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Role of ground water in a water-scarce South Africa and increasing investment for this resource

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The availability of groundwater for use will surely go a long way to partially solve the problem of water scarcity. It is strategically important for socio-economic development throughout the sub-Saharan Africa region.

This is according to a new report by the South African Water Research Commission (WRC). The report seeks to clarify the poorly understood functioning of groundwater in the hydrological environment. The report also provides a regional diagnosis of groundwater for sub-Saharan Africa.

A both top to bottom and vice versa facilitation of multiple actions needs to occur. This requires attention from multiple levels, local, national and regional. The process should start with a model institutional framework, strategically developed by multiple stakeholders and based on an understanding of the roles and requirements of groundwater.

Systematic groundwater monitoring should be implemented in every country and should include the quantity and quality of the resource as well as its use by various economic sectors. The ownership needs to be shared among all stakeholders.

Key to increasing investment in groundwater is a systematic social and economic valuation of groundwater as a commodity for local, national and regional development. This should also provide a basis for improved communication of groundwater's role within the water sector.

Good diplomacy is essential to good governance. Forums should be set up for all levels of stakeholders. Knowledge management should be an on-going contribution from the groundwater science sector to the water sector broadly. This includes sharing, archiving and effectively communicating knowledge.

Groundwater in South Africa

Groundwater, despite its relatively small contribution to the total water supply in South Africa (13%), represents an important strategic water resource. Owing to the lack of perennial streams in the semi-desert to desert parts, two-thirds of South Africa's surface area is largely dependent on groundwater. In these water-scarce areas, groundwater is more valuable than gold.

Although irrigation is the largest user of groundwater, groundwater provides water supply to more than 300 towns and smaller settlements. Over 90% of South Africa's groundwater *occurs in hard rock which is hard to access. It is also contained in faults, fractures and joints and in dolomite, limestone and in dissolved openings called fissures.*

Hard rock aquifers are known as secondary aquifers because the groundwater occurs in openings which were formed after the rock was formed. Over the remainder of the country groundwater occurs in primary aquifers. These comprise porous sediments and soils where groundwater is contained in the spaces between sand grains. Primary aquifers are found in river (alluvial) sediments, in coastal sand deposits, and the Kalahari deposits.

Classification of water in terms of where it is found

Meteoric water – *water in circulation in the atmosphere.*

Surface water – *water found in rivers, lakes, wetlands and the ocean.*

Subsurface water – *all water found below the surface of the earth, including soil water, capillary water and groundwater.*

Groundwater – *all water in the zone of saturation i.e. below the water table.*

Where does groundwater come from?

Groundwater is an important part of the water cycle. It comes from rain, snow, sleet and hail that soak into the ground. The water travels down from the area of recharge passing between particles of soil, sand, gravel, or rock, until it reaches a depth where the ground is filled, or saturated, with water. The area that is filled with water is called the saturation zone and the top of this zone is called the water table. The water table may be very near the ground's surface or it may be hundreds of meters below.

Although groundwater exists everywhere underground, some parts of the saturated zone contain more water than others. This is where some aquifers develop. An aquifer is an underground formation of permeable rock or loose material which can produce useful quantities of water when tapped by a well. They may be small, only a few hectares in area, or very large, underlying thousands of square kilometers of the earth's surface.

Even if groundwater is not used by people, it may still play an important role in the local environment and sustain rural livelihoods that way. Plants may tap into it with their roots and animals may drink it when it discharges to the surface as springs.

How do we access groundwater?

Under natural conditions water in aquifers is brought to the surface through springs or can be discharged into streams or wetlands. It can also be harvested through boreholes. Humans abstract groundwater by drilling a borehole into the aquifer.

Once a successful borehole has been drilled (the choice influenced by specific intended use of water, e.g. for drinking water, water supply to municipality, irrigation and other) we can equip it with any of the following equipments:

Hand pump – *especially if yield of borehole is low, mainly in rural areas, wind pump – mainly on farms, can maintain higher yields and electrical pump/diesel pump – usually when borehole yield is higher, higher assurance supply, or play pump – effective when borehole yield is low, mainly for water supply at schools.*

Boreholes require sophisticated **technology** *with the appropriate technical design, together with proper knowledge of the aquifer. Unfortunately, the importance of good quality borehole design and construction is often underestimated. The lifetime of a borehole and the efficiency of its functioning depend directly on the materials and the technology used. Borehole "failure" is often not linked to aquifer performance, but to the incorrect design and construction of the hole.*

Groundwater Quality

One of the most important natural changes in groundwater chemistry occurs in the soil. Soils contain high concentrations of carbon dioxide which dissolve in the groundwater, creating a weak acid capable of dissolving many silicate minerals. In its passage from recharge to discharge area, groundwater may dissolve substances it encounters or it may deposit some of its constituents along the way. The eventual quality of the groundwater depends on temperature and pressure conditions, on the kinds of rock and soil formations through which the groundwater flows, and possibly on the residence time.

As a result the groundwater chemistry from various places in South Africa will differ depending on the aquifer in which it is found and may make the water unsuitable for certain uses. For example, water from the Malmesbury shale is unsuitable for most uses due to high total dissolved salts. Groundwater in granites (e.g. in Limpopo) naturally contains fluoride in high concentrations.

It is essential to have the quality of the water from a borehole intended for domestic use tested before consumption. Even natural groundwater may contain substances which can make it unfit for consumption.

Groundwater Pollution

Just because water is underground does not mean that it cannot be polluted. Groundwater can be contaminated in many ways. Groundwater associated with coal deposits often contains dissolved minerals poisonous to plants and animals. Pollutants dumped in the ground, in landfills and at sites of animal husbandry or pollutants introduced below ground such as in unlined latrines and burial sites, may leak into the soil and work their way down into aquifers.

Pollutants include substances that occur as liquids like petroleum products, dissolved in water like nitrates or are small enough to pass through the pores in soil like bacteria. Movement of water within the aquifer is then likely to spread these pollutants over a wide area, making the groundwater unusable and spreading disease.

The Danger of Over Abstraction

While groundwater is an abundant resource, it does not mean we should waste it. The maximum quantity of groundwater that can be developed economically in South Africa is estimated at about 6 billion/m³ a year. Some groundwater resources take a long time to replenish. If too much groundwater is extracted too fast, it may become depleted. In coastal areas, fresh water, being less dense, floats on salt water. Over extraction of fresh water may allow salt water to replace it. Therefore, it is important to decide how much water can be extracted from an aquifer before it is developed.

Can we run out of groundwater?

Groundwater supplies are recharged naturally by rain and snow melt. That means we are only able to abstract as much water as that being recharged, otherwise the groundwater supply will run into a "deficit". It is therefore possible that we can run out of groundwater, at least until the supply has been recharged again. This recharge process can take months, years or even hundreds of years. It is important to know how much water is available for abstraction from a specific aquifer **BEFORE** *we start to utilise it.*

Arguments for addressing groundwater in trans-boundary water management

1. *Benefits of groundwater (GW) development and management can be equitably shared across borders to avoid climate-induced distress migration and conflicts*

2. *GW development and proper management have a lot to do with achieving the Millennium Development Goals (MDGs), poverty alleviation, food security, climate change adaptation, and flood and drought mitigation*

3. *An integrated trans-boundary approach facilitates enhanced understanding of water flows and water balances within the aquifer basin and supports improved delineation of the aquifer including active and connected surface water (SW) systems*

4. *GW impacts across borders may not be obvious without joint long-term monitoring. Costs and results of monitoring can be shared*

5. *Impacts of unilateral GW development and use in one member state may affect another*

6. *Developing GW in connection with trans-boundary SW (conjunctive use) may provide a lot of benefits, e.g. floodwaters may be used to replenish GW in overdrawn aquifers; GW pollution may be diluted through riverbank filtration for better drinking water quality, and managed aquifer recharge (MAR) and recovery may support water banking and salinity control*

7. *Many terrestrial ecosystems are GW-dependent and cannot be properly managed without acknowledgement of the GW resources*

8. *SW issues involve or even have root in GW-related activities and impacts, e.g. water from the river may be lost through GW abstraction in the vicinity of the river*

9. *Lake, river, wetland and estuary water quality may be threatened by GW pollution in adjacent upstream aquifer states (mining, intensive agriculture)*

10. *No action and lack of trans-boundary cooperation may result in significant and long-term risks, e.g. haphazard and chaotic exploitation of aquifers with high* *remediation costs if at all reversible (like certain types of contamination and land subsidence)*

Conclusion

Changes in the climate and lack of groundwater management may have a negative trend. There can be many boreholes running dry due to mismanagement. The small rural communities in the aquifer belt depend highly on groundwater and there may be concerns as well. Water may contain more nutrients and bacterial pollution as a result of waste water facilities and pit latrines. Groundwater resources, particularly shallow aquifers are in threat of localized pollution.

When plans to rehabilitate and manage the aquifers are up and running, some water may be used to recharge the aquifers again which guarantees the availability of water for a longer term.

Ike Motsapi & Zwakele Thabede