

Water Resources Development in Nigeria; Past, Present and Future

Etim Ime, I. I. Ahuchaogu and A. F., Alonge

Department of Agricultural and Food Engineering, Faculty of Engineering, University of Uyo, Nigeria.

DOI: <https://doi.org/10.51244/IJRSI.2026.1306000308>

Received: 06 May 2026; Accepted: 12 May 2026; Published: 08 July 2026

ABSTRACT

Water is the second most important resource for man's survival on earth after air, its availability, exploitation, distribution utilisation and management has been a major concern in Nigeria in the last six decades. Its usefulness cut across all aspects of our national economy ranging from hydropower generation, irrigation, water supply, transportation, tourism, fishing and recreation. In Nigeria, the history of water development dates back to the pre-colonial days.

This review aims at examining the trajectory of water resources development in Nigeria from when basins were not identified to this era where GIS has helped out with sustainability. Among other things this paper highlights various projects, establishment, government policies as they relate to the wholesomeness of water and institutional frameworks that have hitherto help shaped the water resources development in the country.

Historical overview has shown water resources in Nigeria have evolved through distinct phases with their accompanied challenges, and has brought socio-economic changes with its economic benefits. This sector of the economy has serviced commerce, industry, agriculture, power, energy, labour, and tourism. This has triggered tremendous growth even though with its uneven geographical spread. In spite of decades of investment and multiple policies reforms access to clean and safe water is still a mirage in many communities across the nation as it involves mixed reflection of progress and persistent gap in infrastructure, governance and service delivery.

In conclusion, it is observed that there are too many government agencies and parastatals that are vested with water resources management in the country hence overlapping responsibilities and conflicting interests. Therefore, it is recommended that government should cut down on the number of agencies responsible for water resources development and the management should be vested on professionals in all areas involved for satisfactory delivery.

Keywords: Water resources, infrastructural development, government policies, sustainability, Nigeria

INTRODUCTION

Beginning Concepts

Water is one of the most essential resources for all lives' activities in human existence. Its importance is far beyond the roles it plays in human survival which includes physiological, healthy living, environmental and economic development. According to Onuh and Bassey (2021), the maintenance of healthy ecosystems, biodiversity, pollution control and desertification are all water related. Water resources development is a whole lot of complex synergy touching nearly every aspect of human existence. Bidaisee (2018) stated that even being recognised of its essential role in all human endeavours, its availability is continuously decreasing with over two billion people lacking clean and safe drinking water globally. Only about 0.3% of global water resources are usable, and increasing population coupled with human activities are leading to water shortages in many countries (Kilic, 2020). Globally, resources mean various things to various professionals, in this contest,

resource is anything in the environment that can be used by humans to satisfy their needs and desires or to achieve social objectives. And this can be water, minerals, soil, plants, animals or human-related assets, all of which must have utility, be assessable, and available in sufficient quantity. The concept of resources is dynamic since things that are not useful today might become valuable in the near future. Some of the most commonly used natural resources include coal, natural gas, oil, water, and forests.

The importance of water has been recognised throughout history, with ancient civilizations revering it as sacred (Mfon *et al.*, 2022). Man's early communal life and civilization like the Sumers, Romans, Egyptians and the Indus is traced to water sources like streams, rivers and lakes (Cech, 2013). About 6000 years before Christ, Iranians had given water a special respect in their scheme of things to the point of worship as recorded in the Holy Avesta, at the time of monotheistic prophet Zoroaster (6000 B.C.) (Mays, 2001). According to (Martin, 2001) the global history of water resources development spans millennia, with early civilisations in Egypt, China and the Middle East pioneering irrigation and flood control projects. Frioux (2014) stated that 70% of the Earth is covered with water of which 97% are in the ocean and 2% are in the rivers, streams, lakes and ponds. This limited quantity of fresh water is further depleted by industrial pollution. It plays crucial role in agriculture, industry, health, energy, environment and the ecosystem (Odume and Slaughter, 2017). The advent of River basin development results in the exploitation of water sources and sometimes causing scarcity downstream (Adeoti *et al.*, 2020). It can be said that the availability of water in a region set the pace for development in such region, be it irrigation, fishing, industry, agriculture, transport, hospitality and even tourism. Frioux, (2014) added that throughout history, mankind had developed technologies to master the water system on Earth, inventing cistern for storage, propellers for convergence and treatment plants for drinking and domestic purposes. The negative part of water cannot be underestimated, as issues of diseases and epidemic stemmed from the absence of safe and clean water, while flooding and landslides are results of excess water.

Water, a resource that is naturally abundant in Nigeria but its richness is poorly managed and its under-utilisation is continuously undermining the socio-economic development in the country (Oyebode *et al.*, 2015). To make this multi-sectorial resource a success, planning, management and implementation of projects are required to effectively utilise and conserve water for various human and environmental needs. A good water resource development can serve the purpose of water supply system for domestic and industrial purposes, irrigation project, hydro-power generation, flood control, groundwater management, water conservation and environmental protection. Nevertheless, global disparities in water distribution persist, and climate change poses new challenges for water resources management (Frioux, 2014).

Nigeria's enormous water sources are unevenly distributed geographically, some are seasonal, while majority flow all year round (Ayoade, 1975; Mfon *et al.*, 2022). The total renewable water resources per capita is estimated at 286.2 Km³/ year, with over 267 billion cubic metres of surface water supplies and 52 billion of groundwater supplies, yet access to clean water is reported to be as low as 69 per cent (Onuh and Bassey 2021; Mfon *et al.*, 2022). Rainwater is a common source of water in all parts of the country, while the northern region faces low rainfall between 100-250mm/ year with higher population the southern region enjoys rainfall range of between 1000-3000mm/year and sometimes enjoys all-year-round even with her lower population (Onuh and Bassey, 2021). However, the country's growing population and rapid urbanisation is putting pressure on the water resources. Hatimi (2013) reported that in developing countries, over a million people die annually as a result of water-related diseases of which 90% of them are children below five years of age.

Water Resources Development, Food security in the light of SDGs

Water resources development is fundamental to achieving the Sustainable Development Goals (SDGs), especially in the context of mitigating hunger, sustaining the economy, and ensuring food security. The place of water in food production cannot be over-emphasised, from crop germination to harvest water is required. According to (Iortyom and Kargbo, 2023), approximately 70% of global freshwater harvest is dedicated to agriculture, mainly for irrigation. Beside rainfall water serves as a boost to agricultural productivity and consequently address food shortages. Various efforts to address hunger and food insecurity have exploited localised irrigation methods which invariably expanded and optimized irrigation as highlighted in the initiatives like Nigeria's Water For expanded Irrigated Agriculture Programme (WEIRPRO), directly increases

crop yields and food availability, thus alleviating hunger. Improved water management such as the adoption of modern irrigation techniques and efficient allocation enables regions to consistently produce enough food, even in the face of climate variability (Adamu, 2023).

One way of sustaining the economy is to make water assessable to all, as it removes various barriers to economic growth through increased agricultural and industrial productivity. Water- intensive food production underpins rural economies, Irrigated agriculture produces about 40% of global food on less than one- third of arable land, supporting livelihoods and stimulating local economies. It is observed that investment in water infrastructure and effective governance reduces poverty, fosters inclusive growth, and builds resilience against climate-related shocks. Iortyom and Kargbo, (2023) stated that food production is water-dependent and that it takes about 2000 litres of water to produce the daily food needs of one person. Therefore, water scarcity could threaten food security.

Historical Perspective of Water Resources Development in Nigeria

Before the arrival of the British colonial administration communal life among Nigerians was geared towards closeness to water sources where domestic needs would be met easily and water stored in clay pots for family use. Water was mainly for domestic purposes like drinking, bathing, cooking, washing and gardening. Women and children were involved in water collection, rainfall harvesting and simple irrigation (Ayoade, 1975; Ahuchaogu *et al.*, 2019^a). The coming of the British colonial administration in Nigeria introduced the piping network system which mainly served urban centres and residences of the colonial Lords. In order to cater for water supplies the British administration established the Public Works Department (PWD) in Lagos, then the construction of the first water treatment plant in Iju, a suburb of Lagos which was completed in 1915 (Onuh and Bassey, 2021). More of such projects were set up in cities like Enugu, Kaduna and Calabar but little was done to the rural areas and agricultural sector (Ahuchaogu *et al.*, 2019^b).

Post- Colonial Era (1970 -1980)

In 1976, the Federal Ministry of Water Resources was created to specifically handle water resources development projects in the country. Prior to this period, water resources functions were scattered across various ministries and departments. The establishment of the ministry was part of a broader efforts by the federal government to centralise and coordinate water resources planning, development and management across the country (Ayoade, 1975; Mfon *et al.*, 2022). It was driven by the need for more integrated and strategic water resources management, especially in the light of agricultural development, urban water supply demands, and rural water needs. The responsibility of the ministry was enormous and inter-related with many sectors of the economy like agriculture, industries hydro-electricity generation, commerce, fishing, legal and tourism. Ojiako, (1985) pointed out reasons to create subsidiaries to cater for specific needs of water. This led to the creation of River Niger and Lake Chad Basin Development Authorities in 1973 and 1974 respectively (Table 1). The responsibilities of the river basin authorities were to see to the development, exploitation and management of the available water resources and land within its jurisdiction (Omole *et al.*, 2013; Olufemi *et al.*, 2015). Several dams and irrigation schemes were initiated, such as the Bakolori Dam and Kainji Dam constructed in 1968 and 1974 respectively for hydroelectric power and irrigation (Onuh and Bassey, 2021). Kainji Dam was Nigeria's first major hydroelectric project established for power generation in the country. The Bakolori Dam came in immediately between 1974 to 1978 with primary focus on irrigation and water supply (Yahaya, 2003). Shortly after, the nation witnessed new financial era described by many as the oil boom, a period of excess money and the inaugurated of the national Planning (1970-1980) (Martins, 2001). This period saw the establishment of the urban water supply and large-scale irrigation projects among other national projects. The establishment of Federal Ministry of Water Resources in 1976 was to coordinate national water projects across the country, formulate policies and manage water resources. Later part of the decade witnessed the creation of more river basin development authorities as seen in Table 1. Figure 1 shows various River Basin Development Authorities and their locations in the country. The River Basin Acts established 12 additional river basins between 1977 to 1979. Yahaya (2003) reiterated that the period between 1970 to 1980 was a transformative period marked by institutional establishment, large-scale investments and strategic national planning.

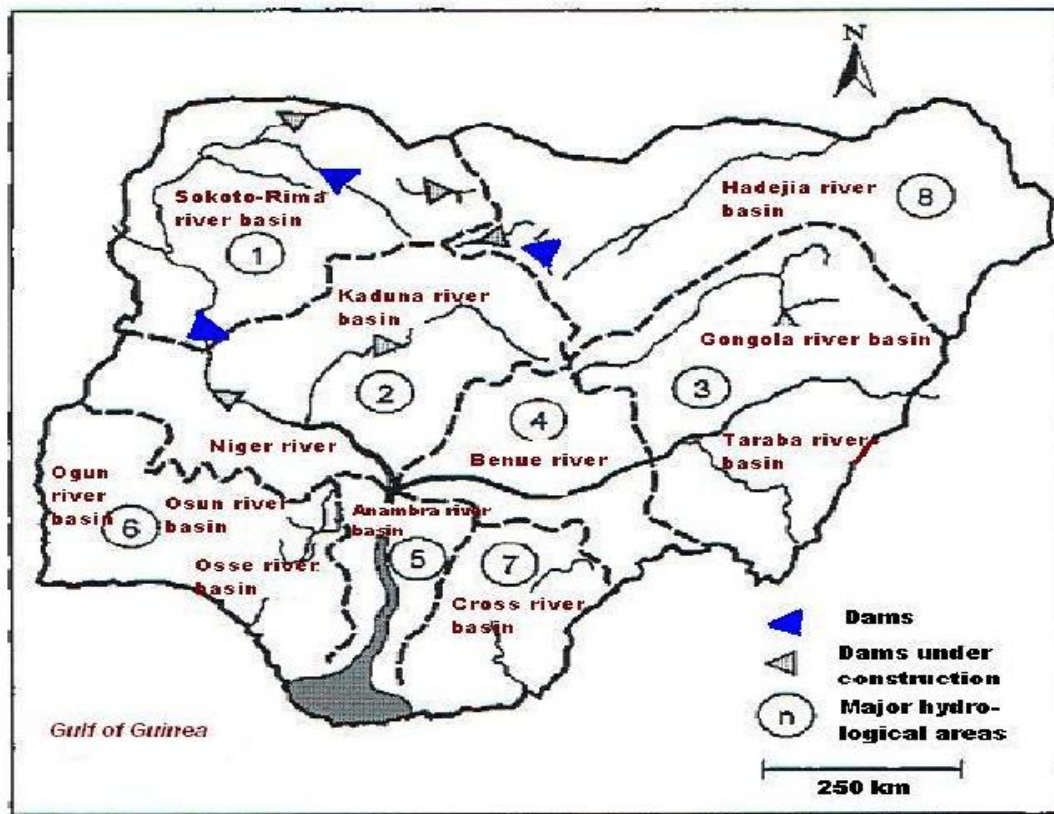


Figure 1; Review of River Basin Development in Nigeria.

Source; Author

All in the bid to develop the national water resources, many other policy frameworks like the Water Resources Acts of 1993, the National Water Policy created in 2004, the Minerals Acts of 1990, and the National Inland Water Authority Decree 13 Of 1997. Under the water resources Act of 1993, the Federal Ministry of Water Resources (FMWR) was given the sole responsibility for both the development and management of water resources in Nigeria. Isukuru *et al.*, (2024) stated that in spite of abundant water resources, the country still faced significant water crisis especially in the northern region of the country leading to drought and desertification, and in the south, water pollution, flooding and oil spillage (Adeoti, 2021, Omokaro *et al.*, 2024). The consequences are chronic environmental pollution as well as severe public health menace.

Table 1; River Basin development in Nigeria and Years of Establishment

	RBDA	Headquarters	States covered	Year of Establishment
1	Chad Basin	Maiduguri.	Borno, Yobe and Adamawa	1973
2	Sokoto-Rima	Sokoto	Sokoto, Zamfara. Kebbi, Katsina	1976
3	Hadejia-Jama'Are	Kano	Kano Jigawa, Bauchi and Yobe	1976
4	Upper Benue	Yola	Adamawa, Taraba, Gombe	1976
5	Lower Benue	Makurdi	Benue Nasarawa, Kogi	1976
6	Cross River	Calabar	Cross river, Akwa Ibom	1976
7	Anambra-imo	Owerri	Anambra, Imo , Enugu	1976
8	Niger- Delta Basin	Port Harcourt	Rivers, Bayelsa, Delta	1976
9	Benin-Owena	Benin City	Edo, Ondo, Ekiti	1976
10	Ogun-Osun	Abeokuta	Ogun, Osun, Lagos	1976
11	Upper Niger River Basin	Minna	Kwara, Niger, part of kogi	1976
12	Lower Niger River Basin	Ilorin	Niger, Kwara, Kaduna, Kogi and FCT	1994

Source; Bureau for Public Entreprises.

National Development Era of 1980-1990

This era witnessed three times changes in government, culminating into inconsistencies in policy implementation and economic downturn. It was a season of sharp drop in oil prices globally and national unsustainable debt burden leading to the introduction of the Structural Adjustment Programme (SAP) resulting into reduced funding of very many projects across the country including water resources development projects (Omobowale, 2021). Many existing facilities began to deteriorate due to lack of proper maintenance. At this point attention was focused on maintaining existing facilities and not the establishment of new ones. Then was the formulation of the National Water Resources Council (NWRC) through the National Water Resources Acts of 1993 and later reenacted as the National Water Resources Acts (Cap W2) Laws of the Federation of Nigeria 2004. According to (Mfon *et al.*, 2021) the mandate of this policy was to formulate policy guidance to the Federal Minister of Water Resources on national policies and strategies for the integrated planning, management, and conservation of the nation's water resources. Secondly, it was put in place to maintain standard and provide guidance for water supply and sanitation services across the country. Furthermore, the council was to serve as a co-ordinating agency of all the various institutions in the water sector such as the River Basin Development Authorities (RBDAs) to ensure a cohesive approach to water management.

The setbacks observed in all these institutional formulations were that there were more in-house policy-oriented water resources administration than technical oversight, thereby leading to the breakdown of the chain of facilities monitoring and evaluation. Attention was later focused on rural water supply (Bello and Ya'u., 2024).

According to Acey (2011), one of the major approaches adopted in improving rural water supply was the provision of boreholes, hand pumps, and small-scale water schemes. These interventions were introduced as practical strategies for extending potable water services to underserved rural communities where centralized urban water infrastructure was either unavailable or inadequate. Rural settlements in many developing countries, including Nigeria, often face serious challenges in accessing safe and reliable water due to poor infrastructure, inadequate government investment, population dispersion, and difficult terrain. As a result, decentralized water supply systems became necessary to bridge the gap in water accessibility.

The drilling of boreholes became a widely adopted solution because groundwater is generally more reliable and less susceptible to seasonal fluctuations compared to surface water sources such as streams and ponds. Boreholes tap into underground aquifers and provide relatively clean water for domestic use, irrigation, and small-scale economic activities. In many rural communities, boreholes significantly reduced the burden of long-distance water collection, especially for women and children who traditionally spend several hours daily fetching water from distant sources (Aluko *et al.*, 2022).

Hand pumps were commonly installed alongside boreholes to facilitate easy extraction of groundwater in areas without electricity or advanced pumping systems. These manually operated systems were considered cost-effective, durable, and suitable for rural environments with limited technical capacity (Sharpe *et al.*, 2022). Hand pumps also encouraged community participation because local residents could be trained in basic maintenance and operation, thereby improving sustainability and ownership of the water projects.

Small-scale water schemes, including community-based water supply networks, mini water treatment systems, and localized distribution facilities were installed to further enhance rural water accessibility. These schemes were designed to serve clusters of households, schools, healthcare centres and local markets. Unlike large urban water projects that require extensive infrastructure and high financial investment, small-scale schemes were more adaptable to local conditions and could be implemented more rapidly in remote areas (Acey, 2011).

The introduction of these rural water supply initiatives contributed to improvements in public health by reducing dependence on contaminated surface water sources that often transmit waterborne diseases such as cholera, typhoid, and dysentery. Access to safe water also supported agricultural productivity, sanitation practices, and socio-economic development within rural communities. However, despite their benefits, many of these projects faced challenges such as inadequate maintenance, poor funding, technical breakdowns, vandalism, and weak institutional management, which sometimes limited their long-term effectiveness.

Overall, the use of boreholes, hand pumps, and small-scale water schemes represented a significant strategy for rural water development and demonstrated the importance of decentralized water infrastructure in improving living conditions and achieving sustainable rural development. One of the major tools used to reach out to the rural populace was the drilling of boreholes, hand pumps and small-scale water schemes as a means of expanding potable water supply to underserved rural communities (Acey, 2011; Aluko et al., 2022; Sharpe et al., 2022).

Between 1995 and 1999, the Federal Government of Nigeria established the Petroleum Trust Fund (PTF) as a special intervention agency tasked with managing and utilizing revenues generated from petroleum price adjustments to improve critical sectors of the Nigerian economy. Among the sectors prioritized by the PTF was the water supply sector, particularly in rural and underserved communities where access to potable water remained inadequate (Okafor *et al.*, 2023).

The involvement of the PTF in the water sector was driven by the recognition that safe and reliable water supply is fundamental to public health, sanitation, agriculture, and socio-economic development. Prior to the intervention, many rural communities in Nigeria depended heavily on unsafe water sources such as rivers, streams, ponds, and shallow wells, which exposed residents to waterborne diseases including cholera, typhoid, diarrhoea, and dysentery. The poor state of water infrastructure in rural areas was largely attributed to inadequate government funding, rapid population growth, poor maintenance culture, and uneven distribution of public utilities (Ali *et al.*, 2023; Daramola *et al.*, 2023).

To address these challenges, the PTF embarked on various rural water supply projects across the country. These projects included the drilling of boreholes, rehabilitation of damaged water facilities, installation of hand pumps, construction of small-scale water schemes, and provision of storage and distribution facilities. The agency focused mainly on rural and semi-urban communities that lacked access to pipe-borne water systems. Through these interventions, the PTF sought to reduce the distance travelled by rural residents in search of water and improve the general quality of life of the people (Daramola *et al.*, 2023; Iroh, 2023).

The PTF's rural water projects contributed significantly to increasing access to potable water in several parts of Nigeria. Many communities benefited from newly constructed boreholes and rehabilitated water systems, which improved domestic water supply for drinking, cooking, washing, and sanitation purposes (Obeta *et al.*, 2023). The interventions also had indirect socio-economic impacts, including reduction in disease outbreaks, improvement in hygiene practices, increased school attendance among children who previously spent long hours fetching water, and enhanced productivity among rural dwellers (Okafor *et al.*, 2023).

Despite these achievements, the PTF water supply initiatives also faced several limitations. In some communities, poor maintenance and lack of technical support led to the breakdown of facilities after a short period of operation. Inadequate community participation, corruption, inconsistent monitoring, and insufficient sustainability planning also affected the long-term effectiveness of some projects. Nevertheless, the PTF represented one of the major federal intervention efforts aimed at improving rural infrastructure and expanding access to safe water during the late 1990s (Obeta *et al.*, 2023; Okafor *et al.*, 2023).

Recent studies continue to acknowledge the importance of intervention agencies such as the PTF in the historical development of Nigeria's rural water supply sector. For example, Ali, *et al.*, (2023) noted that the PTF played a notable role in extending water infrastructure to rural communities and supporting national efforts toward improved water accessibility and rural development.

Democratic Era and Reforms from 1999 to-date

At the inception of the democratic era, the federal government came up with renewed zeal to effect changes in all sector of the economy and one area that needed that most was the water sector after experiencing redundancy for over a decade. The then government started reformations involving both private partners as well as international organisations, while the Federal Ministry of Water Resources served as the central coordinating body. Initiatives such as the National Water Resources. Master Plan in 2013 and partnership with international bodies like UNICEF, and the World bank targeted rural and urban water supply, sanitation and

climate resilience UNICEF/WHO (2015). In order to expedite action national water began the drilling of approximately 23,000 boreholes across the nation during 2000s. This was part of the National Project on the Accelerated Rural Water Supply and Sanitation (NPARWSS). The programme was aimed to improve access to safe drinking water in rural areas. This marked a renewed beginning of the country's collaboration with international bodies like the UNICEF and the World Bank (Olujobi *et al.*, 2022).

The period between 1999 to 2010 witnessed the water resources development in Nigeria faced with significant challenges as a result of climate variability, population growth, and inadequate management practices. Climate change impacts were projected to cost Nigeria between 2 -11% of its GDP by 2020, expected to rise between 6-30% by 2050 (Enete and Ezenwanji, 2011). According to Nwakwoala (2011), government invested so much in the sector but due to poor coordination from its agencies and conflicts among interest group led to resource wastages. Nnaji, *et al.*, (2010) predicted that the Hadejia River sub-catchment may witness potential water scarcity if urgent steps were not taken. Policy development faced contradiction and overlapping in statutory responsibilities, impending implementation. A paradigm shift focusing on River basin Development Authorities (RBDAs) was proposed with emphasis on energy, food and public health sectors for at least ten years a "Dedicated Water Resources Bill" (Okeola and Balogun, 2017; Kolade, 2025).

Public-Private-Partnership in Water Resource Sector

The multifaceted nature of the water sector gives room to many participators in difference areas like agriculture, fishing, irrigation, hydropower and tourism. It became obvious that the government cannot do it alone especially in the area of funding. According to the (United Nations 2019; Kolade, 2025), between 2015 and 2025, Nigeria should have adopted the Public-Private -Partnership (PPP) to enhance its water resources infrastructural development. This collaboration is expected to bridge the gap, improve service delivery and promote sustainable development in the sector. This policy which was tagged; Nigeria National Policy on Public-Private Partnership established in 2013, was set up to provide legal and institution framework for PPPs to ensure transparency and accountability in infrastructural development in the water sector of the economy. The idea was to bring in innovative financing and mechanism such as Build-Operate-Transfer (BOT) models and concession agreement to enhance the development and management of the Nigeria's waterways. This was to attract private investment while alleviating the financial burden on the government (Omokaro *et al.*, 2024). Major among them were the Gurara 1 hydroelectric project in Kaduna, a 30 MW hydro-electric power developed through a concession agreement with North South Power company. Another of such initiatives is the Gurara II, a 360 MW hydro power electric project funded by a \$1 billion Dollars loan from Exim Bank of China with the Nigeria Government contributing the remaining \$240 million. Construction began in 2023 with the completion date being slated at 2026 (Yusuf, 2022).

Other area of interest is the agricultural sector. The government partnered with another consortium in the Rima Valley Irrigation Project covering 110 hectares of land to boost commercial agriculture and in the North-West region of the country. In Ondo State, the Owena Multi-Purpose Dam built to provide water supply through distribution network system developed via PPP arrangement.

Lagos is the commercial hub of the nation with a population density above 16 million people. One of its major problems is water. To cater for this problem, the Lagos State Water Corporation was established in 1986 to manage water issues in the state. This was about the first time the duties of the federal government were transferred to the state. It started as an agency named Lagos State water Management Board in 1979, then became Lagos State Water Corporation in 1986, and later renamed Lagos Water Corporation in 2004 under the Lagos State law. Even though Lagos had the privilege of owning the first water treatment plant in the country that is the Iju treatment plant with an initial designed capacity of 2.45 million gallon per day (MGD) but was primarily constructed to supply water to the colonial residents of Ikoyi in those days (Iroh, 2023). The present installed capacity is put at 210 million gallons per day which is a far cry from expected. It was projected that by 2020 the state water production capacity may have risen to 745 million gallons per day. This was a renewed effort by the state government to solve water problem for the teeming population. It is even proposed that the state will require about \$3.5billion to execute its master plan for water supply. Through PPP the state is planning to construct 45 mini and micro water works to enhance daily water production and distribution across the state (Yusuf. 2022).

The eastern part of the country is not left out in the national water resources development scheme with Anambra State taking advantage of the PPP to construct the Birsa water project. This time, with the installation of solar-powered boreholes in Neni community of the state. In most of these projects, the partnership is to build, operate, maintain and collect revenue (Onuh and Bassey 2021).

This new PPP initiative was equally designed to generate revenue for the federal government. In 2020, the federal ministry of water resources generated approximately 1.92 billion Naira from the concession of the Gurara phase 1 multi-purpose Dam, with 80% allocated to government and 20% to the service provider (Yusuf, 2022). For the fiscal year, the ministry targeted £5 billion in revenue through PPP initiatives. Despite these efforts, some PPP projects have faced challenges. One of them is the Third National Urban Water Sector Reformed Programme (NUWSRP3) backed by a \$250 Billion Dollars World Bank loan, aimed to improve water access in Ekiti, Bauchi and Rivers States. Similar project was carried out in Ogun, Kaduna and Enugu States. Billions of Dollars was believed to flow into the country for water resources development yet clean and safe water continue to be elusive to the citizens and sometimes leaving the country in long-term debts. These two aforementioned world bank loans failed in its second year leaving the country with the repayment of \$6.05 million yearly for an upward period of 40 years. The consequences of these failed projects result in unmet expectation of water supply and continuous impoverishment of the citizens which is against United Nations goal 6, aimed at eradicating hunger and poverty by the year 2030 Hoff, (2009).

Key Challenges Over Time

Water resources development involves large financial resources and expertise to operate functionally. Inadequate funding and poor project execution could cause delayed delivery and implementation. Besides, other factors such as climatic change, demographic, economic, social, technical, legal and political conditions can affect the performance of water resources system (Omokaro *et al.*,2024). Where water issues are deliberated, two parameters are often of utmost importance namely water quality and water quantity. Sharpe *et al.*,(2022), highlighted that the fundamental goal of water resources planning and management is to match the demand for water with the socio- economic system with supply (quantity and quality) of the water system through administration control and management (water regulations laws and infrastructure), without compromising ecosystem sustainability (Ahuchaogu *et al.*,2019^a). The challenges of water management issues are multi-faceted, identifying uncertainties may not rest on administration alone as often noticed in Nigerian cases. Poor infrastructures, rapid population growth, pollution and contamination, climate change, inconsistency in government programme and policy implementation, unfairness in water distribution across the country, conflict over water resources and limited technical expertise, water rights are but to mention a few (Ahuchaogu, *et al.*,2019^b). It is a common phenomenon to see aging water infrastructures still being use. These infrastructures may date to the days the colonial master thereby leading to unclean and unsafe distribution of water. Where population has overstretched water availability the consequences are poor sanitation and increased rate of disease out-break. It can be recalled that before the coming of the colonial rule in Nigeria most settlements were close to water sources (Ali *et al.*,2023). The Nigerian water development history reflects transition from localised; tradition water uses to large scaled state-managed network distribution systems. Industrial waste (solid, liquid and gaseous) is not well managed the result is pollution and contamination of surface, groundwater and the air (Aluko *et al.*,2022). In time past rural dwellers depend mostly on surface water as the major source for domestic purposes, but today greater percentage of these water bodies are polluted with agricultural pesticides thereby degrading the water quality rendering them unsafe for consumption and sometimes these rural dwellers are unaware leading to large spread of water related diseases.

The hydrologic cycle has been distorted in the past six decades with the phenomenon known as climate change which has resulted to water related changes globally., from the rise of the sea level to salt water intrusion, excess rainfall and devastating flooding which in turn reduce water availability in many regions in Nigeria (Omokaro *et al.*,2024).

The weight of water resources management in Nigeria is enormous with the FMWR at the helms of affairs. Carrying these responsibilities alone across the country weakens governance couple with poor policy implementation which rather makes water issues cumbersome. Ineffective management, insufficient funding,

and weak institutional frameworks hinder water resources development projects across the country (Ali *et al.*, 2023). The problem of unequal water projects distribution contributes to the success of water development in Nigeria. It is observed that more water projects are concentrated in northern region of the country than in the south. These disparity in the geographical distribution distort even distribution of socio-economic benefits to the citizens across the country (Isukuru, *et al.*, 2024) Water bodies in some regions serves as a source of conflicts, dispute among communities and states over water rights and usage exacerbate developmental strikes. A sustainable water works will require the presence of technical experts. Insufficient skill personnels have hindered sustainable water management practices in the country. According to Onuh and Bassey (2021), the issue of accountability has echoed many times in the water sector of the nation's economy. In 2003 it was reported that £10.7billion was approved for nationwide water projects including the rehabilitation of existing Dams and construction of new water supply schemes (FMWR, 2016). World Bank, (2003) reported estimated spending of \$500 million on water resource in Nigeria between 1999 to 2004, including projects for rural water supply, urban sanitation and irrigation development. The federal government in 2013 took stock of its investment in water sector of the economy by organising the national water resources master plan, focusing on integrated water resources management and addressing challenges such as climate change and population growth. The current roadmap for the sector is to last between 2011 to 2025, a project implementation outlined as strategies for sustainable water resources development, including dam construction, irrigation and water supply across various states of the federation (Yusuf, 2022).

Budgetary allocation to the FMWR has enjoyed steady increase from 2015 to date, in 2016 there was an upward of 46.5% increase. From 2017 till 2024 the allocation on water resources have enjoyed substantial increase with significant portion of the budget allocated to capital expenditures, underscoring government commitment to development and maintenance of water infrastructure. Allocation to dam-related projects often take large chunk of government budgetary allocation to water resources notable in 2016, 2017, and 2018. A major contrast to the allocation was that most of the years focus was on dam safety and standard, neglecting other areas of water development (Bello, 2021).

According to Omole, (2013), less than 60% of Nigerians have access to safe and clean water. So may have resorted to finding alternatives, Onuh and Bassey, (2021) stated that the decadence in the water sector have led to the emergence of many private businesses in the sector, charging for clean water from five thousand Naira to forty thousand Naira monthly depending on capacity and location. Akpor and Michie, (2011) reiterated that the dearth in the water sector has led to self-help where many have resulted to exploiting the underground water resources in an unstructured, uncoordinated and sustainable manner. This uncoordinated exploitation of groundwater has consequences, considering the geological, geochemistry and other anthropogenic condition may affect the quality of the water. (Olufemi *et al.*, 2015).

Table 12 Dam, locations and other Parameters in Nigeria

S/N	Dams	location	Basin Covered	Year of Commencement of Construction	Year of commission	Capacity in m ³	Purpose of creation	References
1	Kainji Dam	Niger	Niger	1964	1968	15,000	Hydro-electric power, irrigation and fishing.	Ahmadu et al., (2022)
2	Asejire Reservoir	Oyo	Osun		1972	Not specified	Water supply	Utete, and Fregene (2020)
3	Bakolori Dam	Sokoto	Sokoto		1978	450	Irrigation and water supply	Yusuf (2022).
	Tiga Dam	Kano	Kano	1971	1974	1,874	Irrigation and water supply	Bichi et al., (2023)
5	Ede-Erinle Reservoir	Osun	Erinle	1980	1982	Not specified	Water supply	Ojo and Imene

								(2014)
6	Ikere Gorge Dam	Oyo	Oyo		1982	690	Hydropower and water supply	Berga (2006)
7	Kiri Dam	Adamawa	Gongola		1982	615	Irrigation and planned hydropower	Zemba, (2016)
8	Oyan River Dam	Ogun	Oyan		1983	270	Water supply, irrigation, and Hydro power	Babatunde and Nimrod (2011)
9	Zobe Dam	Katsina	Karaduwa		1983	177	Water supply and irrigation	Bello et al (2023)
10	Dadin Kowa Dam	Gombe	Gongola		1984	2800	Water supply and irrigation.	Adamu, (2023)
11	Goronyo Dam	Sokoto	Roma		1984	942	Irrigation	Ahmed, (2023)
12	Jebba Dam	Niger	Niger		1984	3600	Hydropower	Bello, (2021)
13	Jabi Dam	Abuja (FCT)	Jabi		1984	Not Specified	Water supply and fishing	Okonkwo (2022)
14	Jibiya Dam	Katsina	Gada		1987	142	Water supply and irrigation.	Enplan Group, (2004)
15	Shiroro Dam	Niger	Kaduna		1990	Not specified	Hydropower	Adamu (2023)
16	Challawa Gorge Dam	Kano	Challawa		1992	930	Irrigation and water supply	Zemba (2016)
17	Obudu Dam	Cross river	obudu		1999	Not specified	Fishing, Tourism, irrigation and recreation	Esu et al (1995)
18	Zungeru Dam	Niger	Kaduna		Under construction	Not specified	Hydropower	Adamu (2023)
19	Mambilla Dam	Taraba	Donga		Planned	Not specified	Hydro power	Ahmed (2021)

Source; Author.2026

Future Outlooks for Water Resources Development in Nigeria

As Nigeria moves towards meeting the United Nations Sustainable Development Goal 6- ensuring availability and sustainable management of water and sanitation for all, there is a growing urgency to reform, innovate, and invest strategically in the water sector (Onuh and Bassey 2021). The future of water resources development in Nigeria will depend on integrated planning, technological advancement and strong political will. World Commission on Environment and Development in a report published 1987 defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This was adopted by United Nations members in 2015 as one of its 2030 agenda highlighting the connections between the environment, social and economic livelihood of the world citizen It's a concern that caters for tomorrow's world. According to Kundzewicz, (1997), water resources management is fundamental in actualizing socio-economic goals. A joint meeting of the federal government and other international partners came up with a road map in 2013 called the National Water Resources Master plan in line with United Nations SDGs with a target year of 2030, with the aims of improving water supply covering

the rural and urban areas alike. Secondly irrigated agriculture was to be expanded and finally all institutions relating to water were to be strengthened. To enhance efficiency technological and data driven management was not to be neglected, using satellite-based hydrological mapping, remote sensing and automated monitoring systems. The essence is to improve water resources planning and allocation. Digital platforms for billing, leak detection and customer feedback are also transforming urban water utilities in pilot cities.

CONCLUSION

Water resources development in Nigeria has undergone significant transformation, moving from traditional community-based practices to large-scale infrastructural projects and institutional reforms. Past initiatives laid the groundwork for understanding the nation's hydrological potential. The colonial and post-independence eras laid the foundation for modern water systems through the construction of dams, irrigation schemes and urban supply networks. However, decades of underinvestment, mismanagement and weak policy implementation have hindered progress, leaving millions without reliable access to clean water. The present efforts are characterized by ongoing projects, policy adjustments, and increasing awareness of the challenges posed by population growth and climate change. Looking ahead, a sustainable and integrated approach is crucial for national development.

Today, Nigeria faces pressing challenges ranging from aging infrastructure and inadequate financing to the growing impacts of climate changes. Despite these obstacles, there is a renewed opportunity for reform and innovation. National strategies such as the water resources master plan and sector roadmaps signal a commitment to integrated water resource management and climate resilience. The future of water development in Nigeria depends on sustained political will improved governance, adoption of smart technologies and inclusive participation from communities and the private sector. By learning from the past experiences and embracing sustainable data-driven solutions, Nigeria can secure water for food, energy and economic development for future generations

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