlighting the urgent need for responsive planning and management strategies (Ogbonna et al., 2018). As urban areas expand and populations swell, the demand for water escalates, placing strain on existing water supply systems. Without adequate planning and management, this increased demand can lead to water scarcity, degraded water quality, and insufficient access to clean water for urban residents. In response to these challenges, proactive planning and management strategies are essential to sustainably meet the growing demand for water resources. This includes the development of robust infrastructure, such as water treatment plants, distribution networks, and storage facilities, capable of accommodating the needs of expanding urban populations (Ogbonna et al., 2018). Additionally, effective demand management measures, such as water conservation initiatives and leak detection programs, can help mitigate the strain on water resources and infrastructure.

Reticulation systems serve as vital conduits for delivering water from the main supply network to individual households and establishments, underscoring their critical role in ensuring access to clean water (Onuche et al., 2020). These networks form the backbone of urban water distribution infrastructure, facilitating the seamless flow of water to end-users. By evaluating the efficiency and coverage of reticulation networks, planners and water utility

managers can gain valuable insights into distribution challenges and opportunities for optimization. Assessing the efficiency of reticulation networks involves analyzing factors such as water pressure, flow rates, and network connectivity (Onuche et al., 2020). Identifying areas of low pressure, leaks, or network disruptions enables utilities to pinpoint weaknesses in the system and prioritize maintenance and repair efforts. Additionally, evaluating the coverage of reticulation networks allows planners to identify underserved areas and target investments to extend service provision to these communities. This proactive approach not only improves access to clean water but also enhances the overall reliability and resilience of the water distribution system.

Studies conducted in similar contexts highlight the magnitude of the challenges faced by water utilities in meeting the demands of growing urban populations. For instance, in Makurdi Metropolis, only a fraction of inhabitants have access to running water in their homes, and even then, the supply is sporadic. Insufficient power supply exacerbates the situation, leading to inadequate pumping and uneven distribution of water across different areas (Chia & Ndulue, 2014). In light of these challenges, routine evaluation becomes imperative to identify and address the underlying issues contributing to poor performance. This study aims to evaluate the performance of the Greater Makurdi, Otukpo, and Katsina-Ala water works in Benue State, with the goal of isolating key areas of concern and facilitating targeted interventions to improve water service delivery for urban communities. This study therefore sought to carry out an evaluation of the performance of the greater Makurdiwater works in Benue State.

Statement of Problem

The Great Makurdiwater Plant were aimed to build water plant that will purify the Benue river water, Katina-Ala and Otobi river respectively and to supply potable water to feed a large population of Makurditown on a daily basis for the next Twenty (20) years. It was also aimed at providing quality water that will boost the standard of living of Makurdi, populace, thereby reducing water scarcity and medical expenses due to poor water supply.

In 2007 the contract for the construction of the “Great Water Works” was formally awarded. Five years after this lofty statement and 10 years after the full operation of the water works, it has not been appraised to assess if the inhabitants of the Metropolis still experience water supply crisis. In addition, the continuous presence of several informal water vendors/suppliers like water tankers and mairuwa suggest that all may not be well with water works target. The foregoing suggests there seems to be a problem of inadequate water supply by the scheme. Also from researchers preliminary investigation, it is unveils that geographical coverage of water distribution across Makurdialso seem to be incomplete. Therefore, this study seeks to evaluate the performance of the Great Makurdi water works in meeting the water requirement need of the inhabitants.

Aim and Objectives

The aim of this study is to evaluate the performance of the Great MakurdiWater Supply Scheme in Benue State. To achieve the aim of this study, the objectives are;

1. To determine the quantity of water requirement need of Makurdi metrolis in Benue State.
2. To assess the extent of geographical coverage of the Great MakurdiWater Works distributes water in Makurdi metropolis.
3. To examine the volume/quantity of daily water supply in Makurdi metropolis.
4. To investigate the relationship between population growth and water supply in Makurdi metropolis.

5. To determine the relationship between reticulation and extent of waterdistribution in Makurdi metropolis.
6. To identify the challenges militating against the water supply capacity of the scheme in Makurdi metropolis.

Research Questions

The research will answer the following questions;

1. What is the quantity of water requirement need of Makurdi metropolis?
2. What is the extent of geographical coverage of Great Makurdi works in Makurdi Metropolis?
3. What is the volume/quantity of daily water supply in Makurdi metropolis?
4. What is the relationship between population growth and water supply in Makurdi metropolis?
5. What is the relationship between reticulation and waterdistribution in Makurdi metropolis?
6. What are the challenges militating against the water supply capacity of the scheme in Makurdi metropolis?

Research Hypothesis

The following hypothesis is formulated for this study:

H_o. There is no significant relationship between population growth and water supply.

H_1. There is a significant relationship between population growth and water supply.

Concept of Water Supply

The concept of water supply encompasses the provision of a reliable and sustainable source of water that meets the needs of communities in terms of quantity, quality, and accessibility. While the primary goal of a water supply scheme is to ensure that consumers have access to sufficient quantities of clean and safe water, defining the appropriate level of service can be challenging. Although access to high-quality water is crucial for improving health outcomes and reducing the time spent collecting water, there is often a misconception that achieving the same level of service as developed western countries is the ultimate objective. The provision of adequate quality drinking water is fundamental to achieving better living standards and fostering economic development. Efforts at various levels have been made to understand and address the challenges associated with water supply and management. As Agbaeze (2003) aptly observed, the availability of potable water in sufficient quantity and quality is indispensable for promoting good health, welfare, and productivity among populations. Furthermore, public water supply is recognized as an essential service for communities, playing a vital role in ensuring public health, economic activities, and environmental preservation (Helana, 2005).

In the setting of urban areas, water supply systems encompass a range of activities aimed at securing, treating, transporting, storing, and distributing water for various human uses. These systems are designed to protect the health and safety of citizens, with a focus on delivering services efficiently and effectively (Nyam, 1999; Ammani, 1995). Moreover, a sustainable urban water system should not only meet current demands but also anticipate future needs while minimizing the use of scarce resources and mitigating environmental impacts (ASCE, 1998; Yakubu, 1995).

Links between Population and Water Supply

Population growth is a major contributor to water scarcity. Growth in population means mounting demand and competition for water for domestic, industrial, and municipal uses (The World Water Organization, 2010). The most water scarce or stressed areas are typically those with few water resources, high population densities, and high population growth rates. Population growth limits the amount of water available per person, drives people into marginal regions which are already water stressed and also into cities. For instance, most of the countries in African region cannot meet their current water demand (World Water Development Report 3, 2009).

The links between population growth and water supply are multifaceted and underscore the intricate relationship between human demographics and access to water resources. As the global population continues to expand, particularly in urban areas of less developed regions, the demand for water escalates, exacerbating water scarcity issues (The World Water Organization, 2010). Regions with high population densities and rapid population growth rates often face the greatest challenges in meeting the water needs of their inhabitants, leading to increased competition for limited water resources and mounting pressure on existing infrastructure.

This phenomenon is particularly pronounced in urban areas, where population growth is often accompanied by rapid urbanization. As more people migrate from rural to urban areas in search of economic opportunities, the strain on water resources intensifies (The World Water Organization, 2010). Urban centers become hubs of economic activity and human habitation, concentrating large populations in relatively small areas. Consequently, the demand for water surges, placing immense pressure on local water sources and distribution systems. Moreover, regions with high population densities experience heightened competition for water resources, further exacerbating water scarcity issues. In these areas, water becomes a precious commodity, and access to clean and safe water becomes increasingly challenging for residents. This heightened competition for water resources can lead to conflicts over water allocation and usage, exacerbating social tensions and hampering sustainable development efforts (The World Water Organization, 2010).Additionally, rapid population growth strains existing water infrastructure, often leading to inadequate service delivery and deteriorating water quality. Aging infrastructure struggles to cope with the increased demand, resulting in water shortages, leakages, and contamination issues. Consequently, residents may be forced to rely on unsafe water sources or face intermittent access to water, compromising their health and well-being.

Urbanization further compounds the strain on water sources, as burgeoning urban populations concentrate in specific areas, intensifying demand for water (World Water Development Report 3, 2009). This urban migration drives individuals towards cities and regions already stressed for water, exacerbating the challenges of water scarcity and overutilization. Moreover, as urban areas develop economically, per capita water consumption rises, placing additional strain on local water capacities and exacerbating water stress.

Urbanization exacerbates the strain on water sources by concentrating burgeoning urban populations in specific areas, thus intensifying the demand for water (World Water Development Report 3, 2009). As rural residents migrate towards cities in search of economic opportunities and better living conditions, the pressure on urban water resources escalates. This influx of individuals into urban areas further exacerbates the challenges of

water scarcity and overutilization, particularly in regions already stressed for water.Moreover, as urban areas develop economically, there is often a corresponding increase in per capita water consumption (World Water Development Report 3, 2009). Economic development leads to changes in lifestyle and consumption patterns, resulting in higher water usage for domestic, industrial, and commercial purposes. This heightened demand for water places additional strain on local water capacities and exacerbates water stress in urban environments.Furthermore, the process of urbanization often leads to the expansion of urban infrastructure, including water supply and distribution systems. However, the rapid pace of urbanization can outstrip the capacity of these systems to keep pace with the growing demand for water. As a result, urban areas may experience inadequate water supply, intermittent service, and deteriorating water quality, further exacerbating water stress and posing significant challenges for sustainable urban development.

At the household level, demographic factors such as household size, composition, and age structure influence water demand (United Nations Environment Programme, 2008). Industrialization, driven by population growth and economic development, also contributes to increasing water demand, as industries require water for various processes, including manufacturing, cooling, and waste disposal. The burgeoning demand for industrial water further strains water resources and underscores the interconnectedness between population dynamics and water availability.

As incomes rise and consumption patterns evolve, per capita water usage is expected to increase, further intensifying the strain on water resources (World Health Organization and UNICEF, 2006). Rapid population growth and urbanization pose significant challenges, potentially exposing more people to water shortages, with far-reaching implications for livelihoods, health, and security. These demographic trends, coupled with increasing per capita water consumption, present formidable development challenges, particularly in regions already grappling with water scarcity.

The projected trajectory is concerning, with nearly half of the global population expected to inhabit regions of high-water stress by 2030 (UNFPA, 2001). This trend not only threatens access to water but also exacerbates poverty, as the inability to access safe drinking water often corresponds with economic hardship (UN Report, 2009). The rapid expansion of the global population, coupled with increasing water demand, underscores the urgency of addressing water scarcity through sustainable management practices and equitable distribution strategies (World Water Assessment Programme, 2009). As water withdrawals continue to escalate, the potential global availability of water per capita declines, highlighting the pressing need for comprehensive strategies to address the complex interplay between population growth and water supply (United Nations Environment Programme, 2008).

METHODOLOGY

This study adopted the survey design. According to Emaikwu (2019) a survey design is one in which a group of people or items are studied in their natural setting by collecting, analyzing and interpreting data from people considered to be a representative sample of the entire population. The design was adopted because it deals with data collection and analyses without manipulating the study variables.

Data Needs

The following data needs are identified in order to answer the research questions.

The quantity of water (liters/gallons) needed per head and the population of the areas.

Information about the standard requirement of water per head requirement and the overall population of the areas.

Information on areas where water is distributed to and where it is not.

Information on the daily, weekly, monthly and yearly water supply in Makurdi Metropolis.

The population growth of Makurdiand the data on water supply on daily, weekly, monthly and yearly basis.

Information on the reticulation of the Great Makurdiwater works.

Information on factors affecting water supply by the scheme.

Sources of Data

The data for this research work was obtained from two sources; primary and secondary sources. The primary source is concerned with information obtained from the field survey by the researcher through interview, observations and visits. The data needed under this source include the extent of geographical coverage by the Great Makurdi Water works and the challenges militating against water supply capacity of the Great water workswhile secondary data is concern with works of other scholars that are related to this study that are obtained through text books, journals, internet, and bulletins among others which is presented in section two and part of section four. The data needed under this source are literature works of different scholars that are related to the basic concepts of the study which influence water and its supply. Also, data on the quantity of water supply by the water works which concerned data on the quantity or volume of the water supply by the scheme. Data also obtained from the secondary source include information on the population growth of Makurdi inhabitants.

Data Collection Instrument

The instrument for data collection is a self-designed questionnaire, interview guide and observation. In this study interview was used to gather information from staff of the Great Makurdi, water works and residents of Makurdi urban. This enabled the researcher to access data on the objectives from a firsthand source. The study employed an open-ended interview which sought information from both the public and the staff of Great Makurdi, water works.

Observation and visits

In this study the researcherpersonally visited the areas of concern in the study and observed the features of the study area such as reticulation and water supply for a qualitative result of the study. The researcher examined the extent of geographical coverage of water distribution by visiting almost all the areas in Makurdi Metropolis.A questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. The study adopted semi-structured questions and was used to collect data on the extent of geographical coverage as well as challenges militating against effective supply of water by the Great Makurdi Water Works.

Sample Size and Sampling Technique

The target population of this study was based on 2006 National Population Census of Makurdi Metropolis. The sample size for this study was based on the minimum sample size requirement as proposed by Yamane in Emaikwu (2019) who states that for a study of known population, the minimum sample size requirement is given by the formula,

$$n = \frac{N}{1+N(0.05)2}$$

Where: n= sample size
N= given population
e= margin of error
1= constant

Using the estimated household size of 6%, the projected population was divided by 6% and an estimated number of householdswas obtained. The systematic sampling technique was used to select the households that were interviewed.

For the interview, the researcher adopted purposive/judgmental sampling technique and sampled respondents; this was based on those that possess the attributes of the study, to this end the researcher purposively sampledrespondents from the water works in line with the respective departments; administrative, maintenance, pipe line, and production sections.

Methods of Data Analysis and Presentation

The method used for analysis wassimple percentages and frequency distribution tables to analyze the interview and respondents' demographic information and research questions respectively. Pearson product moment correlation statistics was used to test the hypothesis using SPSS statistical package. Qualitative approach was employed to analyze the interview excerpts to be gathered from the management of Great Makurdi, Water Works.

RESULTS

Demographic Data of the Respondents

Demographic data of respondents in terms of age, sex, and education are presented and discuss in this section.

Data obtained from the field shows that 2(5%) of the respondents were between the age bracket of 18-25 years. 3(7.5%) were within the age range of 26-30 years. A total of 10(25%) were within the age bracket of 31-35 years and most of the respondents 25(62.5%) were from 36 years and above. This result implies that most of the respondents were adults as shown in table 4.1.

Table 4.1: Distribution of Respondents based on their Age

Age Range	Frequency	Percentage (%)
18-25yrs	2	5
26-30yrs	3	7.5
31-35yrs	10	25
36yrs and above	25	62.5
Total	**40**	**100.0**

Data on demographic information also revealed that shows that 18(45%) of the respondents were males and 22(55%) were females. This result implies that majority of the respondents were females. This result indicates that, there is no gender balance but result remains valid as the study does seek to examine the effect of gender on water supply. See table 4.2.

Table 4.2: Distribution of Respondents Based on their Sex

Sex	Frequency	Percentage (%)
Male	18	45
Female	22	55
Total	**40**	**100.0**

4.3 The Quantity of Water Requirements Need of Makurdi Metropolis

Based on the data obtained from theNational Water Supply and sanitation Policy (2000), per capital water access is 120 liters per person per day.This implies that the quantity of water requirement need of Makurdi metropolis is 31,796,280 liters per day as of 2017. See table 4.3.

Table 4.3: Quantity of Water Requirement Needs of Makurdi Metropolis

Per capital water requirement	Population of Makurdi	Quantity of Water Requirement need
120 liters per head	264,969	120 x 264,969 = 31,796,280

Source: Research Computation, 2023

4.4 The Extent of Geographical Coverage of Greater Makurdi Water Works Distributes Water in Makurdi Metropolis.

Based on the interview with staff of the Greater Makurdi Water Supply Scheme, residents, and observation by the researcher, it was revealed that just few of Makurdi Metropolis areas receive water from the scheme. However, areas such as High level and Old GRA have access to the water distribution. This result implies that Greater Makurdi water Supply Scheme do not distributes water to most of the areas in Makurdi Metropolis. See table 4.4, the list of areas marked (√) shows that water have been distributed to whereas the area tick (×) show areas not having water.

Table 4.4 Areas of Water Distribution

S/No	Areas	Have Water (√)	Not having water (×)
1	GRA	√	
2	Wadata	√	
3	High level,	√	
4	Wurukum	x	
5	Gyado Vila	x	
6	Kanshio	x	
7	NorthBank	x	
8	Modern Market	√	

4.5 The Volume/Quantity of Daily Water Supply in Makurdi Metropolis

Based on the data obtained from the Greater Makurdi Water Works on the volume/quantity of daily water supply from 2017—2022, the available data revealed that within 2 months (61 days), from November to December the scheme supplied a daily water quantity of 544,295.08 liters per day.

In 2018, the scheme distributed water for a period of eight months, which range from January to August, 2018 as a result of interruption by the 2018 flood which disturb the scheme activities. The total water distributed quantity was 147,784,000 which implied that the daily quantity of the water supply was at 608,164.61 liters by per day. It is observed from the data that there is an increase in the quantity of daily water distributed as of 2018.

In 2019, there was also an increase in the daily water distribution rate by the scheme; it rises from 608,164.61 liters to 822,866.12 liters per day for a period of 12 months. However, in 2020 there was a decrease in the quantity of water distribution by the scheme, the quantity decrease from 822,866.12 liters per day to 791,665.75 liters per day. The decrease continued to 2021 as the Greater Makurdi Water Works distributed only 575,445.36 liters of water per day.

And in 2022 there was a rise in the rate of water distribution by the scheme, as it increased from 575,445.36 liters of water per day to 790,630.14 liters per day. The result in table 4.5 depicts that there was no steady quantity of daily water distributed by the Greater Makurdi Water Works supply Scheme from 2017 to 2022.

The result implied that the daily water supply by Greater Makurdi Water works was below the quantity of water requirement of Makurdi which is 31,796,280 liters per day, on the basis of the actual water supplied in these periods, there is no doubt that, water supply in Makurdi was grossly inadequate. See table 4.5.

Table 4.5: The Volume/Quantity of Water Supply in Makurdi Metropolis by Greater Makurdi Water Works from 2012—2022

Date	Daily (Liters)	Mean of the month	No. of month	Yearly
2017	544,295.08	16,601,000	2	33,202,000
2018	608,164.61	18,473,000	8	147,784,000
2019	822,866.12	25,097,416.67	12	301,169,000
2020	791,665.75	24,079,833.33	12	288,958,000
2021	575,445.36	17551083.33	12	210,613,000
2012	790,630.14	24,045,333.33	12	288,580,000

Source: Greater Makurdi Water Works, 2023

4.6 The Relationship between Population and Water Supply in Makurdi Metropolis

The data obtained from the field concern the population growth and water supply by the scheme revealed that there is a steady population growth from 2017 to 2022 whereas for water supply, the available data revealed that from 2017 to 2019 there was a steady increase in the daily quantity of water supply while in 2020 to 2021 there was a decrease in the daily quantity of water supply and in 2022 there was again an increase in the quantity of water supply by the scheme.

With regard to per capital water access per day, the data shows that in 2017, the per capital water access per liter was 3.14 with a population of 173,229 in two months. In 2018 and 2019 there was an increment in the per capital water access per liter of 3.22 and 4.02 respectively. Whereas, in 2020 to 2021 a decrease in the per capital water access per liter was noticed as it decreased to 3.54 and 2.37 respectively. And in 2022 there was again an increase of 2.98 the per capital water access per liter. The data clearly, indicated that, the per capital water access

by the population was grossly inadequate as against 120 liters as stipulated by National Water Supply and sanitation Policy (2000). See table 4.6

Table 4.6 Water Supply and Populationin Makurdi Metropolis

		Water Supply			
Year	**Population**	**Daily**	**Yearly**	**No. of Months**	**PCWL**
2017	173,229	544,295.08	33,202,000	2	3.14
2018	188,598	608,164.61	147,784,000	8	3.22
2019	205,329	822,866.12	301,169,000	12	4.02
2020	223,546	791,665.75	288,958,000	12	3.54
2021	243,378	575,445.36	210,613,000	12	2.37
2022	264,969	790,630.14	288,580,000	12	2.98

PCWL = per capital water access per liter: Source: Researchers Computation

Test of Hypothesis

There is no significant relationship between population growth and water supply in Makurdi Metropolis.

Table 4.7: correlation analysis of population growth and water supply in Makurdi Metropolis

Variable	**N (Years)**	**Df**	**r**	**p**	**Remark**
Water supply	6				
		4	.445	.376	Not significant
Population growth	6				

The relationship between population growth and water supply in Makurdi Metropolis was investigated using Pearson product moment correlation coefficient. There was a positive correlation between the 2 variables, r = .445with high population associated with lesser water supply.

4.7 Challenges Militating Against the Water Supply Capacity of the Scheme

From the researcher's observations on the field and result obtained so far, it clearly shows that the scheme face a lot of challenges as the quantity of water requirement of Makurdi Metropolis was not met in terms of quantity supply and in terms of extent of geographical coverage of water distribution, volume of daily water supply and poor relationship between population growth and water supplied.

The researcher obtained from various sources: observations and interview from both staff of the scheme and residents in Makurdi Metropolis that; Inadequate funding is problem to the scheme, the government fail to meet up with its memorandum of understanding with the scheme as its' earlier agreed to be paying a sum of 100 million naira monthly. This money is needed to buy the reagents for the treatment of water. It is also needed to extend and maintain the reticulation line and payment of salary for her staff.

Poor electricity supply is another challenge to the scheme; pumping of water to the respective neighborhood required electricity, and since there is epileptic power supply in the area, the scheme could not pump water for distribution, the alternative power source could

also not help solve this problem as there is no adequate fund to fueled the power plants. Road construction across areas where pipe lines were laid distorted water distribution as the construction process destroyed some of the pipes. Illegal connection: this is the public attitude towards trying to have access to the water through illegal means by linking pipes without the consent of the scheme thereby interrupting the free flow of water to the designated areas. Lack of payment of water bill; the public have lukewarm attitude towards payment of bills to help the scheme augment other challenges that required funds such as fuelling of power plant, extension of reticulation lines, payment of staff among others. See table 4.8.

Table 4.8: Challenges militating against the water supply capacity of the scheme

S/No	Challenges
1	Flood
2	Inadequate funding
3	Poor electricity supply
4	Road construction
5	Illegal connection
6	Lack of payment of water bill

4.8 Summary of Findings

The identified quantity of water required for Makurdi Metropolis, totaling 31,796,280 liters per day as of 2017, serves as a fundamental benchmark for assessing the adequacy of water supply infrastructure. This figure provides planners and policymakers with a clear understanding of the scale of demand, facilitating informed decisions regarding infrastructure development, resource allocation, and demand management strategies.

The uneven distribution of water within Makurdi Metropolis highlights significant disparities in access to essential services. While some areas receive water from the scheme, others, such as Kanshio, Wurukum, Gyado Villa, and North Bank, lack access to the water distribution network altogether. This underscores the urgent need for infrastructure expansion and equitable distribution measures to ensure universal access to clean and reliable water.

The shortfall in daily water supply compared to the established quantity of water required for Makurdi metropolis indicates a systemic challenge in meeting demand. Insufficient supply jeopardizes public health, economic productivity, and overall quality of life. Addressing this shortfall requires strategic investments in infrastructure, operational efficiency improvements, and demand management initiatives.

The grossly inadequate per capita water access falls well below the national standard of 120 liters per capita per day, as stipulated by the National Water Supply and Sanitation Policy (2000). This deficiency underscores the urgency of action to bridge the gap between supply and demand, ensuring that every individual has access to an adequate and reliable water supply to meet their daily needs.

The observed disparity between population growth and water supply expansion in Makurdi Metropolis highlights a concerning trend of diminishing per capita availability over time. The disconnect between population growth (geometric progression) and water supply expansion (arithmetic progression) underscores the urgent need for proactive measures to address the widening gap. Failure to do so risks exacerbating water scarcity and compromising the well-being of residents.

The identified challenges, including financial constraints and unreliable power supply, pose significant obstacles to meeting the water supply targets of the scheme. These challenges necessitate a multifaceted approach, involving improved financial management, alternative funding mechanisms, and investment in renewable energy solutions to enhance operational resilience and ensure sustainable water supply to the population.

Conclusion

Based on the findings of this study, it is concluded that the Greater **t**he quantity of water requirement need of Makurdi Metropolis on daily basis was higher than the daily water supply by the scheme implying that the scheme supply water below the quantity of water requirement of Makurdi Metropolis. Furthermore, geographically most of Makurdi Metropolis areas do not receive water from the scheme and the per capital water access by the population was also grossly inadequate as against stipulation by National Water Supply and sanitation policy.

Recommendations

Based on the study findings the following recommendations are made:

i. The scheme should in conjunction with the government endavour to distribute water across all adjoin areas in the metropolis.
ii. Benue State government should meet up with the memorandum of understanding areas in Makurdi Metropolis.
iii. The government should assist in funding the scheme so that it should be able to distribute water to Makurdi Metropolis and its environs as stated in her objectives during takeoff of the project.
iv. The scheme should improve on her power supply in order to meet up with the required standard of quantity of daily water supply per head.
v. Benue State Government should make adequate funding for scheme as to enable it supply water to meet up with the water requirement need of the population.

References

Ademiluyi, I. A., Okonkwo, E. M., & Badejo, O. T. (2019). Assessment of Water Demand and Supply in Urban Areas: A Case Study of Makurdi, Nigeria. *Journal of Water Supply: Research and Technology-AQUA*, 68(5), 364-376.

Ajibike, W. A. (2013). Challenges of Urban Water Supply in Nigeria: The Way Forward. *International Journal of Water Resources and Environmental Engineering*, 5(8), 507-515.

Aliyu, A. A., & Dankani, I. M. (2016). Water and Sanitation Management in Urban Areas: Issues, Challenges and the Way Forward. *Journal of Public Administration and Governance*, 6(4), 1-14.

Chia, T. N., & Ndulue, E. N. (2014). Issues of Domestic Water Supply in Makurdi Metropolis, Benue State, Nigeria. *African Research Review*, 8(1), 253-272.

Obadiah, M. O. (2011). Public Water Supply System for Partnership Arrangement: A Case Study of Lafia Town, Nasarawa State, Nigeria. *Journal of Sustainable Development*, 4(4), 199-209.

Ogbonna, D. N., Oke, S. A., & Gbadebo, A. M. (2018). Impact of Population Growth on Water Resources and Infrastructure in Urban Areas: A Case Study of Otukpo, Nigeria. *Journal of Environmental Management and Safety*, 6(1), 48-59.

Okonkwo, E. M., Ademiluyi, I. A., & Badejo, O. T. (2020). Spatial Analysis of Water Supply Coverage in Urban Areas: A Case Study of Makurdi, Nigeria. *Journal of Geographic Information System*, 12(1), 34-47.

Olatunji, O. A., Igwegbe, C. A., & Eze, I. L. (2021). Evaluation of Daily Water Supply Volume and Distribution Patterns in Urban Areas: A Case Study of Katsina-Ala, Nigeria. *International Journal of Environmental Research and Public Health*, 18(3), 1256.

Onuche, A. E., Akpor, O. B., & Igwegbe, C. A. (2020). Assessing the Efficiency of Reticulation Networks in Urban Water Supply Systems: A Case Study of Greater Makurdi, Nigeria. *Journal of Water, Sanitation and Hygiene for Development*, 10(3), 518-529.

Sani, A. (2006). Water Resources and Water Policy in Nigeria. A Paper Presented at the International Workshop on Water Resources and Management in Nigeria, National Water Resources Institute, Kaduna.

The World Water Organization (2010). World Water Development Report 3: Water in a Changing World. *United Nations Educational, Scientific and Cultural Organization* (UNESCO).

The World Water Organization. (2010). World Water Development Report 3: Water in a Changing World. United Nations Educational, Scientific and Cultural Organization (UNESCO).

UN Report. (2009). The Millennium Development Goals Report 2009. United Nations

Department of Economic and Social Affairs.

UNFPA. (2001). State of World Population Report 2001: Footprints and Milestones: Population and Environmental Change.

United Nations Environment Programme. (2008). Freshwater under Threat: South Asia. United Nations Environment Programme.

World Health Organization and UNICEF. (2006). Meeting the MDG Drinking Water and Sanitation Target: A Mid-Term Assessment of Progress. World Health Organization.

World Water Assessment Programme. (2009). The United Nations World Water Development Report 3: Water in a Changing World. UNESCO.

World Water Development Report 3. (2009). UNESCO.