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RESEARCH ARTICLE

MANAGEMENT OF WATER AND HYDROLOGICAL RESOURCES FOR NIGERIAN NATIONAL DEVELOPMENT: A REVIEW

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ABTRACT

This paper makes an attempt to give an overview of Nigeria's water and hydrological resources and their sustainable management for national developments. Nigeria's water and hydrological sources which include surface water, underground water, numerous rivers and dams and drainage basins were reviewed. Various contributions of these resources for national development were discussed. The paper also discussed the activities of federal ministry of water resources and various parastatals and agencies saddled with the responsibility of controlling and managing water and hydrological resources of Nigeria. Also, challenges facing utilization and management of water resources in Nigeria were highlighted. However, multi-faceted approach and several key strategies towards ensuring sustainable management of water and hydrological resources for national development were likewise suggested.

Keywords: Nigeria, water resources, sustainable management, national development.

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1.0. INTRODUCTION

The management of water and hydrological resources is critical to the development of a society because water plays a vital role in various aspects of human endeavor. Water is needed for domestic, commercial, industrial, agricultural and recreational purposes. All developed nations have a shared history of heavy investment in water infrastructure, institutions, and the capacity to manage water resources adequately. Conversely, less developed nations are usually characterized by inadequate water infrastructure, weak institutions and poor water governance. Given that the demand for finite water resources is increasing, it is important to examine how water resources can be managed to facilitate continued national development Ibrahim, Alakali, Sanyaolu and Usman (2022). The development and management of water resources is influenced by climatic, physiographic and hydrologic features, and perhaps socioeconomic factors of a region.

Nigeria is located in the tropical zone of West Africa approximately between latitudes 4°N and 14°N of the equator and between longitude 3°E and 15°E of the Greenwich Meridian. It has a total land area of 923,771Km^2 with an estimate population of about over 240 million people. The country's north-south extent is about 1,050Km and its maximum east-west extent is about 1,150Km. Nigeria is bordered to the west by Benin, to the northwest and north by Niger Republic, to the northeast by Chad and to the east by Cameroon, while the Atlantic Ocean forms the southern limits of Nigerian territory. Land cover ranges from thick mangrove forests and dense rain forests in the south to a hear-desert condition in the northeastern corner of the country (FAO, 2016). The peculiar and variable nature of Nigeria in location and climate has given rise to certain water resources issues in the country. These issues ranges from precipitation to management of these resources. The annual precipitation ranges from 400mm in North Eastern part to about 2000mm in the south eastern part of the country (Ishaku and Majid, 2010; FAO, 2016). These variations give rise to certain issues like scarcity induced drought to flooding respectively. Legal frameworks to facilitate the management of these water resources over the years have proven to be ineffective.

However, in Nigeria, the total renewable water resources (TRWR) per capital is estimated to be 2514m^3/year yet access to clean water is reported to be low with only 69 percent of Nigerians with access to basic water supply service (FAO, 2003). Judging by the poor access to water supply as evidenced by UNICEF, 2019; NBS, 2017), and the continued degradation of the available water resources, it can be inferred that there are critical issues with the way water resources are managed in the country. At present, the Federal ministry of Water resources overseas all water resources development and management in the country through other smaller ministries and parastatals. Consequently, Sectoral interests and lack of coordination among stakeholders hinder effective water resources management, resulting in over-abstraction and wastage of water resources, and environmentral pollution which negatively affects essential ecosystems (UNDP, 2018; Nwankwoala & Ngah, 2014). As earlier stated, the country is blessed with vast freshwater resources estimated at

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286.2Km^3/year, these resources are not distributed evenly geographically and are subject to seasonal variability. The northern region of the country faces this more sorely as annual precipitation averages between 100-250mm and the high population in this area has resulted in water stress (Ezeabasili, Okoro & Ezeabasili, 2014). In addition, a growing population and urbanization are putting increased pressure on the available water resources such that there is competition across multiple sectors for water resources and access to water is restricted even in areas of the country where water is abundant (Nwankwoala & Ngah, 2014).

2.0. CONCEPTUALIZATION

2.0. WATER RESOURCES OF NIGERIA

In a system known as hydrological cycle, water is continually circulates between oceans, land masses and atmosphere. Seawater in oceans constitute between 94-97% of all water found on the earth as a planet. The remaining 3-6% contains all freshwater resources. Around half of this is frozen in snow, glaciers and icecaps, half is underground as groundwater and the remaining 0-1% is surface water found in rivers, lakes, reservoirs and atmosphere (Leap, 1999). In general, water resources in Nigeria may be presented as

1. Surface sources which consists of streams, rivers, lakes, springs and drainage areas that discharges water toward reservoirs.

2. Groundwater sources which is stored in aquifers.

Surface Water sources: Nigeria drainage system is somewhat considered as a close network of streams and rivers which take their source from the Precambrian Basement complex rocks. Most of the country's rivers have their sources in four main hydrological basins. The four major drainage systems in the country according to Adeaga, Oyebande and Balogun (2006) are:

1. The Niger River Basin Drainage System with its major tributaries of Benue, Sokoto-Rima, Kaduna, Gongola,Katsina-Ala, Donga, Taraba, Hawal and Anambra.

2. The Lake Chad Inland Drainage System comprising the Kano, Hadeija, Jama'are, Misau, Komadougou-Yobe, Yedseran, and Ebeji rivers.

3. The Atlantic Drainage System (east of the Niger) compromising the Cross, Imo, Qua Iboe and Kwa rivers.

4. The Atlantic Drainage System (West of the Niger) made up of the Ogun, Oshun, Oba, Owena and Benin rivers.

All the drainage systems terminate in the Atlantic ocean with an extensive network of Delta channels except the Lake Chad which is an Inland Drainage System.

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Ground water resources: The groundwater sources are limited by the geological structure of the country with more than half of it being underlain by the Precambrian Basement Complex, composed mainly of metamorphic and igneous rocks. However, there are fairly extensive areas of fractured Schists, quartzites and metamorphosed derivatives at ancient sediments from which water is often available at great depth. The sedimentary formations such as the Tertiary deposits of the Chad-Sokoto basins, the cretaceous deposits of the Niger and Benue troughs, and the sedimentary formation of the Niger Delta, yield groundwater in varying quantities (Adeaga, etal 2006).

2.2. Water and Economic Development in Nigeria.

Water has a significant impact on the growth and development of the Nigerian Economy. Apart from the commonly known importance of water for domestic use, human and health, there is a direct relationship between the availability of water and economic activities. The following is a summary of the impact of water on different sectors of the Nigerian economy.

Agriculture: Agriculture provides employment for about 70 percent of the Nigerian population and therefore a critical nerve in the socio-economic dynamics of the country. The population of food crops, cash crops, and livestock depends on the availability of water as about 70 percent of total drawn water is for Agricultural purpose.

Health: Water is for human consumption and necessary basic survival to improve quality of life and human dignity as well as reduce or eradicate water related disease. Improved access to water and sanitation facilities contribute significantly to the public health through reduction of infant and child morbidity and mortality.

Power: Power access to electricity is responsible for declining productivity and competitiveness in Nigeria, with significant impact on economic growth and development. Increasing demand for electricity for domestic and industrial consumption will continue to be on the increase. The water sector has potential to contribute about 15000 Megawatts of hydropower to the country.

Mining: Nigeria is endowed with vast reserves of solid minerals, and the Government of Nigeria is developing strategies on how best to harness the potential in mining for economic growth. The mining and quarrying sector accounted for 6.5% of Nigeria's G D P in 2015, and this bound to increase in the following years. Water is a critical input in mining and therefore a determinant of the success of failure of the mining sector.

Trade and Transportation: Marine transport is essential to the Nation's transport infrastructure and a vital link to the development of the economy. Proper management of the available water resources like rivers and lakes will ultimately improve the navigable water ways for easy movement of agricultural goods, machinery, equipment, people and raw

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materials for industries and finished goods for the teaming populace. Rivers Niger, Benue, Lake Chad and other smaller navigable rivers are being used for the above purposes.

Industry: Most industrial production activities need water as a critical input for production. Industrial and consumer sectors therefore need water for sustainable production operations, to support the long-term economic growth in the country.

Education: Education is critical for breaking the cycle of poverty and yet so many schools especially tertiary institutions in Nigeria Lack access to safe water and sanitation facilities. Availability of clean and safe water will enhance the academic performance of students and avert unrest in various campuses. The lack of safe water can cause even the best students to lose concentration as they deal with various illness, diseases and hunger if there is no water to cook. Students miss classes in search of water, or to care for sick parents or siblings. If teachers are sick as a result of non – availability of clean water, classes get cancelled for all students. Schools cannot run programmes if they cannot provide water to students, faculty and their families

3.0. METHODOLOGY

This study draws data mainly from secondary sources and present logical reviews on the water management and hydrological resources as a panacea for sustainable national socio-economic development. It adopts qualitative method backed by discourse analysis.

4.0. RESULTS

4.1. Institutional Arrangement of Water Management in Nigeria

The turning point for water resources development and management in Nigeria occurred after the severe drought of the 1960s. The Government's response to the catastrophe was the initiation of strategies for coordinated and effective water resources development, culminating in the mid-1970s in the creation of the Federal Ministry of Water Resources and the River Basin Development Authorities (Adeaga, *et al.*, 2006). Presently, the Federal Ministry of Water Resources (FMWR) is responsible for large water resources development projects and water allocation between states (Idu, 2025). FMWR has sixteen (16) parastatals and agencies made up of twelve (12) River Basin Development Authorities (RBDAS), Nigeria Hydrological Services Agency (NIHSA), Nigerian Integrated Water Resources Management Commission (NWRMC). Gurara Water Management Authority (GWMA), and the National Water Resources Institute (NWRI) (Ibrahim *et al*, 2022).

Some of the major responsibilities of the River Basin Authorities in Nigeria are succinctly presented in the highlights that follow.

a. To enhance the development of both surface and underground water resources with particular regard to construction and maintenance of infrastructure;

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b. Management of irrigation schemes which would be handed over to farmers gradually;

c. Supplying water from storage schemes for a fee with approval from the Minister of Water Resources;

d. Keeping up-to-date comprehensive water resources records and requirements in the authority's area of operation.

Table 1: List of River Basin Development Authorities in Nigeria

S/N	RBDA	Area of Operation	Office
1	Anambra-Imo River Basin Development Authority (AIRBDA)	Abia, Anambra, Ebonyi, Enugu and Imo States	Oweri
2	Benin Owena River Basin Development Authority (BORBDA)	The regions of River Benin and Owena and a senatorial district in Delta State	Benin-City
3	Chad Basin Development Authority (CBDA)	Borno, Yobe State and northern part of Adamawa State	Maiduguri
4	Cross River Basin Development Authority (CRBDA)	Akwa Ibom and Cross River States	Calabar
5	Hadejia Jama' are River Basin Development Authority (HJRBDA)	Kano, Jigawa States and north and central parts of Bauchi Sate	Kano
6	Lower Benue River Basin Development Authority (LBRBDA)	The catchment states of Benue, Plateau, Nassarawa States and Kogi State East of the River Niger	Makurdi
7	Lower Niger River Basin DevelopmentAuthority (LNRBDA)	Entire geographical boundaries of Kwara State and a part of Kogi State, west of the River Niger	Ilorin
8	Niger Delta Basin Development Authority (NDBDA)	Delta and Bayelsa States	Port Harcourt
9	Ogun-Osun River Basin Development Authority (OORBDA)	Lagos, Ogun, Oyo and Osun States	Abeokuta
10	Sokoto-Rima River Basin Development Authority (SRRBDA)	Katsina, Zamfara, Sokoto and Kebbi States	Sokoto
11	Upper Benue River Basin Development Authority (UBRBDA)	Gombe, Taraba, two senatorial districts of Adamawa State and one senatorial district of Bauchi State	Yola
12	Upper Niger River Basin Development Authority (UNRBDA)	Niger, Kaduna States and the FCT	Minna

Source: Adapted from (JICA, 2014).

4.2. Current challenges in Water Resources Management in Nigeria.

There are great differences in water availability from region to region in Nigeria from the extremes of desert in the far north to tropical forests and mangroves Swampes in the South.

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There is variability of supply through time as a result of both Seasonal Variation and inter-annual variation. In addition to problems of water quantity, there are also problems of water quality. Pollution of water resources in posing major problems for water users as well as impeding the maintenance of natural ecosystems. During the last few decades, the desire to improve access to water resources in Nigeria has become more and move elosive due to various challenges. The challenges facing the water resources sector in Nigeria include the water resources sector in Nigeria include the following.

- Unevenly distributed water resources and demand necessitating the creation of dams and transportation of water to the areas of need.

- Inadequate access to usable water resources to meet the rapidly increasing domestic and industrial water demand. These are manifested by poor access to clean and portable water in urban, small towns and rural areas: low levels of irrigation agriculture, poor utilization of hydropower potentials and limited inland fishery.

Degrading Watershed and water courses as a result of widespread pollution, including the indiscriminate disposal of hazardous wastes due to poor management and mining control lead to deteriorating water quality.

- Fragmented and Uncoordinated water resources development as a result of inadequate catchment management.

- Unclear roles and responsibilities among the various levels of government, different ministries, departments and agencies at the Federal and States levels.

- Inadequate water resources data collection and management. This leads to poor planning and project designs.

- Extreme weather conditions due to climate change resulting in prolonged droughts, increased flooding widespread erosion and communal conflicts.

- Vicious cycle of unreliable projects that provide services that do not meet consumer needs and for which the consumers are unwilling to pay.

- Poor or inefficient management of water resources infrastructures like dams, reservoirs, Waterworks, with their related distribution networks, irrigation structures and navigable waterways leading to financial losses and unreliable service delivery.

- Poor or lack of motoring and control of ground water resources among others.

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4.3. Suggested Sustainable Management of Water and Hydrological Resources

Sustainable management of water and hydrological resources involves a multi-faceted approach that balances ecological health, economic needs, and social equity. Here are several key strategies according to (FMWR, 2016) for achieving sustainable water management:

1. Integrated Water Resources Management (IWRM)

- Holistic Approach: Consider all aspects of the water cycle and land use planning.

- Stakeholder Involvement: Engage local communities, governments, and businesses in decision-making processes.

- Combining Sectors: Coordinate land use, water sanitation, and industrial water use to minimize conflicts.

2. Water Conservation Practices

- Efficient Use: Promote technologies and practices that reduce water consumption, such as drip irrigation in agriculture and low-flow fixtures in households.

- Water Recycling and Reuse: Develop systems for treating and reusing wastewater for non-potable purposes like irrigation and industrial processes.

3. Pollution Prevention and Control

- Regulation: Implement and enforce regulations to control agricultural runoff and industrial discharges into water bodies.

- Buffer Zones: Establish vegetation along waterways to filter pollutants and protect ecosystems.

4. Ecosystem Protection

- Wetland Conservation: Protect and restore wetlands that play a critical role in natural water filtration and flood control.

- Aquifer Protection: Safeguard groundwater sources from over-extraction and contamination.

5. Climate Change Adaptation

- Resilience Building: Develop strategies to adapt water management practices to the impacts of climate change, including shifts in rainfall patterns and increased flooding or droughts.

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- Data and Monitoring: Use technology for real-time monitoring of water levels and quality to respond rapidly to changing conditions.

6. Sustainable Agriculture

- Crop Selection: Encourage the use of drought-resistant crop varieties and organic farming practices that require less water and improve soil health.

- Agroforestry: Integrate trees and shrubs into agricultural landscapes to improve water retention and reduce soil erosion.

7. Education and Awareness

- Public Engagement: Educate communities about the importance of water conservation and sustainable practices.

- Behavior Change: Promote initiatives that encourage individuals and organizations to adopt environmentally friendly water use habits.

8. Policy and Institutional Frameworks

- Effective Governance: Establish strong legal frameworks and institutions dedicated to sustainable water management.

- Incentives: Create financial mechanisms, such as subsidies or tax breaks, for sustainable practices and technologies.

9. Innovation in Water Technology

- Desalination and Rainwater Harvesting: Develop cost-effective technologies for desalination and capture of rainwater to supplement freshwater supplies.

- Smart Water Management: Utilize data analytics, IoT, and remote sensing technologies to optimize water distribution and usage.

10. Financing and Investment

- Funding Models: Leverage public and private financing for infrastructure projects that promote sustainable water management.

- Cost Recovery: Implement fair pricing mechanisms that reflect the true cost of water services while ensuring access for marginalized communities.

5.0. CONCLUSION

Nigeria is endowed with Large Fresh water resources: both Surface and groundwater sources. The country has four river drainage systems from which numerous rivers take their sources

with a lot of dams cutting across the country from north to south. Therefore, there is need for individuals, corporate organizations and local communities to collaborate with government at all levels to manage and preserve these hydrological resources to ensure water availability for present and future generations while protecting the health of ecosystems.

Competing Interest

The authors have declared that no conflicting interest exist in this study.

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