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## The River Basin

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Water Quality:

### Groundwater Quality



Groundwater is the water held in porous sedimentary layers and rock fractures, anywhere from a few metres to hundreds of metres underground. This water is constantly moving, very slowly through these bodies of rock. Even in seemingly dry riverbeds, such as the lower stretches of the Nossob or the Molopo Rivers, shallow groundwater can flow several hundred metres a day. Along the way it sustains a rich variety of plants and animals that tap the sub-surface waters with deep roots.

In a worldwide context, 94 percent of all available freshwater supplies stem from groundwater. The SADC region has a population of approximately 250 million people, and groundwater meets 60 percent of their daily needs, in particular in the rural areas. In the Orange-Senqu River basin the figure is possibly close to 70 percent.

Therefore, in the basin, groundwater constitutes a very important supply source for water. It is generally considered a cheap and sustainable source of clean water in rural areas. But there are some serious challenges to using and managing the resource, especially in the face of development.

#### A resource that in many areas cannot be replenished

It is a major challenge to ensure quality water supplies in many rural areas of the Orange-Senqu River basin. This is especially the case in Botswana, which depends heavily on groundwater for its rural water supply – not just for farmers, but also for city dwellers, who have second or third residences in remote rural areas. Some have a small house with maize fields, where members of the family will live from December to March; some have a house with a kraal for cattle, goats and/or sheep, where someone will live year-round. As many of these isolated small settlements in rural areas are many kilometres from government water supplies, they need to be self-sufficient and need access to a deep well or borehole to access groundwater for domestic and agricultural/livestock water supplies.

As Botswana's overall demand for water continues to grow, the country is already tapping into most of its accessible water sources. This includes "fossil groundwater" stored in deep aquifers. In effect, this is water from previous climatic eras (i.e. when rainfall and groundwater recharge were higher), which are likely not to be replenished. Also non-fossil groundwater reserves are replenished slowly by infiltration of precipitation and surface water that over a period of years or even decades seeps downwards - known as [groundwater recharge](#). An example of a production well-field supplying groundwater to a remote town is the [Tshabong Wellfield Project](#).

#### Over-exploitation and nitrates – groundwater biggest enemies

The number of animals held in south-western Botswanan cattle posts has increased dramatically over the past few decades. The growing demand for high-quality Botswana beef from the EU and elsewhere has led to overstocking. As water comes from boreholes, livestock can be raised in areas that historically were not suitable for cattle. Farmers' livelihoods have improved because they can exploit the groundwater. However, this expansion of livestock farming in an area where water is not typically abundant has led to falling groundwater levels and in some cases has reduced the diversity of ecosystems. Boreholes have to be drilled deeper and deeper – which poses a fresh range of difficulties:

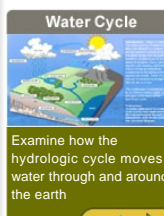
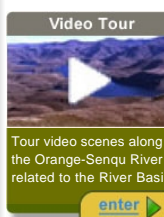
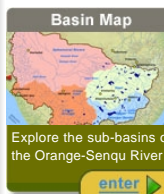
For example, owners of larger herds rely on motorised pumps that naturally breakdown from time to time. In such situations, some farmers have lost hundreds of animals that perish from lack of water. Apart from these smaller issues, a more significant problem is that most farmers know the capacity (quantity) and quality of water in the aquifers they tap into.

About 70 percent of the Kalahari's groundwater is considered unsuitable due to high salt concentrations in the water, including in many places high levels of naturally occurring nitrate - due to geological factors. In some areas of the Kalahari, a saline aquifer sits on top of a fresh water aquifer, or vice versa. This means that if one drills without due caution, the fresh and saline groundwater are mixed.

A further threat comes from large herds grazing close to deep wells, where the consequences can be disastrous. Areas that see intensive use quickly become overgrazed, and the excreta close to unprotected wells can enter the groundwater and contaminate it with nitrates from the faeces and urine of the livestock. Over time, these practices yield the water unusable for livestock watering. Often cattle die because their digestive system converts relatively harmless nitrate into toxic nitrite, which makes their blood incapable of absorbing oxygen. To prevent this, wells should be protected and grazing lands situated at a safe distance. That implies piping water to troughs and erecting suitable fencing, which translates into higher costs.

But it isn't only animals that contribute to nitrate pollution of groundwater. There is nitrate effluent from agriculture (fertiliser); and in many settlements of the western Orange-Senqu River basin, one can see rows of pit latrines built uphill from windmills pumping groundwater, often as little as 50 or 100 metres away. In many areas nitrates and bacteria from human excreta can render groundwater undrinkable and in some cases toxic.

A distressing example was the groundwater disaster of Ramotswa in Botswana. This small town, situated south-west of Gaborone, once boasted the country's



most productive boreholes. Then, in 1997, the boreholes had to be closed due to dramatically increased nitrate levels in the groundwater. It had been contaminated by waste matter from 3 000 latrines and a small industrial area.



**Irrigation in the Kalahari relies on groundwater.**

*Source: Christelis 2008*

( click to enlarge )

#### **Alien Invasive Species – Another Threat for Groundwater**

Another threat for the quality as well as the quantity of groundwater is the region-wide issue of [alien invasive plants](#). Alien invasive plants are plants imported from abroad and described as “invasive” because they out-compete and displace local plants and animals. In addition to coverage in this River Awareness Kit, this subject is described in depth in Leonie Joubert's book “Invaded – The Biological Invasion of South Africa” (Joubert 2009).

**[Next: Water Quality and Fitness for Use](#)** ►