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Sustainability and Challenges of Groundwater Utilization in Developing Countries: A Review

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Abstract: *Groundwater plays an important role in supporting human well-being and economic growth in both urban and rural surroundings, as well as supporting various aquatic ecosystems in Africa. Thus, subsurface water has high significance to the growth and well-being of Africa, if sufficiently assessed and sustainably exploited. This paper highlighted some key groundwater problems and difficulties in developing nations, particularly in Africa with probable chances for sustainable groundwater management. This has been done through a review of related pieces of literature. Groundwater resources in Africa face a growing threat of contamination from urbanization, industrial increase, agricultural and mining activities, and from improper sanitation practices, and over-exploitation owing to growing demand to meet human and agricultural demands. To attain the demand gap of enough freshwater resources the implementation failed in most developing nations owing to fast population growth, urbanization, climate change, improper sustainable skills, and policies for good implementation of sustainable groundwater infrastructure and environmental management. Furthermore, the condition might be poorer in the sub-Saharan region, because of their fast population growth. In the region, the proportion of people who enjoyed piped water on their buildings, which is the preferred choice for urban areas, certainly reduced from 42% to 34% (WHO and UNICEF, 2014a). This noticeably shows that accessibility to 'safe' drinking water sources continues to be a key problem in cities in developing nations. Equally, the trends are the same in good sanitary services. Urban residents without access to improved hygiene increased by 40%, from 541 to 754 million, between 1990 and 2012 (WHO and UNICEF, 2014a).*

Key words: *Challenges, Groundwater, Pollution & Sustainability*

Introduction

The total water resources accessible around the world are projected to be in the order of 46,000 km^3/annum, including about 36,000 km^3/year of surface water and 10,000 km^3/annum of subsurface water (Trenberth *et al*. 2007). Considering the continental level, America has the major portion of the world's total freshwater resources at 45%, then Asia

at 28%, Furthermore, Europe possesses 15.5% and Africa was estimated to be 9%. In terms of resources per resident in each world continent, America has 24,000 m^3/annum, Europe 9,300m^3/annum, Africa 5,000m^3/annum, and Asia 3,400.1m^3/annum (FAO 2003) in Gaye & Tindimugaya, 2019.
In addition, around the world, regions that have sustainable subsurface water balance are decreasing daily. Three difficulties that dominate subsurface water use are depletion owing to over-pumping; waterlogging and acidity owing to insufficient drainage and inadequate conjunctive use; and pollution owing to agricultural, industrial, and other human actions. In regions of the world, particularly with high population density (Shah, 2001).

MacDonald *et al.* (2012) produced the first quantitative maps of subsurface water resources in Africa which exposes the extent and distribution of freshwater stored as subsurface water. The volume of subsurface water is projected to be 0.66 million km^3, more than 100 times the annually renewable freshwater resources and 20 times the freshwater stored in African lakes (Gaye & Tindimugaya, 2019).

According to Gaye & Tindimugaya, 2019. the maps shown in figure 1, establish the uneven distribution of subsurface water across the region and, in particular, the huge subsurface water volumes accessible in the sedimentary basins of northern Africa. The potential for boreholes yielding greater than 5 Lit/ sec outside of large sedimentary basins is not common but limited to specific areas needing careful examination and development. However, for many African countries, suitably sited and constructed boreholes support a hand pump (a yield of 0.1–0.3 Lit./sec), and sufficient storage is available to bear abstraction through annual variations in recharge.

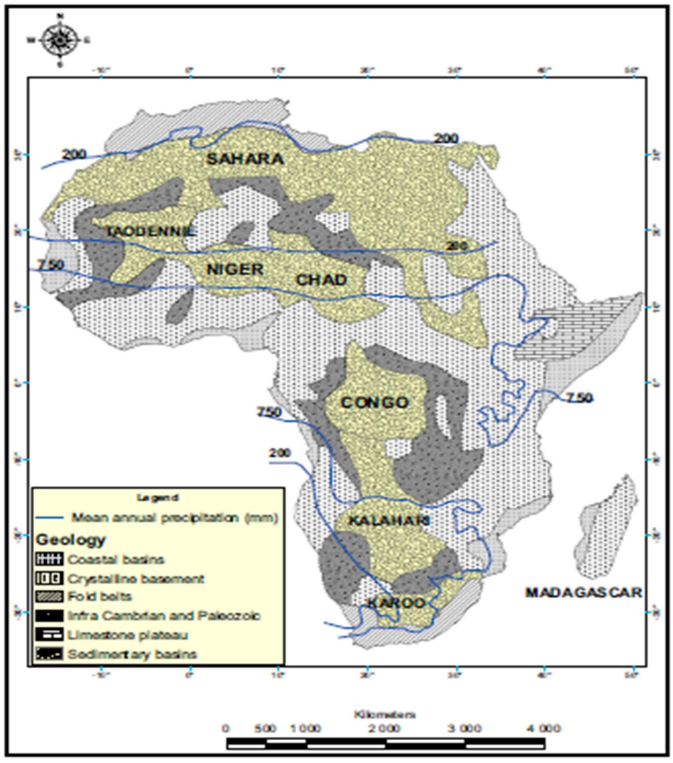

Fig. 1 Groundwater regions of Africa
Source: Gaye & Tindimugaya, 20

Furthermore, urbanization contributes to problems of freshwater sustainability, which also contributes to increasing in freshwater demand. For example, in the Asia–Pacific regions, water usage per day per capita varies from 250–300 litres, although in developing nations it is projected to vary from 60–200 litres per capita per day (IWA 2002). The growing urbanization leads to higher water demand and the associated demand for sanitation services dwelling huge stress on water resources and their infrastructures. Setting up water and wastewater industries is huge capital intensive and maintenance costs for collecting of sewage, transport, and treatment, but at the same, while providing a low return on assets (less than 5% /year) (Wilderer 2004). This is partially because sewage systems are locally designed to act only as a channel to transport wastewater to its destination, the treatment plant. The contaminated disinfection plant is also compromised as cities enlarge meanwhile the infrastructure becomes unable to deal with the growing load of contaminated water produced. Furthermore, the removal of untreated sewage to water bodies is not acceptable and even conveyance to long distances through aging infrastructure takes the risk of leakage and polluting subsurface water owing to leachate (Burn *et al*. 2003; 1998; Eiswirth *et al.* 2000).

It is currently assessed that 1.1 billion people around the world lack quality water resources likewise 2.6 billion people faced the absence of acceptable hygiene (UNICEF *et al.* 2004). The associated global health burden is projected that nearly 4000 – 6000 children are losing their lives daily due to the consumption of contaminated water, good hygiene, and bad sanitation (WSSCC, 2004). UN MDG's intended to minimize the percentage of people lacking access to freshwater sustainability and sanitation at least by half in the year 2015. Accessibility to freshwater is still a serious problem in higher percentages in Asian nations where around 675 million people are deprived of freshwater resources (UNICEF *et al.* 2004). In Sub-Saharan African nations, only around 36% of the population has access to basic hygiene (UNICEF *et al.* 2004). The MDG projected that hygiene must be delivered for nearly 2.1 billion people varies from 2002 - 2015 when adjusting for population growth. Provision of toilets for around 13 years for 2.1 billion people needs at least 44,300 installations every day for the next 13 years (assuming 1 toilet per 10 persons). Assuming the price per installation is $100 USD for basic dry hygiene, then the project needs just to construct a basic level of hygiene in the successive 13 years cost $4.4 million USD daily (UN Millennium Project 2005). In 1991, a survey showed that in developed nations, water loss as a proportion varied from 8 - 24%. Nevertheless, in middle-income nations, water loss varied from 15 - 24%, and in developing nations, water loss varied from 25 - 45% (WHO 2001). Numerous largest documented waterborne epidemics in the last 2 decades have been associated with cross-contamination in the water delivery system due to leaks (Renkevich *et al.* 1998).

In addition to the consequences on human health and food production, shortage in the delivery of freshwater leads to deep political burdens and instability. During an international freshwater day message by UN Secretary-General Kofi Annan on March 22, 2002, he warned that global security relies on resolving the water crisis and stated that

"Fierce national competition over water resources has prompted fears that water issues contain the seeds of violent conflict" (ENS 2002). How we manage increasing freshwater scarcity and yet preserve adequate water for health, sanitation, agriculture, and industry is a severe task for the close future. Various policies will be essential for the variability of climatic, economic, and cultural locations affected by freshwater scarcity. Some progress has been made in that total global freshwater abstractions began to be stable in the 1970s and 1980s, and in some industrialized nations, water abstractions have weakened owing to differences in irrigation practices, water recycling, and management (Gleick 2003; Postel 2000).

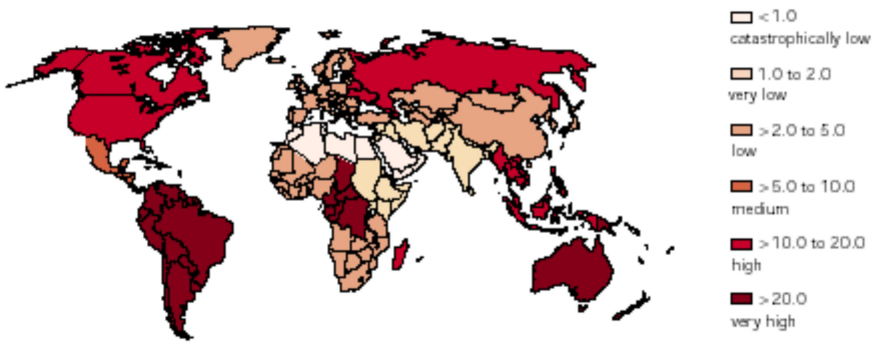

Figure 2: Water availability in 2000 (Measured in terms of 1000m^3/capita/Annum)

（**Source: UNEP, 2002a**）

Conclusion

Groundwater is one of the most vital natural resources which contributes to the global freshwater supply. The groundwater water system responds to human and climatic variations gradually (relative to surface-water systems), and climate variation still could affect the Subsurface water system significantly through changes in groundwater recharge as well as groundwater storage and utilization. These variations result from changes in temperature and rainfall or from changes in land use/land. Furthermore, the provision of high-quality water and wastewater infrastructure in developing countries requires a huge outlay of funds.

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