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GROUNDWATER FOR SUSTAINABILITY DEVELOPMENT IN NIGERIA: A REVIEW

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Abstract
Groundwater is simply the water found below the earth surface in fractures of rock formations or pore spaces. It is a major source of water for domestic, agricultural and industrial uses. Despite the availability of vast water resources across Nigeria, access to safe water is still a challenge. Hence, this paper reviews the challenges hindering the use of groundwater for sustainable development in Nigeria despite the abundance of water resources across the country. Some of the challenges were found to be associated to over-exploitation in rural areas, urbanization, failed policies and management plans, poor data management, Inadequate funding of existing water resources programs, uncoordinated exploitation of ground water as well as the effects of climate change. The paper concludes with recommendations for proper strengthening of groundwater-related research and educational programs as well as monitoring of groundwater resources across the country in terms of its quantity and quality in all water resources development programs across the country to address some of these challenges.

Keywords: Climate Change, Development, Groundwater, Nigeria, Sustainability,

1.0 INTRODUCTION

Groundwater is simply the water found below the earth surface in fractures of rock formations or pores space. It has become a major source of water for domestic, agricultural and even industrial uses due to its being an important basic amenity to life and human survival. The use of groundwater has particular relevance to the availability of many potable water supplies because it has a capacity to balance large swings in precipitation and associated increased demands during drought and when surface water resources reach the limits of sustainability (Garuba, 2023).

Unfortunately, access to this potable source of water, that is ground water supply is still a problem especially in rural areas of Nigeria where it is accessed mainly in form of shallow wells (Jibrin, 2019).

Despite the fact that Nigeria is a country that is blessed and endowed with enormous water resources as seen in its volume of rainfall, surface and subsurface water resources (Paul and Ubong, 2021), it has failed in its responsibility of providing potable water especially in the northern region where about 70% of the population do resort to self-help in addressing their water needs by exploiting the underground water resources in an unstructured and uncoordinated, and unsustainable manner (Akpor and Muchie, 2011; Chukwu, 2015).

Although, efforts were made in the past by the Nigeria government to harness its abundant water resources by establishing about 12 River Basin Development Authorities (RBDAs) across the country, under the Federal Ministry of Water Resources (FMWR), with the responsibility of managing the water resources of the country, provision of water for irrigation and municipal supply, basic hydrological data, its collection, storage and analysis for national water planning and policy making, yet, no fruitful sustainable development has been achieved (David, 2013).

In addition, despite the seeming evidence of over-exploitation of ground water in Nigeria, there are still no accurate studies showing the estimate of the total volume of groundwater used for agricultural and other purposes in Nigeria. This is a challenge to groundwater development, as there is no adequate knowledge of how much groundwater is used. Yet, this information is required for proper planning and development of groundwater in Nigeria (Onugba and Yaya, 2008).

To achieve the goals of groundwater management and sustainability, a good understanding of the fundamental processes that influence groundwater quantity and quality is required. The management of groundwater resources under pressures of climate change and human activities is becoming a global challenge, which encompasses changes in the characteristics of inter-related climate variables in space and time, as well as derived changes in terrestrial processes and anthropogenic activities that affect the environment Therefore, it is important to understand the challenges regarding groundwater management in Nigeria and to suggest possible ways for a systematic management and regulation.

The aim of this paper is to review major factors hindering groundwater development in Nigeria and to suggest possible ways for its sustainable development.

2.0 THE NEED FOR GROUND WATER DEVELOPMENT IN NIGERIA

The need for groundwater development could be observed in the ability to offset the imbalance between water demand and supply especially during drought/dry season (Mukherji, 2018; UNESCO, 2011). The relative ease of availability and accessibility

in most parts of Nigeria translates to the presence of hand dung wells as well as pumped well across the country. The presence of various strata/layers of soil below the earth surface serves as a natural medium of groundwater purification during abstraction and recharge of aquifers. This helps to improves the water quality. Also; a good amount of groundwater abstraction could help to increase the amount of runoff from precipitation through infiltration to recharge aquifers, which would ordinarily lead to high water table resulting to flood occurrence in most part of Nigeria (Onugba and Yaya, 2008)

3.0 Challenges of Groundwater for Sustainability Development in Nigeria

According to the African Union Report (2011) and WHO/UNICEF (2017), Nigeria has consistently failed to meet her global water security commitments to health, agricultural, potable water supply, and environmental sustainability despite the increase in access to water from 51 - 68 percent between 1990 to 2016. This may be due to the following reasons (World Bank,2018):

3.1 Rate of groundwater abstraction and recharge: Groundwater abstraction refers to the amount of water that is taken out of an aquifer while Groundwater recharge is the process by which water is added to an aquifer. If the rate of abstraction (water extraction) is higher than the rate of recharge, the aquifer will naturally become depleted. The rate of abstraction is generally higher in the northern part of the country due to its population as well as the rate of recharge is lower due to lower precipitation volume when compared to southern Nigeria, which is characterized with higher rainfall intensities and occurrence (Annual Performance Survey, 2022; Michael *et al.*, 2006).

3.2 Population increase: Nigeria is one of the fastest growing countries in terms of population in sub-Saharan Africa and the world at large, which leads to over dependency on groundwater resources to meet with its domestic and agricultural needs, hence over abstraction which may lead to land subsidence and environmental degradation **(**NPC,2018; Oramah**,** 2016; Amah, 2015).

3.3. Pollution of groundwater resources: The sources of groundwater pollution in Nigeria are from agricultural activities that is leaching of top soils by chemical or fertilizer applications for agricultural purposes into the soils. It also includes domestic and industrial indiscriminate disposal of waste products. This may lead to degradation of water quality and a great health risk to the people relying on groundwater for domestic uses (Olajuyigbe *et al*., 2019, Ocheri *et al.*, 2014; Muhammad, 2014; Ifeoma, 2014).

3.4 Climate Change: In recent years the world at large has experienced the effect of climate change of which Nigeria is not left out of this (World Bank, 2016 and IPCC, 2019). These effects are seen in terms of late onset of rainfall/dry spell spell/drought in the Northern region of Nigeria, leading to low runoff and precipitation necessary to recharge aquifers, while in the southern part of the country, climate change results to excess rainfall leading to over recharge of aquifers. Hence, flooding could occur (Flood Impact Assessment, 2023; Annual Performance Survey, 2022; FAO, 2011) which may also lead to discharge of pollutants as well as washing of contaminants into surface and subsurface water resources.

3.5 Inadequate funding of existing water resources programs: Inadequate management of groundwater resources as seen in the performance of Federal Ministry of Water Resources (FMWR), the River Basin Development Authorities (RBDAs) and State Water Agencies (SWAs) has led to failure of the sector to sustain existing water resources in the country. Over the period of ten years, budgetary allocation to water resources development in Nigeria has not risen consistently despite the rapid population increase. In addition, increasing water demand is not taken into consideration in budgetary allocations. Also, the national budget for these parastatals reveals that 70% of the budget is expended on recurrent expenditures and 30% of the budgetary allocation on capital expenditures (Adeniran, 2021; David, 2013), this made them not to sustain exiting water resources in the country.

3.6 Uncoordinated exploitation of ground water: Usually, groundwater is exploited by individual/private companies provided there is availability of funds, especially in urban areas of the country, without proper geophysical and geohydrological analysis prior to exploitation. This may lead to environmental degradation and poor quality of water made available for domestic consumption (Owolabi *et al.* 2019; Fagbohun and Olaleye, 2019).

3.7 Urbanization: The search for greener pastures has led to excessive migration of individuals to the urban areas of the country. The lack of pipe borne water has left a large population of people and industries with no other choice than mainly groundwater exploitation as a source of water supply. Also, urbanization affects the land use pattern leading to more impermeability in urban areas in Nigeria which. may lead to more runoff available than percolation or infiltration which is ordinarily meant to recharge aquifers. This may account for flood occurrence in urban areas of the country (Nimzihirwa *et al*., 2009, Study Session 5, n.d).

3.8 Absence of regulatory bodies: There are practically no regulatory bodies in the country that is charged with the responsibility of controlling the exploitation of groundwater. This explains why there is indiscriminate exploitation of ground water in the country (Olajumoke. and Margarita, 2019; David, 2013)**.**

3.9 Poor data management: The Nigerian water resources sector does not have a data base or complete hydrogeological systems in the country needed to model the aquifer systems. This makes it difficult to make informed decisions on policies and regulations on groundwater development. There is also no accurate data on the total volume of groundwater used for annual domestic and irrigation purposes in Nigeria, despite the importance of the information for sustainable development planning (Olajumoke and Margarita,2019; David; 2013)**.**

3.10 Failed Policies and Plans for Groundwater Management in Nigeria:

There were efforts of the Federal Government of Nigeria to harmonize the Water Act of 1993 and the National Water Resources Masterplan of 1995, to come up with the National Water Policy of 2004 so as to control the exploitation and management of the national water resources in a sustainable manner, and to meet the needs of both the present and future generations (Jimoh *et al*., 2020; Nwankwoala and Udom, 2011). These efforts have not seen the light of the day. In addition, there is still an increasing inverse relationship between water supply and demand in Nigeria.

The recommendations of the 1995 Water Resources Master Plan could not be achieved even after 20 years due to reasons such as: incorrect demand projections, weak implementation structure and deficient regulations and lack of adequate budgets. Hence, the 2013 master plan was enacted stimulating concrete actions to solve problems of such as, low rate of access to safe and clean water and sanitation facilities, Low contribution of irrigation to national food security and insufficient utilization of hydropower for renewable energy by integrating development, utilization and management of water resources through evaluation of water resources potential and demand projection on the basis of the philosophy of Integrated Water Resources Management (IWRM)(The Project for Review and Update of Nigeria National Water Resources Master Plan, 2014).

4.0 Sustainable Groundwater Management Practices

It is important to monitor the rate of groundwater abstraction, promote efficient water use practices to ensure groundwater sustainability in Nigeria (Adeleye *et al*.,

2021; Anand and Walia, 2021). These are highlighted below:

4.1 Use of alternative water resources: Nigeria is reasonably blessed with other sources of water such as small rivers and larger rivers (Benue and Niger). It is also bounded at south-south, southwest by various water bodies. The annual rainfall varies from about < 500 mm in the north to >3000 mm from North to South, respectively (Olajumoke and Margarita, 2019). If these surface water resources could be properly harnessed and managed it will lead to less exploitation of groundwater.

4.2. Adoption of sequential process of groundwater development: Proper Ground water development involves three processes of exploration, evaluation and exploitation (Onugba and Yaya, 2018). But often than not, only the last process (exploitation) is adopted by most groundwater explorers leading to failure of such groundwater systems.

4.3 Water Conservation Techniques: Adoption of appropriate rainwater harvesting techniques and soil conservation measures especially in the northern region, where agricultural activities are carried out via irrigation, thus, using water from other sources would lead to less exploitation of groundwater resources (Wada *et al.,* 2019).

5.0 Conclusion

This paper reviewed researches on the challenges of groundwater resource management and sustainable development in Nigeria. The findings revealed that, poor data management, inadequate funding of existing water resources programs, uncoordinated exploitation of ground water, inadequate funding of existing water resources program are among the factors responsible for insufficient potable water supply and over exploitation of groundwater in rural and urban regions of Nigeria despite its vast water resources. Hence, the paper suggested that, there should be an establishment of autonomous body which would be responsible for groundwater development as well as the regular appraisal of the RBDA, and FMWR for improved service delivery as this indirectly affects deliberate groundwater recharge. In addition, regular public sensitization (end users) on the need to adopt useful water conservation techniques and appropriate waste disposal and its implication on groundwater resources. Groundwater potential mapping through the use of Remote Sensing and GIS to develop predictive maps in data scarce region should be adopted. Conclusively, strengthening groundwater-related research and educational programs as well as monitoring of groundwater resources across the country in terms of its quantity and quality in all water resources development program should be encouraged.

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