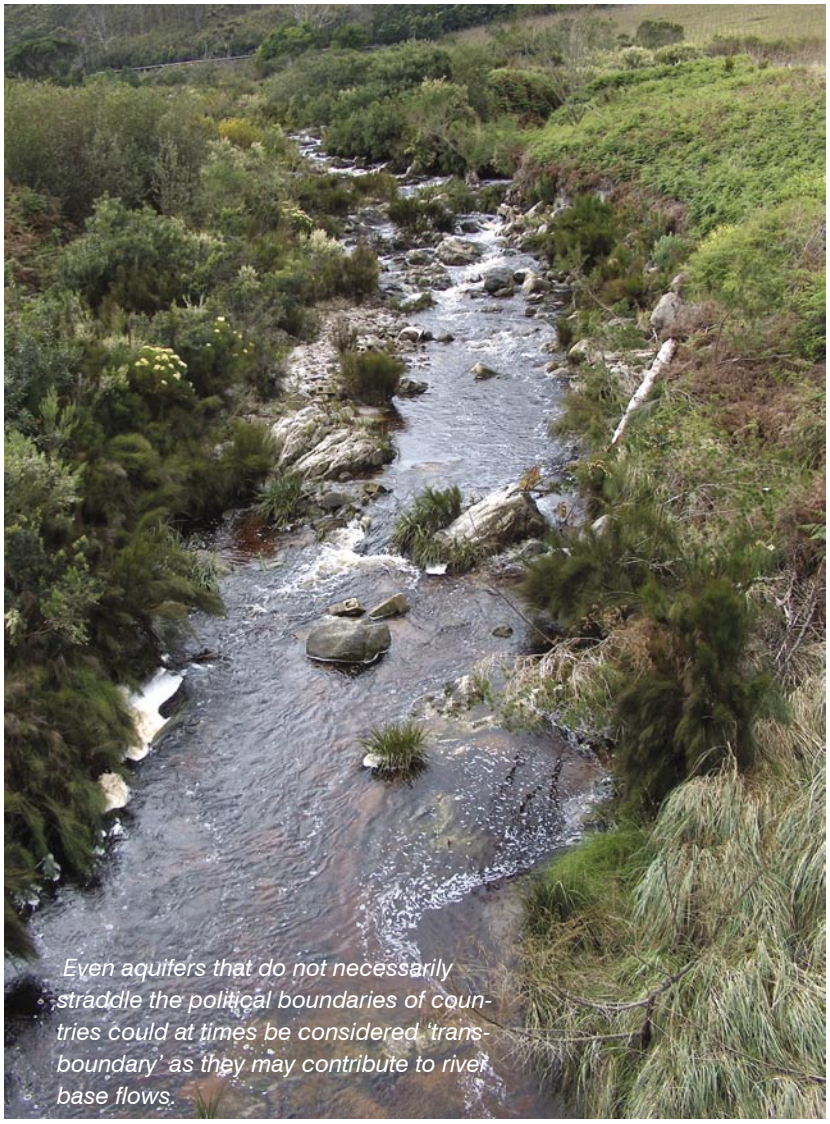


*Even aquifers that do not necessarily straddle the political boundaries of countries could at times be considered 'transboundary' as they may contribute to river base flows.*

# Managing Southern Africa's Shared Aquifers

***During the last 50 years, more than 200 international treaties for transboundary watercourses have been signed across the globe. Unfortunately, the same cannot be said for transboundary groundwater resources. Lani van Vuuren reports.***

The world's aquifers have been described as 'secretive', 'hidden', and 'mysterious'. All indications are that we just do not know enough about them. Transboundary aquifers, i.e. those underground resources which cross the border between two or more countries; are an estimated three times greater in volume than internationally shared surface waters. However, they are generally not well understood by decision makers and policy developers, in some cases being blatantly ignored.

There is still no comprehensive worldwide inventory of transboundary aquifers, and very little experience worldwide in the joint management of these resources, even though some of them contain huge quantities of water.

Today's best practice in sustainable water management – Integrated Water Resources Management (IWRM) – focuses on river basins as the unit of management, explains Dr Anthony Turton, Head of the African Water Issues Research Unit at the University of Pretoria. "However, this overlooks two fundamental realities; one, that groundwater aquifer systems, while being an integral part of the overall water resource, seldom correspond with the surface water management unit, i.e. the river basin. Two, in almost all cases, groundwater systems are, by their very nature, transboundary."

Even aquifers that do not necessarily straddle the political boundaries of countries could at times be considered 'transboundary' as they may contribute to river base flows. Groundwater use in such aquifers therefore may have an impact downstream across international boundaries. Aquifers may also receive most of their recharge in one country, but discharge in another.

Internationally, there is a trend to increasingly address groundwater in international agreements,

non-binding instruments and interstate compacts, from a resource management as well as an environmental perspective. Unfortunately, many of these agreements only contain a passing reference to the subject.

"Aquifer characteristics need to be adequately considered when formulating groundwater law and policy," maintains Chusei Yamada, Special Rapporteur on shared natural resources to the United Nations International Law Commission. For example, groundwater flows though small pores in rock material and can thus move at a snail's pace of around a few millimetres a day. This slow movement of groundwater does not allow for much mixing of its constituents. Therefore, pollutants are concentrated and move slowly. On the other hand, surface water can flow at a rate of several metres per second. The turbulent flow of the water allows pollutants to mix and distribute more evenly throughout the water system."

"An understanding of basic hydrogeology, including the proper use of scientific terminology, is thus necessary for law and science to agree on groundwater issues. Factors that determine groundwater quantity and flow should be taken into account when determining how to apply international law principles to groundwater," notes Yamada.

The complex characteristics of groundwater place increased pressure on the scientific community to provide the necessary data and information for the formulation of adequate policies and laws concerning transboundary aquifers. This includes the quantification of aquifer potential, recharge calculations, defining compartment boundaries, determining recharge 'episodes', and defining recharge zones. Most groundwater investigations undertaken by individual countries still tend to stop at the border.

## TRANSBOUNDARY AQUIFERS IN SOUTHERN AFRICA

Within the Southern African Development Community (SADC) it is estimated that 37% of the population rely on formal or improved groundwater supplies, while another 40% rely on unimproved resources (both surface and groundwater resources). With about a third of the regional population living in drought-prone areas, groundwater will undoubtedly play an increasing role in socio-economic development in the future.

As it is elsewhere in the world, there are more transboundary aquifers in the region than there are transboundary river basins, with South Africa and Botswana both having the greatest number of known shared groundwater systems. The UNESCO-led ISARM (Internationally Shared Aquifer Resources Management) Initiative has identified 19 transboundary aquifers in southern Africa to date. While the extent of these transboundary aquifers is relatively known, the resources have not been properly quantified to take the transboundary conditions into account. Moreover, there are no formal structures (if any) to govern these shared resources.

Fundamental tools for transboundary groundwater management, such as hydrogeological maps and maps of groundwater vulnerability and water scarcity, are not available in the SADC region, with existing information mostly limited to the country concerned. The most arid countries such as Botswana, South Africa and Namibia have devoted understandably the most attention to groundwater resources exploration, assessment, developing and monitoring.

There seems to be little regional consensus on the measurement and management of transboundary groundwater resources, resulting in the lack of regional monitoring networks, for example. The international arena offers little guidance in this respect, notes Dr Turton.

The responsibility for management of groundwater resources is often fragmented between different authorities and at different scales. This issue has been exacerbated in recent years with the move towards decentralisation of management responsibility. Typically, local government, water departments, planning departments

*Irrigated agriculture is a large user of groundwater, especially in countries such as South Africa.*

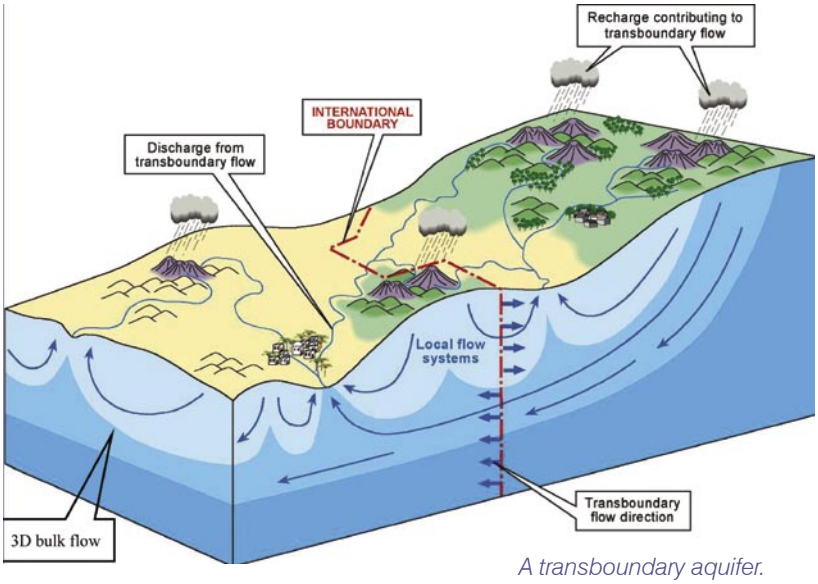
and environmental departments are responsible for different aspects of groundwater management, with both central and regional offices of the departments further diffusing responsibility.

Dr Turton reports that there is only one known international agreement involving management of groundwater systems in SADC, focused on the waters shared by Botswana and Namibia in the Chobe-Linyanti area of the Caprivi Strip.

Investigations by organisations such as CSIR indicate that various transboundary aquifer systems are not yet on record. This tends to make these aquifers more vulnerable to overabstraction and pollution as countries sharing the same resource might have different policies regarding groundwater use and protection.

One possible reason why transboundary aquifers have remained largely in the shadows could be the lack of political interest, former Department of Water Affairs & Forestry (DWAF) Deputy Director: Geohydrological Information, Jan Girman, points out. "International transboundary groundwater resources, such as the Nubian Sandstone Aquifer System, shared between Libya, Egypt, Chad and Sudan, have been highly politicised. The same cannot be said for southern African aquifers."

As of yet there does not seem to be the same intense competition for transboundary groundwater resources between countries as there are for shared surface resources. Generally, where large-scale abstraction takes place on one side of the border, little or no abstraction takes place on the other side. Of course, this could change significantly in future as more groundwater resources are earmarked for social and economic development, reports Girman.




Courtesy ISARM

*A transboundary aquifer.*

While South Africa's water legislation and policies have received worldwide acclaim, there is a significant gap as far as management of transboundary aquifers are concerned, DWAF Deputy Director: Groundwater Resource Assessment & Monitoring, Eddie van Wyk tells *the Water Wheel.* "This can be seen with groundwater resources such as the Zeerust-Gaborone Aquifer, straddling South Africa and Botswana, which, despite being prone to pollution, is not being managed as a transboundary aquifer."

Another example is the Pomfret-Vergelegen Aquifer, a high-yielding karstic aquifer in the North West of South Africa, straddling the border with Botswana. Water abstraction for irrigated agriculture from this aquifer has been increasing on the South African side, causing a dewatering of the overlying unconfined upper

**TABLE 1**
**Transboundary aquifers in SADC as identified by ISARM**

| Aquifer Name | Countries |
|---|---|
| Rift Aquifers | Kenya, Tanzania, Uganda |
| Kagera Aquifer | Tanzania, Uganda |
| Kilimanjaro Aquifer | Tanzania, Kenya |
| Coastal Sedimentary Basin I | Kenya, Tanzania |
| Coastal Sedimentary Basin II | Mozambique, Tanzania |
| Limpopo Basin | Mozambique, Swaziland |
| Coastal Sedimentary Basin III | Angola, DRC |
| Coastal Sedimentary Basin IV | Angola, Namibia |
| Coastal Sedimentary Basin V | Namibia, South Africa |
| Congo Intra-cratonic Basin | Angola, DRC |
| Karoo Sandstone Basin | Mozambique, Tanzania |
| Shire Valley Alluvial Aquifer | Malawi, Mozambique |
| Northern Kalahari/Karoo Basin | Angola, Botswana, Namibia, Zambia |
| SE Kalahari/Karoo Basin | Botswana, Namibia, South Africa |
| Ramotswa Dolomite Basin | Botswana, South Africa |
| Nata Karoo Sub-basin | Botswana, Namibia, Zimbabwe |
| Tuli Karoo Sub-basin | Botswana, South Africa, Zimbabwe |
| Medium Zambezi Aquifer | Botswana, Mozambique, South Africa, Zimbabwe |
| Karoo Sedimentary Aquifer | Lesotho, South Africa |

*Source: ISARM*

*Groundwater is playing an increasingly important role in water supply, especially in rural areas.*

Kalahari Aquifer, a CSIR report reveals. This also has the potential to unknowingly impact upon groundwater users in Botswana, because of the inherent transmissivity of the system.

Differing legislation in the two countries and the differing approach to groundwater management and water resource protection can cause South African farmers to migrate to Botswana to exploit the groundwater there from the same aquifer.

Where international surface water treaties are in place, the lack of understanding of groundwater resources can cause it to be largely ignored when it comes to developments in transboundary basins. The government of Botswana is reportedly going ahead with construction of the Lower Shashe Dam to be built about 50 km east of Francistown. The dam, which is expected to be completed by 2010, will be the largest in the country at an estimated 4,9 million cubic metres fill volume.

The Shashe River is one of the main tributaries of the Limpopo River, shared between South Africa, Zimbabwe, Mozambique and Botswana. On the South African side, huge volumes of water are abstracted from the alluvial deposit below the Limpopo River for use in the kimberlite treatment process at De Beers' Venetia Mine and by irrigation farmers at Weipe and Pontdrift, explains Willem du Toit, Deputy Director: Water Resources Information: Limpopo.

**"Lack of institutional capacity at all levels seriously hampers transboundary groundwater management."**

"Potential recharge reduction as a result of the dam could not only impact these water users, but also the already endangered riparian forest remaining along the Limpopo River and the emergent Limpopo-Shashe Transfrontier Park." All indications are that users of the alluvial aquifer were not informed of plans to construct the dam prior to approval by the Botswana government.

Lack of institutional capacity at all levels seriously hampers transboundary groundwater management. "In South Africa, for example, groundwater issues were largely ignored until 1998 when the National Water Act officially recognised groundwater as part of the hydrological cycle," says Girman. "Much has needed to be done since then to quantify the country's groundwater resources, build a strong scientific understanding of the aquifers present and, more recently, to evaluate and award groundwater licenses. All of this has stretched the limited available skills base. At this stage, transboundary aquifers are just not at the top of the to-do list."

## SADC GROUNDWATER INITIATIVE

Despite the challenges in implementing sound transboundary aquifer management, the region does have a good starting point, namely the SADC Protocol on Shared Watercourses, which came into force in 2003. A regional strategic plan for IWRM was developed in 1998 which includes 31 priority projects, one being regional groundwater management.

To assist with the latter, the international donor community is funding a project investigating ways to enhance regional cooperative management of transboundary aquifers. This forms part of a larger drought management initiative. Funded jointly by the World Bank, the Global Environment Facility and the Swedish Development Agency, the US$7,5-million SADC Drought Management Project has the establishment of a regional Groundwater Management Institute of Southern Africa (GISA) as one of its objectives. This institute will continue long-term monitoring of transboundary groundwater resources.

It is hoped that the tools developed through this project will assist in building some consensus regarding the management of transboundary groundwater resources. There is also a hydrogeological mapping component to this project, which is being funded by the French and German governments. Once established, GISA will be the custodian of these outputs.