Towards Transboundary Aquifer Management in Southern Africa

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Abstract

The sustainable and efficient management of water resources became one of the priorities of the SADC to ensure water supply security for the future. River basin organizations (RBO) have been established for all major river basins in the region to ensure the joint transboundary management of surface and groundwater resources and avoid future conflicts. Especially in the more arid part of the SADC region namely Namibia, Botswana and the north-western part of South Africa groundwater is the main source of domestic water supply. Nevertheless sustainable groundwater management, especially on a transboundary level is missing or inadequate. Critical shortcomings in transboundary groundwater management (TBA) appear to be in the organizational framework, and the institutional as well as individual capacity. The project "Integrating Management of Transboundary Groundwater Resources into the River Basin Organisations" (with a focus on ORASECOM) has been developed and proposed to GEF for funding. The project aims at improving the development and management of transboundary aquifers in two pilot areas within the framework of the Revised SADC Protocol on Shared Watercourses and the UNILC Draft Articles on the Law of Transboundary Aquifers. Two rather different transboundary aquifers, the Stampriet Kalahari-Karoo Aquifer and the Ramotswa Dolomite Aquifer were chosen to ensure that a full range of different management needs and challenges are addressed in the project. Increased water supply security for local, regional and transboundary development within a context of growing climatic unpredictability and change is expected to be the direct benefit/impact of the project. The interventions of the project will address the existing knowledge gaps and common understanding of the pilot TBA and the capacity development needs on the relevant intervention levels. Furthermore it will contribute to enhance coordination among countries, donors, projects and agencies and establish cooperative processes for the integration of groundwater resources management into a river basin organizational framework such as ORASECOM. It is envisaged that the project will serve as a demonstration of replicable approaches and that its results will be recognized and used as "best practices" for the joint management of other TBAs within the SADC region.

1 INTRODUCTION

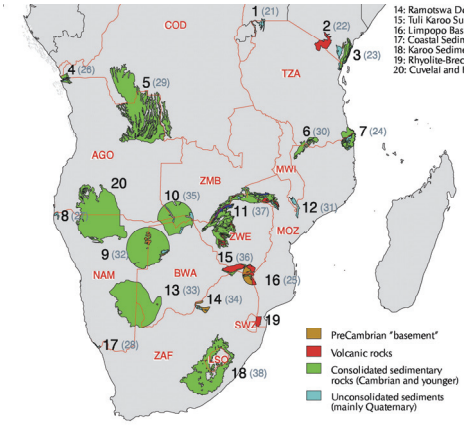
Although groundwater resources are critically important for poverty alleviation and socio-economic development throughout Africa, the sustainable utilization and management of the resource has remained inadequate relative to its importance. The internationally preferred approach is to manage groundwater resources in the context of (transboundary) basin management and within the IWRM process. Major policy, legal, and institutional reforms regarding the joint utilization and management of both transboundary surface water and groundwater resources have been adopted by the Southern African Development Community (SADC). Nevertheless the unique role and advantages of groundwater as a significant source for sustainable water supply has not been sufficiently addressed in the portfolio of the transboundary RBO and the local basin management committees (BMCs).

This paper provides the background to the occurrence and use of groundwater resources in Southern Africa, with special reference to transboundary aquifers, as well as the water institutional development within the region. The first steps towards integrated management of groundwater resources across international boundaries within the region are discussed, and to show the methodology of the process and the way forward, is illustrated by means of a major transboundary aquifer management project that is planned by three of the countries in cooperation with a major river basin organisation.

2 GROUNDWATER IN SOUTHERN AFRICA

Hydrogeology

Approximately 60 to 65% of the SADC region is covered by crystalline rocks with aquifer systems developed in the weathered regolith and within the fractured bedrock. The aquifers developed in these areas are generally unconfined, locally developed and relatively small in aerial extent. A further 10% of the region is covered by areas designated as "complex hydrogeological structures", such as folded and faulted meta-sedimentary sequences as well as lavas. Approximately 25 to 30% of the region is covered by major groundwater basins that are aerially extensive and exhibit primary porosity and permeability. These basins include the Permian-Triassic Karoo sedimentary basins that cover large areas in South Africa, Botswana, Zimbabwe, Zambia, Namibia and Angola. The large Tertiary sedimentary basin in the Democratic Republic of Congo (DRC) and western Angola has hardly been exploited as it lies in a humid zone. Along the coastal areas, especially in Mozambique and Tanzania, extensive Cenozoic coastal plain deposits constitute an exploitable aquifer resource. Similar deposits occur to a lesser extent along the west coast of the region. The Kalahari basin is a vast area of unconsolidated aeolian sand, tertiary to recent in age, which potentially forms a huge primary aquifer resource. However, areas with saline groundwater occur in the Kalahari within the three countries, where this unit is extensive. The transboundary nature of several of these groundwater systems has been recognized for a long time, but a more systematic mapping of transboundary aquifers only commenced recently through the launching of UNESCO IHPs International Shared Aquifer Resources Management (ISARM) project in SADC. The transboundary aquifers within Southern Africa, based on a first inventory, are shown in Figure 1.



No	Aquifer name	Countries
1	Kagera Aquifer	Tanzania, Uganda
2	Kilimanjaro Aquifer	Tanzania, Kenya
3	Coastal Sedimentary Basin I	Tanzania, Kenya
4	Coastal Sedimentary Basin II	DR of Congo, Angola
5	Congo Intra-cratonic Basin	DR of Congo, Angola
6	Karoo Sandstone Aquifer	Mozambique, Tanzania
7	Coastal Sedimentary Basin III	Mozambique, Tanzania
8	Coastal Sedimentary Basin IV	Angola, Namibia
9	Northern Kalahari/Karoo Basin	Namibia, Botswana
10	Nata Karoo Sub-basin	Angola, Namibia, Zambia, Botswana
11	Medium Zambezi Aquifer	Zambia, Zimbabwe, Mozambique
1	Shire Valley Alluvial Aquifer	Malawi, Mozambique
1	Stampriet Kalahari/Karoo Basin	Namibia, Botswana, South Africa
14	Ramotswa Dolomite Basin	Botswana, South Africa
15	Tuli Karoo Sub-basin	Botswana, South Africa, Zimbabwe
16	Limpopo Basin	Zimbabwe, South Africa, Mozambique
17	Coastal Sedimentary Basin V	Namibia, South Africa
18	Karoo Sedimentary Aquifer	Lesotho, South Africa
1	Rhyolite-Breccia Aquifer	Mozambique, Swaziland
20	Cuvelai and Etosha Basin	Angola, Namibia

Figure 1: Transboundary aquifer systems in Southern Africa (Vasak, 2008)

Availability and use of groundwater

The climate of the eastern and northern part of the SADC region is characterized by humid tropical and equatorial conditions. Perennial surface water is mostly utilised in these areas and groundwater resources receive less attention and is generally not as carefully monitored and managed when utilised. In the more arid parts of the SADC region, especially in Namibia, Botswana and north-western South Africa, surface water is predominantly only available for short periods during the rainy season. Groundwater therefore assumed great importance because it is perennially available and in most cases is the only principal source of fresh water. Groundwater is the largest water source for domestic water supply in the region, while it also plays a significant role in stock watering, irrigation and mining. It is estimated that 36% of the urban population in the SADC Region relies on groundwater (Molapo et. al., 2000), compared to 23% that is supplied with surface water. The remaining 40% of the population, mainly in rural areas remains unserved with formal water supply schemes, and largely depend on informal and traditionally developed groundwater sources (*i.e.* hand dug wells, springs, etc). The importance of using groundwater for bigger settlements and larger scale

water supply is often underplayed. Drought events are endemic in large parts of the SADC region and their frequency and intensity are expected to increase in the future due to global climate change. Groundwater supplies already play a critical role during both short-term and extended droughts. Its availability where it is needed reduces the need for large-scale investments in long distance water supply infrastructure.

Groundwater Use and Management in the SADC Region

There is still a general prejudice among the public and political authorities against the use of groundwater as a reliable, cost-saving and clean source of water supply and its importance for socio-economic development in the SADC region is still poorly understood. Groundwater resources are often under-utilized, unsustainably exploited, and not adequately managed. In a recent assessment (Braune *et al*, 2008) found that despite some progress has been made, the performance in IWRM is still poor compared to relevant international best practice in particular regarding institutional capacity and the establishment of an enabling environment. There appears to be awareness at the decision-making level about the importance of groundwater management, but this is not yet adequately reflected in policies, legislation and their implementation. Some of the broad conclusions from this assessment were:

- Despite the inability of bulk water supply to satisfy remote demand at reasonable costs there is still a general bias towards surface water resource development and long distance piped water supply systems within the region;
- Critical shortcomings in groundwater management appear to be the lack of an organizational framework, institutional and technical capacity and of information and awareness at all levels;
- A lack of macro-planning for groundwater prevails, as most of the activities are undertaken on an ad-hoc or crisis response basis. This is one of the most neglected areas in relation to groundwater development and management.

The SADC Groundwater Management Programme (SADC, 2005) is trying to address these shortcomings and is making progress at a regional level, e.g. the development of a Code of Good Practice for Groundwater Development, a regional Hydrogeological Map and, recently, the establishment of a Groundwater Management Institute.

3 ADDRESSING TRANSBOUNDARY AQUIFER MANAGEMENT

General Context

It must be recognized, that equitable multilateral management of a transboundary aquifer is in itself not an easy accomplishment. International law has thus far only rarely taken account of groundwater. While surface water treaties abound, groundwater is either nominally included in the scope of these instruments, mainly if it is “related” to surface waters, or it is not mentioned at all. Spatial variation, the groundwater rights of stakeholders within each Basin State, water quality degradation, water conservation, and the potential of conflict, in particular because of the unseen and little understood nature of groundwater, are issues that need to be resolved. Ultimately a cooperative management model needs to be jointly developed, which yields the highest level of net social welfare (Peck, 2010). The Law of Transboundary Aquifers, adopted by the General Assembly of the United Nations on 15 January 2009, explains in detail the issues to be covered while introducing TBA management.

Regional Context

The SADC region appears to be well placed to pilot transboundary aquifer management. Formal regional cooperation in the water sector was established in 2000 through a Revised Protocol on Shared Watercourses in the SADC. This formal regional roll-out of the international water law, initiated by the Helsinki Rules, is unique in Africa. The overall objective of the Protocol is to foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses and advance the SADC agenda of regional integration and poverty alleviation. The main measure in terms of the Protocol is ‘to promote and facilitate the establishment of shared watercourse agreements and shared watercourse institutions for the management of shared watercourses’ (SADC, 2000). Of the 15 major river basins which are shared by two or more nations, 11 already formed an institutional framework for shared management. An important groundwater

milestone has been the resolution in 2007 by the African Ministers Council on Water (AMCOW), as part of a major Africa Groundwater Initiative, to '*promote the institutionalisation of groundwater management by river basin organisations to ensure regional ownership of the initiative'.* SADC endorsed the AMCOW policy in 2008.

4 PROGRESS TOWARDS TRANSBOUNDARY AQUIFER MANAGEMENT IN SOUTHERN AFRICA

General Project Outline

In 2007, the International Hydrological Programme of UNESCO launched the International Shared Aquifer Resources Management (ISARM) project in SADC, starting with an inventory of major transboundary aquifers in the region. As one of the main outputs the ISARM Steering Committee recognized the need to develop and apply transboundary aquifer management principles on a pilot basis. The Stampriet Kalahari-Karoo aquifer system (Basin No. 13 in Figure 1) and the Ramotswa Dolomite Aquifer (Basin No. 14 in Figure 1), involving Namibia, Botswana and South Africa were identified and included in the final project proposal. These rather different transboundary aquifers have been chosen to ensure that different management needs and challenges are addressed in the project. The Stampriet Kalahari-Karoo aquifer has been already investigated while developing a management plan for the Namibian part of the Stampriet Kalahari-Karoo aquifer system, the so-called Stampriet Artesian Basin (JICA, 2002). As part of the study, a conceptual model as well as an exploratory numerical model, was developed for the larger part of the transboundary aquifer system (Peck, 2010). While commercial irrigation accounts for approximately 46% of total abstraction on the Namibian side, Botswana mainly uses its abstraction for pastoral farming and domestic use, whereas in South Africa the use is mainly in a very large game reserve and for stock watering on commercial farms. A key finding was that, given the episodic recharge events and the flow patterns postulated under those conditions, over-abstraction in Namibia would have regional impacts on the system. Therefore the concluding recommendation of this study was that joint transboundary management of this aquifer system is needed to ensure long term water supply security.

The transboundary Ramotswa Dolomite Aquifer represents a completely different aquifer type and different management requirements. The aquifer is of critical importance for bulk water supply in both Botswana and South Africa, but is highly vulnerable and currently in a state of deterioration caused by multi-source pollution and inadequate cross border management and collaboration. Water from the aquifer is used for domestic water supply by the Ramotswa community in Botswana and is listed as one of the resources which need protection to secure sustainable future use. Botswana plans to rehabilitate the Ramotswa well field in order to augment the supply of water to the capital, Gaborone. The aquifer was investigated in 2002 by the Water Research Commission in South Africa to develop an institutional framework for groundwater management. The implementation of this exercise is still not fully functional, especially where transboundary conditions prevail, and the proposed TBA project is expected to address these shortcomings in a transboundary approach.

The SADC endorsed the proposed project from the beginning and at its 3rd SADC Multi-stakeholder Water Dialogue in 2009, recommended that the recently published UN International Law Commission Draft Articles on The Law of Transboundary Aquifers should be fleshed out within the framework of the SADC Protocol on Shared Watercourses as part of the project.

The three Basin States agreed to approach the Global Environmental Facility (GEF) for a funding contribution. A Project Information Form (PIF) was prepared and will be sent for approval in the early part of 2011. The project title is "Integrating Management of Transboundary Groundwater Resources into the River Basin Organisations with a focus on ORASECOM". The expected GEF Focal Area outcome is to catalyze multi-state cooperation to balance conflicting water uses in transboundary surface and groundwater basins while considering climatic variability and change.

Project Objective, Approach and Expected Impacts

The overall project objective is "to improve development and management of transboundary aquifers" in two pilot areas within the framework of the Revised SADC Protocol on Shared Watercourses and the UNILC Draft Articles on the Law of Transboundary Aquifers.

The chosen approach foresees to concentrate on two major project components, firstly filling existing knowledge gaps and reaching satisfactory common understanding of the TBA (resulting in decision support tools and a common database), and secondly developing the necessary capacity on the relevant intervention levels. The capacity development interventions will target primarily the ORASECOM basin and the national (partner countries') institutions such as basin management committees, and it will address institutional, organizational and individual capacity development needs. The project intends to bridge a major gap between regional policy expression and the reality on the ground by shared learning of the functioning of the local TBA systems and its joint management requirements. The experience gained will be built into IWRM processes and structures at national, river basin and regional management levels in a harmonized and sustainable way (PIF, 2010). The main direct benefit/impact is increased water supply security for local, regional and transboundary development within a context of growing climatic unpredictability and change.

The different interventions of the project will address:

(a) Improvement in scientific understanding of the TBA systems through the development of a Transboundary Diagnostic Analysis, in order to reach an informed consensus on the factors affecting its integrity at the national and at the transboundary level,

(b) Capacity development on all intervention levels within the relevant structures of the partner countries and the RBO to enable joint TBA management,

(c) Enhanced coordination among countries, donors, agencies and projects,

(d) An established, cooperative process for the integration of groundwater resources management into a river basin organizational framework.

It is envisaged that the results of this project will be recognized and used as “best practices” for the joint management of other TBAs within the SADC region and globally.

5 CONCLUSIONS

Groundwater is of strategic importance in the Southern African region, particularly for the up-liftment and prosperity of thousands of communities living in poverty. It also serves as a critical buffer during droughts, which are endemic within the region, and will play a crucial role in adaptation to climate change. Despite this importance, there is still a wide-spread bias towards the utilization and management of surface water resources in the region.

The SADC has made significant progress in water institutional development, including the establishment of river basin organisations, all functioning within the framework provided by the Revised SADC Protocol on Shared Watercourses. Good regional assessments of groundwater resources have been made and guidelines for their utilization and management have been developed. However, harmonized implementation of the management guidelines by the Member States is still lacking. Groundwater management performance must therefore still be rated as “below expectation” when compared to relevant international best practice.

Encouraged by recent high level continental and regional policy direction regarding the institutionalization of groundwater resources management in basin organisations, there is now a significant thrust towards transboundary aquifer management within the region. At the heart of this development is a pilot project in which Botswana, Namibia and South Africa have joined forces under the umbrella of the Orange-Senqu River Commission, to transfer their pilot aquifer management experience into IWRM processes and structures at national, river basin and regional management levels in a harmonized and sustainable way.

This exciting initiative is seen to have continent-wide significance, because of the general struggle of African countries to meet the challenge to achieve socio-economic development without compromising the sustainable utilization of their vital groundwater resources in meeting the Millennium Development Goals and combating the adverse effects of climate change.

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