



RESEARCH ARTICLE

ASSESSMENT OF POTABLE WATER INVESTMENTS AND SUSTAINABILITY

CHALLENGES IN NIGERIA

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ABSTRACT

The paper will critically analyze the initiatives towards the supply of the Nigerian people with the potable water infrastructure and assess how sustainable the efforts were in the long run. The study is conducted using a longitudinal survey as a research methodology to analyze the time and nature of potable water investments. The research heavily relies on the available literature and statistical tables as well as on the empirical data pertaining to the potable water investments at the Nigerian context. Both the colonial and post-independence eras witnessed the construction of the public potable water utility with the main intentions of improving human health, sanitation, hygiene, and general well-being. They were found to have four phases of potable water investment the colonial and early independence period (1900-1975), River Basin Development Authority period (1976-1992), the Rural Water Supply and Sanitation Agency period (1993-2000), and the Millennium Development Goals/Sustainable Development Goals period (2000 to the present) period. The paper presents the factual importance of external support in forming the investment of potable water at these intervals. Despite the high level of emphasis on the idea of sustainability in the policy-making process, there is a lack of sustainability in practice because of poor execution and inefficient management of investments. This has resulted in little substantive advancement in the provision of potable water infrastructure especially against the backdrop of the decreasing ability of the government to serve the increasing population of Nigeria at a very high rate. The study suggests the budgetary increments intended to provide potable water, a reevaluation of the water management systems to engage and develop a sense of ownership among the people, and above all, the centralization of sustainable cost recovery systems in order to record meaningful results and milestones.

Keywords: Portable water supply, investment prospect, constraining factors, sustainable management

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1.0. INTRODUCTION

The supply of water to residential, commercial and public places is obtained through a long pipeline network by procuring water, treating it, and broadcasting it. The potable water that is considered to be of high quality and safety can be utilized by humans and other domestic applications. Non-potable water, however, which has not met the requirements of safe human consumption, may still be used as a source of toilet flushing, irrigation, and industrial processes (Halicki & Halicki, 2022). Water services are usually supplied by municipalities or government bodies, usually at controlled prices (Brettenny and Sharp, 2016; Zheng and Wu, 2023). Potable water is a resource that is very important in societies throughout the world.

According to the World Commission on Environment and Development, sustainable development refers to development that satisfies the needs of the current and still allows future generations to satisfy their own needs (Brundtland, 1987). This principle is based on the fact that economic activities are supposed to incorporate the environmental consideration. Sustainable development is seen as one model of developing a balanced environment that promotes quality of life in various aspects. This paradigm states that the gains of using natural resources should be sustained within an acceptable time frame (Larijani, 2016). It is a dynamic process which is associated with changing the institutional structures, investment focus, technological developments and resource management plans so as to meet the present and prospective needs (Khan and Khan, 2012).

Investment can be defined as the putting of capital or resource in assets, projects or financial instruments in anticipation of future returns or benefits. It involves investing money with the aim of: (i) securing the principal investment against depreciation, (ii) building the value of the initial capital over time, (iii) acquiring a steady flow of income, (iv) diversification of an asset portfolio to reduce risk, (v) funding initiatives providing quality of life and improved community services, and (vi) investing in initiatives to benefit underserved or marginalized groups (Rohan Chogale; Lincoln, 1916). It is relevant to state that the investment under consideration is related to the public goods. Paul Samuelson introduced the concepts of non-excludability and non-rivalry as defining characteristics that distinguish pure public goods from private goods.

Non-excludability refers to the impracticality or prohibitive cost of excluding non-payers from consumption, while non-rivalry indicates that one individual's consumption does not diminish availability for others. Conversely, the notion of a public bad encompasses goods that generate negative externalities, such as air pollution, water contamination, deteriorated infrastructure, and disease (Ministry of Foreign Affairs, 2001). Investments on the provision of potable water are provided as public goods and are intended to improve public hygiene, health and sanitation.

The history of the creation of potable water systems is closely connected with the path of the human history. Since the beginning of human civilization, water has been a natural resource. The ancient societies saw the strategic location of settlement close to water bodies since water availability was a major factor that dictated the right of habitation (Amoah and Yahaya, 2013). An example of such a pattern is Mesopotamia, which was the first human settlement located between the rivers Euphrates and Tigris (Houcine Rhili, 2023). Water treatment began in around 4000 B.C. and the purpose of the exercise was to enhance the flavor and smell of drinking water. Initial methods were boiling, filtration, and sunlight. It is worth mentioning the fact that the Egyptians used alum as a coagulant to enable the settling of suspended matter around 1500 B.C. In the 19th century the discovery of



filtration came into the limelight in Europe after it was found in the 1700 B.C. The main reason that caused the water to be treated at this time was the elimination of turbidity, or the visible cloudiness (US EPA, 2000).

By the mid-19th century, scientific interests had moved to solving invisible contaminants. An example is in 1855, the causal relationship between cholera and the contamination of water was put into place by epidemiologist Dr. John Snow. Later on in 1900, medical officers Henry Strachan and Edward H. Reed carried out research studies showing that pathogens like hookworm (*Ancylostoma duodenale*), roundworm (*Ascaris lumbricoides*) and Guinea worm (*Dracunculus medinensis*) are in drinking water supplies. They have found that more than a half of the population was infested with worms that were related to fecal contamination (NAI Lagos Annual Report, Medical Department, 1900: 155; Amoah and Yahaya, 2013).

In Nigeria, the notable water sources in the pre-colonial period were Hand-Dug Wells, Creeks, and open Streams. Hand Dug Wells about four fathoms (24 feet) were reported in northeastern Nigeria (Barth, 1857; Johnson, 1921). Different water storage system was used such as use of mortars, calabashes (gourds used to collect and store water), rock carvings (groings around 2 cm deep), animal skins and water pots (Barth, 1857; Bascom, 1955). Women were the ones that primarily produced and maintained water storage containers. As a case in point, pottery, where high-quality clays were used to create large water storage vessels to be used in households and sometimes in commerce, was an almost exclusively female trade (Hinderer, 1877; Johnson, 1921; Adeniran et al., 2021). The pre-colonial era witnessed the adoption and introduction of most of the water treatment practices used in other civilizations e.g. use of alum in many parts of Nigeria.

The water scarcity crisis in Lagos significantly influenced the prioritization of water infrastructure development in Nigerian urban centers. Samuel Johnson (1921) described Ketu as “a place badly watered, their drinking water being kilometres away from the town,” a condition that precipitated outbreaks of diarrhoea and dysentery (Barth, 1857; Onobhayedo, 2022). Consequently, by 1907, the Public Works Department (PWD) had designed and implemented a piped water system for Lagos, a project completed in 1919 at a cost of £296,700 (NAI Annual Report. Medical Department, 1914).

Subsequently, piped water schemes were established in various locations including Ijebu-Ode (1926), Abeokuta (1913–1914), Kano (1931), Ile-Ife, Ogbomoso, Iseyin, Oyo (1939–1962), Iwo, Ede, Osogbo (1939), Port Harcourt, Calabar, Enugu (1945–1950s), and Ibadan (1930–1952). By 1953, Nigeria had developed 28 water supply schemes (Adibe et al., 2018; Boge, 2019). The expansion of potable water infrastructure was impeded by the economic downturn of the 1930s Great Depression and the disruptions caused by World War II (1939–1945), during which maintenance of existing facilities was prioritized (Danladi, 2019; Adejumo, 2019). In 1966, the Western Region of Nigeria established a dedicated Ministry of Water Resources to manage potable water investments, a model subsequently adopted by other regions and the Federal Government. Presently, the Federal Capital Territory of Abuja and each of Nigeria's 36 states maintain their own Water Corporation Boards (Amoah and Yahaya, 2013; Onobhayedo, 2022).

The National Development Plans provided the framework for the construction of colonial water infrastructure (Okigbo, 1989). The construction of dams at this time was mostly directed to the social services and welfare goals such as flood control and water supply to the people (Mabogunje, 1968). Following the passing of the second and third Colonial Development and Welfare Acts made it easy



to build more dams (Utietiang, 2015). During the 1970s and 1980s, the dams boom was accompanied by the Sahelian droughts in Nigeria, which are the indication of programmed developmental interventions based on the ideologies of colonialism (Adeniran et al., 2021). More information can be found in Table 1.

Even with the emergence of piped water systems, the old methods of getting water like the Hand Dug Wells and Rainwater tanks remained in use at the same time. Smaller settlements especially were left to depend on traditional sources of water and were not widely covered by networks of piped water. However, the active work on sanitary campaigns was done by the instructors, missionaries, propaganda groups, and sanitary inspectors, with the emphasis on the need to boil the water before it was consumed. The sanitary inspectors were very strict on imposing laws such as water treatment, covering the wells, pool drainage, guarding the water sources, and good water storage habits (Onobhayedo, 2022).

The investments made by the post-independent governments on potable water infrastructure can be divided into four phases: (i) the extension of the National Development Agenda; (ii) formation of the River Basin Development Authorities (RBDAs) in 1976; (iii) the creation of the Rural Water Supply and Sanitation Agency (RUWASSA) in 1990; and (iv) the implementation of the initiatives of international character, including the Millennium Development Goals (MDGs) in 2000 and the Sustainable Development Goals

2.0. LITERATURE REVIEW

2.1. Trends Directions and Development in Water Resource Management

River Basin Development Authorities (RBDAs) Built in 1976

The River Basin Development Authorities (RBDAs) have their origin in the Agricultural and Water Development Program initiated by the World Bank in 1974 as a continuation and extension of the National Development Plan 1970-1974 and came within the context of the Nigerian national development. The Federal Military Government officially instituted the RBDAs through the Decree No. 25, which was passed on June 15, 1976, to develop a full institutional system of managing the river basins in Nigeria. They were put within the authority of the Federal Ministry of Agriculture and Water Resources and assigned the responsibilities of constructing, operating and maintaining reservoirs, developing the surface and ground water sources of potable water, irrigation and generation of hydro-electricity (FMWR, 2003). Catchment basins have been identified as the basic unit of water management, quality control and pollution management in the 1989 National Policy on Environment (Water Aid, 2008).

Originally, there were eleven RBDAs represented by the following basins: Niger Delta, Middle Niger, Ogun/Osun, Benin/Owena, Chad, Cross River, Hadejia/Jama'are, Upper Benue, Lower Benue, Anambra/Imo and Sokoto/Rima. The program has mainly focused on production of hydroelectric energy, agricultural irrigation and supply of potable water in cities (Balogun & Ukeje, 1986; Swyngedouw, 2007; Verhoeven, 2015). The number of multipurpose dams constructed was 39 percent between 1972 and 1993 and 30 percent was done between 1993 and 2007. Overall, it elaborated 12,651 boreholes and wells as well as 190 dams. The Nigerian RBDAs were the largest World Bank development projects in low-income countries at that time with an estimated price of



about US 1.2 billion (IEG, 2012). Most of the large dams in northern Nigeria were finished during the democratic rule of 1979 to 1984, and the majority of dams in the southwestern part were completed in the period 1984 to 1998 (Adeniran et al., 2021).

Even with these successes, the program faced problems such as neglect, abandonment, and inefficiencies in its operations, which can be largely explained by its large size and scope of operation that was capital intensive. As a result, the government launched several policy changes in sequence trying to reconsider and improve the operating structures and technical specifications of the RBDAs. There are certain policy developments pointed out in the next section.

Water Resources Decree of 1993

The water resources Decree No. 101 was passed on the 23 rd of August 1993 with the aim of ensuring that Nigeria water resources are planned, developed and utilized in the best way possible. This act gave the Federal Government the power to control and oversee the utilization of the surface and ground water resources. One of the serious aims of the decree was to avoid excessive use and pollution of water sources, which would help to preserve the quality of potential drinking water sources (WaterAid, 2008; Oluwasanya et al., 2011).

National Water Resources Development Master Plan (NWRDMP) of 1995 5.1.2

The first overhaul in terms of re-evaluating the 1976 River Basin Development Authority (RBDA) program in order to streamline water resource management in Nigeria was the National Water Resources Development Master Plan published in 1995. This plan did not only focus on the financial and economic dimensions of managing water resources but it focused on the developmental aspect of the infrastructure of flood control, irrigation and provision of water (JICA, 2013). Among the critical goals, there were the discovery of water sources, the development of water quality monitoring systems, and the need to promote the practice of integrating water resource management with the purpose of guaranteeing the sustainable availability of potable water (Adamu, 2021).

The NWRDMP offered to build 208 large and medium-sized dams in the long term to facilitate irrigation and water supply programs (JICA, 1995; Adeniran et al., 2021). These dams and related boreholes were estimated to cover 1.5 million hectares to irrigation and make potable water available to 80 percent of the population (JICA, 1995). Japan International Cooperation Agency (JICA) was supposed to be one of the major sources of funds. Also the Petroleum Trust Fund because it was formed between 1996 and 1999, was to fund the water supply boreholes projects.

National Water Supply and Sanitation Policy (NWSSP) of January 2000

In comparison to the Water Resources Decree of 1993, the National Water Supply and Sanitation Policy (NWSSP) of January 2000 urged the federal, state, and local governments to take charge of the water supply services. The policy identified four subsectors of sanitation and water supply, which are rural, urban, small-town environment, and water resource and sanitation management. The NWSSP has established some objectives, such as: (i) coverage of rural water supply is increased to 80 percent by 2010 and to 100 percent by 2015; (ii) coverage of rural sanitation is increased to 60 percent by 2010 and 90 percent by 2015; (iii) community participation in the management of sanitation and water supply services; and (iv) increasing the participation of the private sector in the delivery of such services (Adeleye et al., 2014)



The long-term objectives of the policy were to: (i) increase access to water supply and sanitation services nationwide to address socioeconomic needs; (ii) provide the poor with affordable access to basic water and sanitation services; (iii) privatize water supply and protect interests of poor people; (iv) introduce a system to monitor the performance of the sectors to inform pertinent policy changes and development; and (v) transform water and sanitation sector to achieve, and maintain standards that are in line with the international standards (FMWR, 2000).

Master Plan on National Water Resources Development 2013

The failure of water, its pollution, and the need to implement sustainable management of water resources to suit the needs of a growing population and the rise in urbanization raised the need to establish the National Water Resources Development Master Plan (NWRDMP) in 1995 and was later revised in 2013 (JICA, 2013). The new plan was to bring about limited coverage of municipal water supply with an aim of having 100 percent coverage and an estimated increase of water demand was projected to be high in 2030. In addition, it stressed the need to improve the efficiency of the existing water supply infrastructure, that was then underutilized (Adamu, 2021).

5.2 Rural Water Supply and sanitation Agency (RUWASSA) Founded in 1990.

Before the formation of RUWASSA, there was the National Borehole Programme that was established in 1981 to 1985 but had little effects. In 1990, Nigeria officially established the Rural Water Supply and Sanitation Agency (RUWASSA) that in 1993 began drilling boreholes as a state service of utility. RUWASSA collaborates with various stakeholders such as the local government, international donors, non-governmental organizations, and community-based organizations. Nevertheless, the deterioration of the urban piped water systems caused a strategic redistribution of borehole development projects in urban locations (African Development Bank Group, 2018). RUWASSA is a result of the merging of two policy frameworks.

5.2.1 Rural Water Supply and Sanitation Policy (RWSSP) of 2000.

The RWSSP was planned keeping in mind the goal of ensuring that all the rural population had access to water supply structures and that the aid was channelled to the communities that are able to sustain the existence of water supply structures. The policy aims at solving the rural water supply and sanitation issues by assigning greater roles to the rural communities. It aims at enhancing the ability of the federal, state and local governments to assist communities to gain and maintain the basic water supply systems, with supplementary support of the private sector. The policy is also meant to increase the capacity of the private sector to drill high-quality hand-dug wells, boreholes and latrines on state and local levels and to sustain water supply infrastructure and the National Primary Healthcare Program. The policy will reinstate healthier lifestyle practices by focusing on the provision of clean water, good hygiene, management of diarrheal diseases, and proper disposal of excreta (WaterAid, 2008).

2.2. Millennium Development Goals and Investments in Potable Water in Nigeria.

National Economic Empowerment and Development Strategy (NEEDS)

In 2003, the Nigerian government came up with the National Economic Empowerment and Development Strategy (NEEDS) as a model to help in the attainment of the Millennium Development



Goals (MDGs). Between 2003 and 2007, NEEDS used the Presidential Water Initiative (PWI), at the time of poor sanitary conditions in the country. The program was meant to see that the state capitals, 75 percent of other cities and towns and 66 percent of rural communities could have water supply and sanitation (WSS) services by the end of the program (Adeleye et al., 2014; WaterAid, 2008). NEEDS has understood that health can only be achieved through having a clean living environment. As a result, the policy has focused on ensuring that the government lays priority on water supply and sanitation as a tool to support environmental health (NPC, 2004; USAID, 2017). These goals were meant to decrease the rate of water borne diseases and enhance the health of the population, which is in line with the overall goals of the MDGs (Egbinola, 2017).

The 2004 National Water Supply Policy

The NWP of 2004 promoted institutional and regulatory reforms on the state level, and attempted to open up the water sector to the participation of the private sector. The policy offered a detailed outline that was to be followed in improving access to potable water and sanitation services in Nigeria under the strict compliance of the demand-driven approach that is provided in the 2000 National Water Resources Master Plan (NWRMP). Akpabio (2018) notes that the policy had several major provisions: (i) to increase the coverage of rural sanitation and rural water supply to 60% and 80%, respectively, by 2010 and 2015 (ii) to promote community inclusion in the provision of the sanitation and water supply services; and (iii) to promote the participation of the private sector in the supply of the services.

This policy of 2004 recognized the necessity to strike a balance between the uses of water, its distribution, and conservation in a participatory process which should be backed up by a regulatory framework under river basin management. It was based on a combined and demand-oriented approach as well as effective management of the water resources that tried to maximize the use of the underutilized investments (WaterAid, 2008). The policy conceptualized water as an economic good since provision of water is costly and failure to recover the costs may jeopardize service sustainability. It made the distinction of the use of water, domestic, industrial, commercial, and other categories a priority in order not to overload populations with the severe expenses of accessing to other necessary social services. It is especially important considering that more than 70 percent of the population in Nigeria lives below the poverty threshold of one dollar per day, which is the poverty profile of the country (WaterAid, 2008). The MDGs therefore affected the budgetary allocation of the governments in developing water resources.

National Water Resources Act of 2007

The Draft National Water Resources Act of 2007 was meant to provide a solution to fair, advantageous, efficient and sustainable management of surface and ground water resources in Nigeria. This bill creates a new institutional structure by spelling out the roles and mandate of the relevant authorities concerning the management of the water resources in the country. Moreover, it forms the basis of some of the major regulatory instruments, such as: (i) issuing water use licenses; (ii) dam construction and safety standards; (iii) compliance and monitoring; (iv) providing a dispute resolution process; and (v), repeal or amendments of certain laws and other provisions (WaterAid, 2008).

According to WaterAid (2008), the Act aims to ensure that Nigeria's water resources are protected, utilized, developed, conserved, managed, and controlled in a manner that incorporates the following



principles: (i) meeting the essential needs of both present and future generations; (ii) managing surface and groundwater resources based on aquifer boundaries and natural river basins, respectively; (iii) promoting equitable and affordable access to water; (iv) adhering to the polluter pays principle while safeguarding aquatic ecosystems and the water environment to ensure resource sustainability; (v) recognizing existing traditional water uses; (vi) fostering public interest in the effective, sustainable, and beneficial utilization of water; (vii) supporting social development, poverty reduction, improved public health, and economic growth; (viii) managing flood and drought risks; (ix) preventing pollution and degradation of water resources; (x) addressing increasing water demand, encouraging conservation, and acknowledging the economic value of water; (xi) facilitating appropriate private sector participation in water service delivery; (xii) promoting dam safety; and (xiii) fulfilling international obligations (WaterAid, 2008).

2.3. Sustainable Development Goals and Potable Water Investment in Nigeria

Partnership for Expanded Water Supply, Sanitation and Hygiene (PEWASH)

In 2016, the Partnership of Expanded Water supply, Sanitation, and Hygiene (PEWASH) was initiated to make the sustainable development goal (SDG) 6, i.e. water and sanitation, goal is met by the year 2030. The main goals of the program are: (i) ensuring that in rural regions and small towns, the availability of potable water will increase to 100% in 2030, whereas the current availability is 67% (ii) ensuring that the company covers the whole sanitation in rural regions and small towns will increase to 100% in 2030, and today, it reaches 29% (iii) ensuring that the active involvement of the commercial sector, civil society organizations, and local communities in the supply of water and sanitation services; and (iv) developing the

PEWASH emphasizes the need to have a collaborative strategy involving stakeholders, development partners, and all levels of government in order to meet its targets. Also, the program promotes the implementation of relevant technologies to enhance water infrastructure sustainability, including rainwater harvesting systems and solar-powered boreholes (NWRP, 2016).

National Water Resources Policy

The National Water Resources Policy 2016 (NWRP 2016) is a federal policy designed to deal with sanitation and water supply. It is aware of the outdatedness of the National Water Sanitation Policy of 2004 and is aimed at filling the current gaps by removing barriers to access to clean and sufficient water. The policy is clearly aimed at providing universal access to adequate and clean water by the year 2030 (Moodley and Imonikhe, 2018). One of the major requirements is to sustain funding towards Water, Sanitation, and Hygiene (WASH) programs on all government levels (NWRP 2016). Additionally, the policy promotes the development of a modern law on water resources, which will capture the existing needs and outlines various possible pieces of legislation to support its goals. The NWR framework has introduced new actions aimed at having effective and sustainable water management with the focus on the resilience of WASH infrastructure to severe environmental conditions including flood and climate change. The policy also emphasizes sustainable practices in water use such as smart irrigation (NWRP 2016).

Particularly, sustainable water use is essential toward meeting and supporting the universal access target of future generations (IWA 2024). The policy also incorporates the provisions to set up a



coordinating committee and to foster the joint management of trans-boundary water resources (UN 2024). Although these are the good attributes, the instructions of the policy are more of advice and not binding. The general target of achieving total availability of clean and adequate water is consistent with the targets proposed in the 2004 and 2016 sanitation policies despite the differences in the period in which the two are supposed to be achieved, that is, 2015 and 2030 respectively. These two policies support international goals and present policies on how to achieve the goals.

National Water Policy

The National Water Policy of 2020 is a detailed framework that is expected to provide all the Nigerians with an adequate and safe water supply through the challenges associated with the lack of water, its quality, and management. The approach emphasizes the application of mixed, comprehensive principles of water resource management. It supports the practice of integrating water supply, sanitation, and hygiene (WaSH) services in multiple levels of government and in different sectors. The policy also encourages devolution of the water management roles to state and local governments so as to improve in offering the potable water services. It also promotes the formation of public partners with the privates through the promotion of co-operation between the government and the business world.

The policy highlights the necessity to enhance the capabilities of organizations that deal with water management. This involves the enhancement of governance systems, capacity building of employees and enhanced operational success of water supply institutions. Water delivery projects are supposed to be long-term viable, and this requires institutions to be made stronger. The policy contains policies regarding the water quality control and surveillance to ensure that contamination does not occur and that the population health is not endangered. The latter is needed to enhance the overall health outcomes and reduce the rate of waterborne infections (Egbinola, 2017). Regrettably, these policies are just recommendations and the foreign donors can choose whether to approve and fund these plans or not.

Cross-border projects on drinkable water investments in Nigeria.

The World Bank, European Union, UK Department for International Development (DFID), Japan International Cooperation Agency (JICA), United Nations Children Fund (UNICEF), African Development Bank (ADB), and other non-governmental organizations like WaterAid are busy funding investments in potable water infrastructure in Nigeria. International aid channeled to the drinkable water supply in Nigeria is made easier by a number of programs and partnerships which enhances water, sanitation and hygiene (WASH) services in Nigeria. The World Bank and International Development Association (IDA) became the leading financiers by issuing huge loans in 2014 (250 million), 2015 (250 million), and 2021 (700 million) as a part of the Sustainable Urban and Rural Water, Sanitation, and Health (SURWASH) initiative. In 2021, a loan that was issued directly targeted the benefit of an estimated 6 million people (afrik21.africa, en.wikipedia.org).

The African Development Bank also disbursed 1.44 billion dollars in different sectors with an approximation of 31 percent (~447 million) of the amount being allocated to water and sanitation projects. Another big scale undertaking in this framework that is notable is the Keffi-Akwanga water infrastructure project. In partnership with the African Development Bank via the African Growing



Together Fund (AGTF) the People Republic of China is funding urban water projects, such as Akure and borehole drilling projects. At the state level, large amounts of money are granted by the European Union, Japan International Cooperation Agency, United States Agency for International Development, United Nation Children Fund, African Development Bank and other non-governmental companies like the Corporate Accountability and Public Participation Africa (WB 2021, ADB 2024, CAPPA 2023) to fund rural and sanitation infrastructure.

To sum up, the amount of cumulative international financing legally channeled to the water sector in the last few years has already exceeded 2 billion in the form of loan and grants. This funding has been greatly supported by the huge investments directed towards it by the World Bank/International Development Association amounting to \$1.2 billion, the African Development Bank contributing 500 million dollars out of its total assets amounting to 1.44 billion and the People's Republic of China with AGTF providing 20 million dollars as direct investment in project oriented programs. Furthermore, the European Union, Japan International Cooperation Agency, United States Agency for International Development, UNICEF, and various non-governmental organizations collectively contributed amounts ranging from tens to hundreds of millions.

3.0. METHODOLOGY

This study primarily targeted information, documentaries, and research findings related to investments on potable water infrastructure in Nigeria. Particular emphasis was placed on public pipe-borne water systems and borehole inventories because these two are the focus of States and the Federal Governments. In term of organization of ideas, the review of literatures was carried out to reflect the phases in the investment on water infrastructure. Government policies guiding water investments at each level were also discussed. The extent to which sustainability principles were integrated into the implementation of potable water programs was also assessed. These were done to reflect the longitudinal details associated with investments. Data were generated from secondary sources. The content of some major studies were summarized in tabular form and used for explanatory purposes. A comprehensive consultation of recent scholarly publications was undertaken to ensure the recentness and relevance of the paper. Their perspectives are presented in the discourses that follow.

4.0. CONTENT ANALYSIS AND DISCOURSES

4.1. Assessment of Performance of Potable Water Investments in Nigeria

The water supply efforts geared towards the supply of drinkable water have not brought about an effective water supply of clean water or notable reduction of water-borne diseases in Nigeria. The population continues to suffer lack of access to potable water even with huge and ever-growing financial investments. The industry has been unable to meet the water needs of the residential and commercial consumers fully because of severe shortages of services (WaterAid, 2017). Many city families have to use excessive amounts of money to buy drinking water that is sold by vendors when it is not available in the government gallons. As can be expected, water stress, poor sanitation, and hygiene are still the main causes of mortality in Nigeria (Live This Day, 2016).

As the World Health Organization and UNICEF (2017) note, only 69 percent of Nigerians had access to better water sources, as of 2015, and even the accessible sources of potable water do not always perform effectively. According to the 2019 Joint Annual Survey Report released by the Federal



Ministry of Water Resources (FMWR) and the National Bureau of Statistics (NBS) and the UNICEF, a total of 9 percent of people over the age of 200 million in the country were receiving complete basic Water, Sanitation, and Hygiene (WASH) services. According to World Bank Group (2021), some 60 to 80 million people do not have a basic access to drinking water services. Moreover, roughly thirty nine percent of rural households lack the access to even basic water supply services (WHO/UNICEF, 2021).

Table I: The World Bank Agriculture and Water Development Programs in Nigeria Program

Program Name	Loan Amount (US\$ million)	Loan Approval (Year)	Loan Closed (Year)	Completed (Year)	Planned Dams	Dams	Completed Others	Water Component	Supply	
Lafia ADP	27	1977	1984	1985	0	400	0	259	Unlikely	Unsatisfactory
Ayangba ADP	35	1977	1985	1985	0	0	0	24	Unlikely	Unsatisfactory
Ilorin ADP	27	1979	1988	1992	0	0	0	0	Uncertain	Unsatisfactory
Oyo North ADP	28	1980	1988	1989	40	300	12	1391	Uncertain	Unsatisfactory
Ekiti-Akoko ADP	32.5	1980	1986	1986	35	0	0	0	Uncertain	Unsatisfactory
Bauchi state ADP	132	1981	1989	1989	25	1300	0	1480	Uncertain	Satisfactory
Sokoto state ADP	147	1982	1990	1990	0	1200	32	3500	Uncertain	Unsatisfactory

Sources: Guardian Nigeria 2025 (<https://www.theguardian.com>),

Lagos Water Corporation 2023 (Annual Water Supply and Distribution Report)

National Emergency Management Agency 2022 (Flood Disaster Impact Assessment Report)

A scrutiny of Table I above elucidates that the sustainability of water investments has acquired an ambiguous characteristic since the initial independence epoch in 1977. A World Bank loan was sanctioned for the execution of seven water supply initiatives between 1974 and 1980. These encompassed 330 dams and 700 additional water supply infrastructures. At the conclusion of the implementation phase in 1988, merely 144 dams (44%) were finalized, and these dams were appraised as either ambiguous or improbable to be sustainable. The subsequent generation of Agricultural Development Projects (1981–1986) was similarly evaluated regarding sustainability as either ambiguous or improbable, with the exception of one in southern Borno (Table I).

Initiatives of the subsequent generation of ADPs (1981–1986) were likewise assessed as either ambiguous or improbable to be sustainable, with the exception of one in southern Borno. There exist detrimental cycles of unreliable initiatives that deliver services which fail to satisfy consumer requirements and for which the consumers exhibit reluctance to remunerate (Federal Ministry of Water Resources, 2016). The government's administration and provision of adequate surface and groundwater resources have conspicuously faltered, resulting in substantial water security dilemmas



in numerous regions (Jideonwo, 2014) and pervasive water supply deficiencies nationwide (WaterAid, 2006).

There is insufficient access to usable water resources requisite to satisfy the rapidly escalating domestic and industrial (economic growth) water demand. This is manifest in the inadequate access to clean and potable water in urban locales, small towns, and rural communities; diminished levels of irrigation agriculture; suboptimal utilization of hydropower potential; and restricted inland fishery.

Table II: Assessment of Water Accessibility in Nigeria (as of 2024)

Category	Indicator / Project	Details	Source/Year
Access to Water	Population with safely managed drinking water	29%	UNSDG 6 Report, 2022
	Population with safely managed sanitation	32%	UNSDG 6 Report, 2022
	Population with hand-washing facility (with soap)	31%	UNSDG 6 Report, 2022
Water Infrastructure	Functionality of infrastructure	46% of existing water systems non-functional	WaterAid / FMWR, 2023
	Urban water supply (Lagos)	Installed capacity: 210 MGD; Needed: 745 MGD	Lagos Water Corp, 2023
National Investments	Hand pump failure rate	42% broken in rural communities	WASH Survey, 2006
	R&D in water resources (FMWR)	₦9.6 billion (₦6.3bn from 2019–2021 alone)	FMWR Budget Reports
	National WASH Plan Goal	90% safe water access, 80% sanitation by 2025	NDP 2021–2025
Major Projects	Clean Nigeria Campaign (Open Defecation Free LGAs)	78 LGAs certified ODF out of 774 (~10%)	UNICEF Nigeria, 2024
	NUWSRP III (Urban water in 5 states)	\$266 million (Ogun, Kano, Enugu, Ondo, Plateau); supported by AFD	AFD, 2023
	Kano River Irrigation Project	22,000 ha under irrigation (Phase I); plans to scale to 66,000 ha	FG/NRBDA, 2023
	Gurara II Hydroelectric Project	\$1.24 billion project; 360 MW capacity; expected 1,130 GWh/year; backed by China Exim Bank	Ministry of Power, 2024
	Maiduguri Dam Reconstruction	₦80 billion; to support irrigation, flood control, and supply	Borno State Gov, 2025
Climate & Resilience	National flood displacement (2022)	1.4 million people displaced	NEMA, 2022
	2025 Floods	6 th major flood episode May 2025	Guardian/AP, 2025
Challenges	NEWMAP (2012–2022)	Gully erosion restored, catchment systems in 23 states; stormwater systems built	World Bank Report, 2022
	Water budget allocation	Consistently below 2% of national budget	WaterAid Nigeria
	Population pressure	Water withdrawal doubled from 1987–2010	FAO AQUASTAT
	Governance	Fragmented responsibilities across MDAs; poor monitoring & accountability	WASHNORM 2021, World Bank

Source: Federal Ministry of Water Resources (FMWR, 2021)



Table II demonstrates that Nigeria exhibited minimal progress in areas such as the proportion of the population with access to safely managed drinking water, infrastructure functionality, urban water supply, hand pump reliability, water budget allocation, and water governance.

4.2 Challenges Hindering the Sustainability of Potable Water Investments in Nigeria.

Several challenges have contributed to the failure of potable water investments in Nigeria. A primary factor is frequent policy changes. During the pre-colonial and early independence periods, as well as following the creation of new states, potable water infrastructure was established as a foundation for development.

At that time, water infrastructure was regarded as a public good essential for development. Currently, the focus has shifted toward economic returns on investment. This transition has led to management challenges, resulting in the deterioration or abandonment of water project facilities. Many states are still developing strategies to achieve effective cost recovery and sustain their water projects (Oluwasanya et al., 2011).

The capacity and coverage of early waterworks were not expanded to address ongoing and rapid urban growth. For instance, in Ibadan, the existing infrastructure cannot meet the water demands of the growing population. By 1972, the combined capacity of the Eleyele and Asejire waterworks was already inadequate (Areola & Akintola, 1994; Akpabio, 2012). Rapid urbanization has rendered efforts to provide potable water largely ineffective. Additionally, the deterioration of existing infrastructure due to aging, construction activities, and erosion remains a significant concern.

The ability to invest in essential services and infrastructure has been hampered by financial limitations (Egbinola, 2017; Adeleye et al., 2014). The costs of water production and distribution for domestic and industrial supply, irrigation, husbandry, horticulture, and other uses are escalating, while financial resources continue to dwindle. Water scarcity in Nigeria has been caused by a lack of political will to allocate impactful financial resources capable of ensuring long-term serviceability and relevance in the country (WHO, 2015; Obeta and Nwankwo, 2015; Ogunbode and Akinola, 2019).

Table III: Federal government Capital Expenditure for Water and Agriculture in the National Development Plans between 1962 and 1992.

Plan	Years	Projected Resources (N million)	Water (Other Irrigation) (%)	than Agriculture (%)
10-Year plan	1945–1955	NA	NA	NA
Development programs	1955–1961	NA	NA	NA
First	1962–1968	2434	3.6	13.6
Second	1970–1974	9051	5.8	n/a
Third	1975–1980	43,783	2.8	5.0
Fourth	1981–1985	96,968	0.4	11.1
Fifth	1988–1992	n/a	n/a	n/a

Source: Federal Ministry of Water Resources; JICA. *Supporting Report 6-8: Water Resources Management Plan*; Japan International Cooperation Agency (JICA): Abuja, Nigeria, 2014; Volume 5.

In the first post-independence National Development Plan, 3.6% of the national budget was allocated to the development of potable water. Subsequent plans recorded allocations of 5.8% in the Second NDP, 2.8% in the Third NDP, and only 0.4% in the Fourth NDP. These figures illustrate a declining



trend beginning with the Third NDP (1975–1980), a period that followed shortly after independence (see Table III). The marginal financial commitment to the sector persisted until the year 2000, when the adoption of the Millennium Development Goals redirected attention to water provision (see Table IV). This implies that the sector remained chronically underfunded for nearly twenty-three years prior to the year 2000.

Table IV: Financial Allocations to Water Supply in Nigeria Federal Budget (1991-2004)

Year	Capital Allocation to Water (million naira)	% of total capital Expenditure
1991	83.8	0.02
1992	71.7	0.01
1993	63.3	0.12
1994	197.5	0.6
1995		
1996	2,195.1	14.9
1997	2,786.2	1.5
1998	3,843.4	1.5
1999		
2000	14,388.0	2.2

Source: Gbadegesin and Olorunfemi (2007).

It is necessary to stress that the potable water programs in Nigeria have always been dependent on external donations, grants, and loans which were in most cases insufficient to satisfy the infrastructural needs of water supply and sanitation. Since the colonial period up to the current times, foreign aid and assistance has played a significant role in the financing of water projects. Nevertheless, in most cases, the work of international donors has been poorly coordinated, mobilized, and, in certain cases, managed with unsuitable disbursement of funds (Ogunbode et al., 2014; Adeniran and Oyekale, 2021; WHO, 2015; Obeta and Nwankwo, 2015).

Additionally, a significant number of the states in Nigeria have not had the necessary technical and managerial skills to plan, execute and oversee water supply and sanitation projects (Obeta, 2019; Egbinola, 2017). Poor management of important infrastructure like dams, reservoirs, waterworks, distribution systems, irrigation, and navigable waterways has not only caused loss of finances but also compromised delivery of services reliably. Lack of proper public awareness on the practices related to water management also complicated the difficulties related to the enforcement of the Water Resources Decree of 1993 (Adejumo, 2019; Ogunbode et al., 2016; Oluwasanya et al., 2011). Lack of proper monitoring and control of the water resources and inadequate data collection and management has been a big setback in the planning and execution processes.

The problems have been worsened by institutional inefficiencies. The roles and responsibilities between ministries, departments and agencies between various levels of government have been undefined. The absence of transparency in policy frameworks has created overlaps and gaps in service delivery and this eventually hinders the implementation of the programs (Akpabio, 2018; Ogunbode and Ifabiyi, 2017). These institutional shortcomings are often characterized by overlapping processes, delays in the bureaucratic system, wastage of resources, and general inefficiency in the way the process of water program formulation and enforcement is conducted.



Moreover, the previous policies did not focus on community involvement in the management of water sufficiently (Egbinola, 2017). This left most communities out of decision-making and managing of the potable water and sanitation services despite subsequent policies emphasizing the need to involve the communities (Adeleye et al., 2014; Ogunbode and Ifabiyi, 2019). An example of such policy is the National Water and Sanitation Policy of 2004 which did not have much impact. As of 2007, the number of states that initiated public-private partnership (PPP) arrangements by entering into service contracts was four out of thirty-seven, including Lagos, Cross River, Kaduna, and Ogun (USAID, 2017).

Worsening these governance and institutional issues are high pressures of the environment. The water resources in Nigeria are also facing the threat of pollution due to blind dumping of dangerous wastes, destruction of watercourses and low ground water in areas underlain by the crystalline rocks. Additionally, the problem of climate change has triggered the severity of extreme weather conditions, experienced in long droughts, frequent flooding, extensive erosion, and increasing communal conflicts. All these processes, together with the commodification of water, the effects of the COVID-19 pandemic, and the increased environmental pollution, as well as the overall consequences of climate change, demonstrate the necessity to have strong policies on water protection, and systemic governance changes in Nigeria and other countries (Ngozi, 2024).

5.0. CONCLUSION

The Nigerian government has intensified its efforts to expand access to potable water. Notably, in 2018, a State of Emergency was declared with the objective of ensuring universal access to safely managed and sustainable water services by 2030, in line with SDG 6. During the colonial and early post-colonial periods, significant investments were made in potable water infrastructure through strict adherence to national development plans and changes in government headship did not affect project implementation in any way.

If developmental projects are structurally backed by law and operationally designed to be completed once started, irrespective of whoever is in government, Nigeria will have multiple success stories to tell, including the water sector. The present emphasis on regime based project award and execution had resulted in the abandonment and decay of several water investments all over the country.

There is the need to re-examine the need for maintenance and expansion of water projects at least after a decade. The rate of population growth is increasingly rendering water projects ineffective in terms of coverage and serviceability. The significance of water for hygiene, drinking, cleaning, religious, aesthetic, and various human economic activities made it exceptionally indispensable to human survival and health.

Recent policies have increasingly emphasized community participation in water management. This approach could be further expanded to foster community ownership and, where appropriate, privatization of services. Strengthening maintenance culture remains essential, and may require the enforcement of regulatory measures to ensure compliance. The growing involvement of private operators in potable water provision reflects the recognition of water services as viable economic ventures.



However, cost recovery mechanisms must be structured in ways that remain affordable, particularly for vulnerable communities, potentially through community-based arrangements. There is the need for donor and the international bodies to monitor their gestures and ensure effective service delivery. International bodies, considering their dominant influence on water provision should please consider the spatial spread and the geographical units of the country in the allocation and implementation of projects.

Conflict of Interest

The authors declare that no conflict of interest exist in this manuscript.

REFERENCES

- Adamu, S. (2021). Why implementation of National Water Resources Master Plan has been poor. *The Guardian Nigeria*. Retrieved from <https://guardian.ng/news/why-implementation-of-national-water-resources-master-plan-has-been-poor-by-minister/>
- Adejumo, S. A. (2019). Assessment of Public Involvement in Urban Water Supply. *Ibadan Planning Journal*, 8(1 & 2), 1-9.
- Adeleye, O., Akintola, O., & Areola, O. (2014). Historical evolution of water provision during the colonial administration. In *Water Supply and Sanitation in Nigeria: The Role of the State and the Market*.
- Adeniran, A. A., & Oyekale, A. S. (2021). Water infrastructure sustainability in Nigeria: A systematic review of challenges and sustainable solutions. *Water Policy*, 23(2), 245-261.
- Adeniran, A.; Daniell, K.A.; Pittock, J. Water Infrastructure Development in Nigeria: Trend, Size, and Purpose. *Water* 2021, 13, 2416. <https://doi.org/10.3390/w13172416>
- AfDB [Africa Development Bank Rural Water Supply and Sanitation Project] (2024), Our Interventions – Africa Development Bank Rural Water Supply and Sanitation Project. <https://afdb-rwssp.ng/our-interventions/>
- African Development Bank Group (2018). Rural Water Supply & Sanitation Initiative. RWSSI Impacts. <https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/rural-water-supply-sanitation-initiative> accessed on 10/18/2024
- Akpabio, E. M. (2012). Water meanings, sanitation practices and hygiene behaviours in the cultural mirror: A perspective from Nigeria. *Water International*, 37(7), 812-818.
- Akpabio, E. M. (2018). Water Quality Management in Nigeria: The Role of National Effluent Limitation Regulation. *Journal of Environmental Management*, 213, 1-10.
- Amoah S. T. and Yahaya A. (2013). Evolution of Water Systems and its Challenges in the Wa Municipal of Ghana. *Journal of Environment and Earth Science* www.iiste.org ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online) Vol. 3, No.7, 2013.P15-24



- Areola, O., & Akintola, O. (1994). Water Supply in Nigeria: A Historical Perspective. In *Water Supply and Sanitation in Nigeria: The Role of the State and the Market*.
- Balogun, E. D., & Ukeje, E. U. (1986). The Impact of River Basin Development Authorities on Nigerian Agriculture: A Case Study of Niger River Basin Development Authority. *CBN Economic and Financial Review*, 24(2), 64-76.
- Barth, H. Travels and Discoveries in North and Central Africa: Being a Journal of an Expedition Undertaken under the Auspices of H.B.M.'s Government, in the Years 1849–1855; -D. Appleton and Co.: New York, NY, USA, 1857; Volume 3.
- Bascom, W. Urbanization Among the Yoruba. *Am. J. Sociol.* 1955, 60, 446–454. [CrossRef]
- Brettenny, W., & Sharp, G. (2016, January 29). Efficiency evaluation of urban and rural municipal water service authorities in South Africa: A data envelopment analysis approach. *Water SA*, 42(1), 11. <https://doi.org/10.4314/wsa.v42i1.02>
- Brundtland, G.H. (1987) Our Common Future: Report of the World Commission on Environment and Development. Geneva, UN-Dokument A/42/427. <http://www.un-documents.net/ocf-ov.htm>
- Danladi, J. (2019). A history of the transformation of water supply in Kano, Nigeria, 1924-1960. *Journal of Advances in Humanities and Social Sciences*, 5(1), 12-20.
- Edmond E. Lincoln (1916). The Control of Return on Public Utility Investment. *The American Economic Review* vol 6.No 4. Pp. 869-873.
- Egbinola, C. N. (2017). Trend in Access to Safe Water Supply in Nigeria. *Journal of Environment and Earth Science*, 7(8), 89-100.
- Federal Republic of Nigeria, (FRN) (2000). Water Supply and Sanitation. Interm Strategy 73 Note, Retrieved March 29, 2008, from <http://siteresources.worldbank.org/NIGERIAEXTN/Resources/was1100.pdf>
- Federal Republic of Nigeria.(2020). *National Water Policy*. Retrieved from [FAOLEX](<https://faolex.fao.org/docs/pdf/nig158231.pdf>).
- FMWR 2019, Water, Sanitation and Hygiene: National Outcome Routine Mapping (WASH NORM): A Report of Findings (FCT Abuja: FMWR, 2020).
- FMWR. 2000. —National Water Supply and Sanitation Policy. Federal Ministry of Water Resources (FMWR), Department of Water Supply and Quality Control, Abuja.
- FMWR. 2003. —Water Resources Management Institutions in Nigeria: Institutional Mapping Report. Draft Report, Federal Ministry of Water Resources (FMWR), Abuja.
- Halicki, W., & Halicki, M. (2022, June 14). From Domestic Sewage to Potable Water Quality: New Approach in Organic Matter Removal Using Natural Treatment Systems for Wastewater. *Water*, 14(12), 1909. <https://doi.org/10.3390/w14121909>
- Hinderer, A. Seventeen Years in the Yoruba Country: Memorials of Anna Hinderer; The Religious Tract Society: London, UK, 1877.



- Houcine Rhili (2023). The World Bank's Water and Sanitation Policies in Policies. Transnational Institutes. 28 September 2023. <https://www.tni.org/en/article/the-world-banks-water-and-sanitation-policies-in-tunisia>
- IEG. Agricultural Development Projects in Nigeria. 2012. Available online: <http://lnweb90.worldbank.org/oed/oeddoclib.nsf/DocUNIDViewForJavaSearch/FE7BA13642E3E0D7852567F5005D85CF> (accessed on 17 August 2018).
- Imonikhe O. M. and Moodley K. [2018], 'The Challenge of Effective Policy Implementation in Nigerian Urban Water Utilities' 18(5) Water Supply 1696
- ing Water, Sanitation and Hygiene 2000-2020: Five Years Into the SDGs. Geneva. Available from: <https://washdata.org/> (accessed 7 January 2022).
- International Water Association (IWA), 'Sustainability in Water Supply' (IWA Publishing) accessed 3rd January 2024. <https://www.iwapublishing.com/news/sustainability-water-supply>
- JICA.(2013). *National Water Resources Master Plan 2013 Executive Summary*. Japan International Cooperation Agency.
- JICA; Federal Ministry of Water Resources and Rural Development. The Study on the National Water Resources Masterplan (NWRMP) Summary and Main Text; Japan International Cooperation Agency (JICA): Abuja, Nigeria, 1995; Volume 1.
- Jideonwo J. A. [2014], 'Ensuring Sustainable Water Supply in Lagos, Nigeria' Master of Environmental Studies Capstone Projects, 58 accessed 4th January 2024.
- Johnson, S. The History of The Yorubas: From the Earliest Times to the Beginning of the British Protectorate; Lowe and Brydone: London, UK, 1921.
- Khan H, and khan I. U (2012) from growth to sustainable development in developing countries: A conceptual framework. *Environmental Economics* 3(i), pp. 22-31
- Larijani A.H. (2016) sustainable Urban Development, concepts, features, and indicators. *International Academic Journal of Science and Engineering*, 3(6), 9 – 14.
- Mabogunje, A.L. (1968). *Urbanisation in Nigeria*. 1st Editin. University of London: London, UK, .
- Ministry of Foreign Affairs (2001) Financing and Providing Global Public Goods: Expectations and Prospect. Page 4.
- NAI. (1914). Annual Report. Medical Department. Pp. 47
- NAI. Lagos Annual Report, Medical Department, 1900
- National Planning Commission (NPC) (2004). National economic and development strategy. Nigerian National Planning Commission, Abuja
- National Water Resources Policy 2016. <https://www.waterresources.gov.ng/wp-content/uploads/2020/2021/01/national-water-policy.pdf> accessed 10 June 2021.



- National Water Supply and Sanitation Policy Paper (NWSSP), (2000). Department of Water Supply and Quality Control, Ministry of Environment, Abuja, NIGERIA.
- Ngozi Chinwa Ole, (2024). Achieving Universal Access to Clean Water in Nigeria: An Analysis of Extent Laws and Policies. RUNJJIL (Redeemer's University Nigeria). *Journal of Jurisprudence and International Law* , 4(1).
- Niyi Gbadegesin and Felix Olorunfemi, ATPS W. Working paper series No 49 2007, African Technology Policy Studies Network (ATPS) Assessment of Rural Water Supply Management in Selected Rural Areas of Oyo State, Nigeria. Policy Studies Network (ATPS).
- Obeta M. and Nwankwo C. F. [2015], _Factors Responsible for Rural Water Supply Shortage in Southeastern Nigeria *Journal of Environmental Geography*, 21 8(3-4).
- Obeta, M. C. (2019). Private for-profit rural water supply in Nigeria: Policy constraints and options for improved performance. *Journal of Water and Land Development*, No. 41 (IV–VI), 101–110. DOI: 10.2478/jwld-2019-0033.
- Ogunbode T. O. and I. P. Ifabiyi (2017) Application of Water Poverty Index (WPI) in Assessing Water Accessibility in the Rural Suburbs of Ogbomosho Zone of Oyo State, Nigeria. *Asian Journal of Environment & Ecology*, 3(2): 1-9, 2017; Article no.AJEE.34095. <https://www.researchgate.net/publication/318056765>
- Ogunbode T. O. and I. P. Ifabiyi (2019) Relationship between Evapotranspiration and water Availability in the Tropical Regions: A Case Study of a South Western City in Nigeria. *ACRI*, 16(4): 1-10, 2019; Article no.ACRI.47174, DOI: 10.9734/ACRI/2019/v16i430097. <http://www.sdiarticle3.com/review-history/47174>
- Ogunbode T. O. and Ifabiyi I. P. (2017) Domestic Water Utilization and Its Determinants in the Rural Areas of Oyo State, Nigeria Using Multivariate Analysis. *Asian Research Journal of Arts & Social Sciences* 3(3): 1-13, 2017; Article no.ARJASS.34096 ISSN: 2456-4761
- Ogunbode Timothy O., Esan Vincent I., Oyebamiji Victor O. and Akande John A. (2024), Sustainable development goal 6 and the challenge of pipe-borne water connectivity in a growing tropical city: a case study. *Discover Sustainability* (2024) 5:53, <https://doi.org/10.1007/s43621-024-00239-w>
- Ogunbode, T. O, Ifabiyi, I. P., Olutona, G. O. and Akintunde, E. A. (2016). Spatial Characteristics Of Underground Water Chemistry In Some Selected Rural Areas Of Ogbomosho Zone Of Oyo State, Nigeria. *European Journal of Earth and Environment* Vol. 3, No. 2, 2016 ISSN 2056-5860. UK Page 17 www.idpublications.org
- Ogunbode, T.O. and Akinola, O.T. (2019) _Hydrochemistry and water quality index application in the assessment of groundwater quality in Oyo State, Nigeria_, *Int. J. Hydrology Science and Technology*, Vol. 9, No. 6, pp.657–674. <https://www.researchgate.net/publication/33709873>
- Okigbo P.N.C (1989). *National Development Planning in Nigeria 1900-92*; Currey: London, UK, 1989.
- Oluwasanya, G. O., Ayantobo, O. O., Idowu, O. A., & Eruola, A. O. (2011). Water Quality Evaluation of Hand-Dug Wells in Ibadan, Oyo State, Nigeria. *Global Journal of Science Frontier Research*.



- Onobhayedo A.O. (2022). A Historical Analysis of the Nexus between Water Supply and Disease Control in Western Nigeria, 1900-1945. *KIU Journal of Social Sciences* Copyright©2022 Kampala International University ISSN: 2413-9580; 8(2): 45- 52
- Sanjo K.A. , Chinade A.A. , Abdulsamad A., (2024)Water governance: challenges and prospects for the implementation of sustainable development goal six in Nigeria. *Afr. J. Environ. Sci. Renew. Energy*, 14(1) (2024), pp. 86-109, 10.62154/fkz0pq18
- Swyngedouw, E. (2009). The Antinomies of the Post-political City: In Search of a Democratic Politics of Environmental Production. *International Journal of Urban and Regional Research*, 33(3), 601-620.
- This Day Live (2016) The most polluted cities in the world. <http://www.thisdaylive.com/index.php/2016/06/02/who-nigeria-has-four-of-the-mostpolluted-cities-in-the-world/>
- UN, (2024). ‘Transboundary Waters’ accessed 3rd January <https://www.unwater.org/water-facts/transboundary-waters/>
- UNICEF Nigeria (2018) Water, Sanittion and Hygiene. <https://www.unicef.org/nigeria/water-sanitation-and-hygiene>
- United Nations Children’s Fund (UNICEF) and the World Health Organization, (WHO) (2021). *The measurement and monitoring of water supply, sanitation and hygiene (WASH) affordability: a missing element of monitoring of Sustainable Development Goal (SDG) Targets 6.1 and 6.2*. New York:
- United States Environmental Protection Agency, USEPA (2000). *Electrokinetic and Phytoremediation in Situ Treatment of Metal-Contaminated Soil: State-of-the-Practice*. Draft for Final Review. EPA/542/R-00/XXX.
- USAID (2017). Potable Wells Improve Water Access in Chad. <https://2012-2017.usaid.gov/results-data/success-stories/potable-wells-improve-water-access-chad>
- Utietiang, B. (2015). Historicizing Development: Nigeria’s 1945 Colonial Plan. *J. Pan. Afr. Studies* 8, 5–25.
- Verhoeven, H. Water, Civilisation and Power in Sudan (2015). *The Political Economy of Military-Islamist State Building*. Cambridge University Press: New York, UK, 2015. [CrossRef]
- Wateraid (2008). *Water and Sanitation in Nigeria: A Briefing on National Policy*. Water and Sanitation in NEEDS and National Development Plan (NDP).
- WaterAid (2017) Water and Sanitation in Nigeria. A Briefing on National Policy -. www.wateraid.org/~media/Publications/watersanitation-nigeria-national-policy.pdf.
- WaterAid, (2006). National Water Sector Assessment in Nigeria‘ July, accessed 9 January 2024.
- WaterAid. (2023). *WaterAid Nigeria Country Programme Strategy 2023-2028*. Retrieved from [WaterAid Nigeria](<https://www.wateraid.org/ng/sites/g/files/jkxoof381/files/2024-02/WATERAID%20Country%20Programme%20Strategy%202023-2028%20new%20v9%20%281%29%20010823.pdf>).



WHO [2015], ‘Sanitation, Drinking-Water and Hygiene Status Overview’ [2015], https://www.who.int/water_sanitation_health/monitoring/investments/nigeria-10-nov.pdf?ua=1 accessed 25th December 2023.

WHO and UNICEF (2021), Progress on Household Drink Source:

WHO/UNICEF (2017). *Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines*. Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF).

World Bank Group (2021). Improving Water Supply, Sanitation and Hygiene Services in Nigeria. Press Release, May 25, 2021. <https://www.worldbank.org/en/news/press-release/2021/05/25/improving-water-supply-sanitation-and-hygiene-services-in-nigeria>

Zheng, X., & Wu, X. (2023, July 27). Government Linked Companies (GLCs) as Investors in Water Sector in China: Implications for Public–Private Partnership (PPP). *Water Economics and Policy*. <https://doi.org/10.1142/s2382624x23710042>