

MANAGING NIGERIA'S GROUNDWATER RESOURCES FOR SAFE DRINKING WATER

¹Dan-Hassan M. A., ²Amadi A. N., ³Yaya O. O. and ⁴Okunlola, I. A.

¹Rural Water Supply and Sanitation Department, FCT Water Board, Abuja, Nigeria

²Department of Geology, Federal University of Technology, PMB 65, Minna, Nigeria

³National Water Resources Institute, Kaduna, Nigeria

⁴Department of Chemical and Geological Sciences, Al-Hikmah University, Ilorin, Nigeria

*Corresponding author: geoama76@gmail.com

ABSTRACT

The management of Nigeria's groundwater resources for safe water provision requires knowledge and capacity to effectively harness the resources for sustainable development. However, good planning and implementation strategies are needed to achieve sustainable operation and maintenance management. The wide variations in hydrogeological regimes across the country result insignificant differences in the availability and quality of groundwater. Lack of coordination and enforcement of best practices in the groundwater industry and the absence of community ownership of most rural water supply schemes have greatly affected the management of Nigeria's groundwater resources. Therefore, collaboration between the different stakeholders is necessary to understand and address the general and peculiar issues of sustainability, with emphasis on the impact of groundwater resources in ensuring national water security, poverty alleviation and improving the health conditions of the people. Conduct of research and establishment of national groundwater data base management system should be encouraged in order to economically and sustainably utilize the resource.

1. INTRODUCTION

About 60 million Nigerians live in rural communities of less than 5000 and half of these in even smaller communities of less than 1500. The main economic activities in rural areas are agriculture and livestock rearing with about two-thirds of the population engaged in subsistence farming. Despite the abundant water resources in the country, the current water supply coverage in rural areas is 40 – 50%, for which groundwater is the most widely used option (Onugba and Yaya, 2008).

It is therefore imperative to consider management of groundwater resources in the context of safe drinking water provision and the ultimate goal of improvements in the standards of living of the citizenry. The benefits of groundwater development and management are linked to the inherent characteristics of the groundwater resources: most aquifers provide large water storage space and help stabilize water supply during peak of dry season and droughts; the slow flow of groundwater through small voids helps in purifying water; necessitating lower or no treatment costs prior to its use as drinking water; the general availability of groundwater makes it a resource easy to access; and in areas of extensive aquifers, groundwater development can increase recharge and also decrease flood intensity (Onugba and Yaya, 2008). This paper reviews groundwater management in Nigeria with reference to technical and socio-economic challenges and proffer solutions to ensure safe drinking water provision.

The lack of access to adequate safe water supply contributes to death and illness, especially in children. Thus, the improvement of access to safe water is a crucial element in the reduction of under-age mortality, morbidity, particularly in poor rural areas. Access to water also means that considerable amount of time women and children spend in fetching water could be used more effectively on other tasks, a key component in poverty alleviation efforts. Improvement in water supply and sanitation services leads to improvement in people's health and quality of their livelihood.

2. Geology and Hydrogeology

The hydrogeology of Nigeria is explained in detail in Adelana et al. (2008). There are three main aquifer types in Nigeria: crystalline rocks, consolidated sedimentary rocks and unconsolidated sedimentary deposits (Figure 1). In crystalline basement areas, folds, joints and shear zones are common but localized. The weathered mantle renders the normally impermeable crystalline rocks suitable for ingress and storage of water (Offodile, 2014). In prospecting for groundwater in these areas, it is important to determine the lateral and vertical limits of the faults, fractures, joints and also the extent and thickness of the weathered mantle. The major geological units are:

(i). The Basement Complex comprises over 50% of the country's area and are moderate to poor aquifers, contributing the groundwater supply. It consists of low permeability rocks with groundwater occurring in weathered mantle and fractured zones. Yields frequently range between less than 1.0 l/s and 2.0l/s.

(ii). The sedimentary Basin Formations such as the Tertiary deposits of the Chad and Sokoto Basins, the Cretaceous deposits of the Niger and Benue troughs, and the sedimentary formations of the Niger Delta, yield groundwater in varying quantities.

(iii). The Tertiary Volcanics found in parts of Plateau, Cross River, Adamawa and Taraba states.

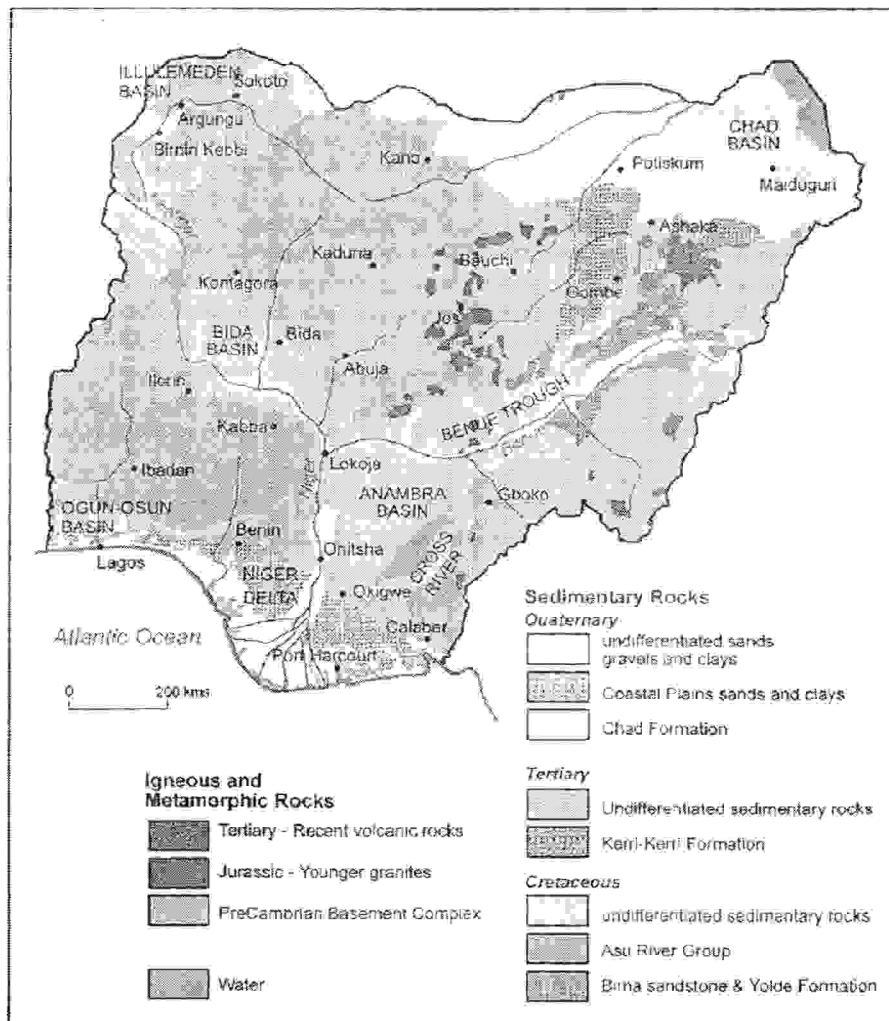


Figure 1: Geological map of Nigeria (Adapted from Mc Donald *et al.*, 2008 and Olasehinde, 2010)

3. Development and Management of Groundwater in Nigeria

Public water supply in Nigeria started in the early 20th century (FRN, 2000) in only a few towns and was managed at the lowest administrative level. Amongst the early beneficiaries were Lagos, Calabar, Kano, Ibadan, Abeokuta, Ijebu Ode and Enugu. The schemes were maintained with revenue from water sales with virtually no operational subvention from the government. With the creation of regional governments in the early 1950s, the financial and technical responsibilities for developing new water schemes were taken over by these regional governments who assigned supervisory manpower to oversee operations and maintenance. However, the regional governments were slow in setting up independent bodies to develop, operate and manage the water supply. The first water corporation was formed in the western region in 1966 which took over

all the assets and liabilities, including the existing staff. The staff of the Water Division of the Ministry of Works was also transferred to the new

The Federal Government got involved in the management of water resources in 1976 when the Federal Ministry of Water Resources and the 11 River Basin Development Authorities (RBDAs) were created. The purpose of the RBDAs was to provide bulk water, primarily for irrigation of dry season farming in some selected project sites mostly located in rural areas of the country. They were not involved in the domestic water supply. Today, all the 36 states and the Federal Capital Territory of Abuja have water corporations or public utility boards managing their public water supply. Their efforts are supplemented, in many cases, by local governments who supply water to small villages within their jurisdictions.

Following the adoption of the National Water Supply and Sanitation Policy in January 2000, the Nigerian Government considered the provision of water supply services to be the domain of the Federal, State and Local Governments. However, the public sector was not successful in meeting more than a small portion of the demand for water by residential and commercial users. Services were critically in short supply. For example, out of the 85 million people (FRN, 1991) living in urban and semi-urban areas, less than half have reasonable access to reliable water supply. Many urban households, often the poorest, end up purchasing water from private vendors at a higher price than the public supply. A few rural communities were provided with hand-operated boreholes and wells which yield little or no water during the dry seasons due to incessant breakdown and fall in the water table. Water supply services, where they exist, are unreliable and of low quality; and are not sustainable because of difficulties in management, operation and pricing as well as due to failure to recover costs. Many water supply systems show extensive deterioration and poor utilization of existing capacities, due to under-maintenance and lack of funds for operation. Additionally, the high cost of imported equipment especially in terms of a depreciating currency and inadequate cost recovery policies contributed to large financial deficits in many State Water Authorities (SWAs). This left most SWAs dependent upon state subventions to finance the operations and maintenance of their water systems, to service debt and to finance new investments. But the states' own financial constraints often limited the amount of recurrent capital subventions, requiring the SWAs to defer maintenance and limit new investment. Fiscally, both in small towns and rural areas, the focus must be on phasing out of subsidies for maintenance altogether and restricting such subsidies to partial capital costs; to engender greater community ownership.

From the foregoing it becomes clear that water supply has suffered a serious management setback despite government efforts at improving the water sector, leaving the poor rural dwellers not benefited much from this noble plan. It was realized that public water supply was not only urban biased but in many cases fail to meet the increasing demand. The idea of hand pump borehole came to bear in the preceding decades.

The Federal Government of Nigeria with the assistance of External Support Agencies (ESA) has undertaken several massive groundwater development projects through the following agencies (Onugba and Yaya, 2008):

- National Borehole Programme (1981) of President Shagari's Civilian Administration;
- Directorate of Food, Roads and Rural Infrastructure (DFRRI) Rural Water Supply Programme (1986 – 1992) of General Babangida's Military Government;

- Petroleum Trust Fund (PTF) Rural Water Supply Programme (1996 – 1998) of general Abacha's Military Government;
 - Improved Access to Water Supply and Sanitation Programme (2000 – 2001) of President Obasanjo's Civilian Administration;
 - National Rural Water Supply and Sanitation Programme through the MDGs Office (2010 – present) of Yar'Adua – Jonathan Administration
- These were mainly borehole projects that greatly depended on the Government in power without tangible continuity strategy in place. Hence, sustainability of the projects became a major concern. The major external support Agencies in rural water supply and sanitation include UNICEF, UNDP, World Bank- Assisted Agricultural Development Project, European Union (EU), Department for International Development (DFID), Water Aid, Japanese International Development and Co-operation Agency (JICA), etc.

4. Challenges of Managing Groundwater for the Provision of Potable Water

The major challenges affecting groundwater management in Nigeria include the following::

Difficult geological terrains pose a challenge to groundwater exploitation. Groundwater is usually the first option to be considered for water supply and in most cases, the exploration and exploitation encounter very challenging terrains, especially in some areas underlain by Crystalline Basement rocks. For example, to meet the minimum yield requirement of 15 l/min for hand pump boreholes in some parts of the Basement Complex of Northern Nigeria has become a difficult task to achieve due to the poor permeability of the Formations.

Uncoordinated and unregulated development of groundwater may result in water quality issues which appear when the scale of the problem has reached a catastrophic level. The case of high concentration of Lead (Pb) and other radioactive compounds in groundwater due to informal mining activities in some communities in zamfara State provides a good example.

Lack of government regulation/policy and enforcement allows individuals to decide on their own how to protect and monitor their water without due consideration to pollution threats mostly due to on-site sanitation.

Beneficiaries of groundwater projects often expect the Government to provide operation and maintenance fund. This wrong "notion" has made most water schemes unsustainable. An assessment of the functional status of

- boreholes in the rural communities FCT indicated a functional status of 64% (Table 1). Lack of ownership and maintenance culture were the reasons advanced for the failure of some of the water schemes.
- viii. The effect of extreme climatic conditions in the northern parts of the country is likely to impact on groundwater resources as annual recharge from rainfall is unpredictable. The situation in the southern parts of the country, especially in the Niger Delta areas, is not the availability or quantity of the groundwater but the challenge of quality posed by occurrence of iron and salt water intrusion.
 - ix. Rapid urbanization without proper planning can result in contamination of groundwater resource, especially where there are poor sewerage facilities. This situation occurs in some urban slums in the country (Dan-Hassan *et al.*, 2012; Amadi *et al.*, 2013 and Amadi *et al.*, 2014).
 - x. There has been an upsurge in the demand for groundwater in urban areas of Nigeria recently and this has the tendency to give rise to over-exploitation of the aquifers. A typical experience is the case of some areas of Abuja city where groundwater is now encountered at depths twice the depth normally drilled in the past ten years.
 - xi. Lack of Community Ownership of rural water supply schemes has been a major threat to operation and maintenance coupled with the non-involvement of women in planning and implementation of rural water supply projects (Dan-Hassan, 2001).
 - xii. Technical Challenges due to inappropriate technology for exploration and exploitation of the groundwater resource. This includes inadequate participation of professionals, issues of epileptic power supply, high cost of diesel fuel for electric generators, inappropriate sizing of solar panels/pumps, etc.
 - xiii. Willingness to pay by community members in order to ensure smooth operation and maintenance of the facility still remains a hurdle to cross in some communities.
 - xiv. The frequent vandalisation and theft of borehole water scheme components have been militating against the smooth operation and maintenance of rural water supply facilities. Therefore, there is the need to provide extra security measures and components to the borehole facility in order to ensure safety and sustainability of the water scheme.
 - xv. A major indicator of the lack of access to safe drinking water is the reported cases of water borne diseases in our health institutions. In recent years, cases of cholera epidemic, with about 350 deaths reported in the Northern region of the country was not unconnected with the use of unsafe water sources and poor hygiene conditions (FMOH, 2010). Since the outbreak was reported across the nation with another emergence in the South West, it was appealed to all the governors of the 36 states on the need for increased funding to combat the epidemic, yet the scourge seemed to be raging unabated (Ishaku *et al.*, 2011). The cholera death toll rose to 431 in 11 states, as Bauchi, Borno, Yobe, Adamawa, Kano, Jigawa, and Taraba. Others were Katsina, Rivers, Ogun, Cross River, and Osun states, while no fewer than 4,665 cases were recorded. Cholera remains a global threat and is one of the key indicators of social development. While the disease no longer poses a threat to countries with minimum standards of hygiene, it remains a challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed.

Table 1. Functional status of boreholes in the Area Councils (A.C.) of FCT

	Gwagwalada A.C.	Kuje A.C.	A.M.A.C.	Abaji A.C.	Bwari A.C.	Kwali A.C	Total No.
No. of functional boreholes	62	135	45	97	11	8	358
No. of non-functional boreholes	42	74	21	11	27	23	198
Total No. of boreholes assessed	104	209	66	118	38	31	556
No. of handpump boreholes	39	25	26	38	19	20	167
No. of Motorised/Solar boreholes (with tanks)	65	184	40	70	19	11	389

(Source: Author's current study)



(a)



(b)



(c)



(d)

Figures 2(a - d): A display of poor conditions of groundwater supply in parts of the country.

5. Way Forward for Managing Nigeria's Groundwater Resources

- i. Management strategy must be formulated and implemented for sustainable groundwater resources development using the appropriate mechanism that ensures community ownership, operation and maintenance.
- ii. Capacity development to improve knowledge and skills of professionals in the groundwater industry and also advocate for attitudinal change for people to take responsibility of managing the water facilities in their communities.

- iii. Strengthen the National Water Resources Institute or other existing institution to coordinate the conduct of research in groundwater development and management and serve as the data bank for Nigeria's groundwater resources. This should also lead to charting a course of action for practical implementation of the findings of the research.
- iv. Conduct stakeholders' workshop to sensitize professionals and the public on the significance of practical implementation of the "code of practice" for water well industry and enforcement of the regulations. Boreholes are being drilled all over the

country without "hydrogeological control" and therefore, the need to enforce regulations for sustainability of the resource has become more imperative than ever before.

v. Collaboration between the different stakeholders to understand and address the general and peculiar issues of sustainability with emphasis on the impact of groundwater resources in ensuring national water security, poverty alleviation and improving the health conditions of the people.

vi. Promotion of Water Quality Standards and Surveillance ensures safe water provision. Therefore, capacities should be built at all levels to ensure water quality awareness. Communities should be encouraged to develop and implement water safety plans while the local government authorities should be equipped to provide remedial actions. State water safety strategy should be developed and Water Quality Monitoring and Surveillance Committees established and empowered to undertake periodic water quality monitoring and assessment. In conducting this task, the quality of water to be delivered should comply with the Nigerian Standards for Drinking Water Quality.

6. CONCLUSION

The development and management of Nigeria's groundwater resources require urgent practical reforms to ensure adherence to best practices in the exploitation of the resource without undermining its sustainability. This requires the involvement of all stakeholders at all levels.

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