Needs Assessment to Support Groundwater Management in International Basin Organisations of Africa

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List of acronyms and abbreviations

ABO	Aquifer basin organisation
AfDB	African Development Bank
AGWC	African Groundwater Commission
AGW-Net	African Groundwater Network
AMCOW	African Ministers Council on Water
ANBO	African Network of Basin Organisations
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources)
CAR	Central African Republic
CoE	Centres of Excellence
DSS	Decision Support System
DPSIR	Driver-Pressure-State-Impact-Response
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
ECOWAS	Economic Community Of West African States
EIA	Environmental Impact Assessment
ENTRO	Eastern Nile Technical Regional Office
ENSAPT	Eastern Nile Subsidiary Action Program Team
GEF	Global Environmental Facility
GEUS	Geological Survey of Denmark and Greenland
GMISA	Groundwater Management Institute of Southern Africa
GSB	Geological Survey of Botswana
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Co-operation)
GW	Groundwater
GWP	Global Water Partnership
IAEA	International Atomic Energy Agency
IAH	International Association of Hydrogeologists
IGAD	Inter-Governmental Authority on Development
ISARM	Internationally Shared Aquifer Resource Management
IW:LEARN	International Waters Learning Exchange and Resource Network
IWMI	International Water Management Institute
LCBC	Lake Chad Basin Commission
HQ	Head quarter
IAEA	International Atomic Energy Agency
IAH	International Association of Hydrogeologists
IBO	International Basin Organisation
IGRAC	International Groundwater Resources Assessment Centre
INBO	International Network of Basin Organisations
IWRM	Integrated Water Resources Management
JASD-NSAS	Joint Authority for the Study & Development of the Nubian Sandstone Aquifer System
LIMCOM	Limpopo Watercourse Commission
MAR	Managed Aquifer Recharge
MDGs	Millennium Development Goals
NBA	Niger Basin Authority

NBI	Nile Basin Initiative
NELTAC	Nile Equatorial Lakes Technical Advisory Committee
NEPAD	New Partnership for Africa's Development
NSAS	Nubian Sandstone Aquifer System
OKACOM	Permanent Okavango River Basin Water Commission
OMVS	Organisation pour la Mise en Valeur du Fleuve Sénégal (Organisation for the Development of Senegal River)
ORASECOM	Orange - Senqu River Commission
RBF	River Bank Filtration
IBO	
RCSARM	Regional Centre for Shared Aquifer Resources Management
RSAP-IWRM	Regional Strategic Action Plan ofr IWRM
SADC	Southern Africa Development Community
SNAPE	Service National d'Aménagement des Points d'Eau (National Service of Water Points Management), Guinea
SPLASH	European Union Water Initiative Research Area Network (EUWI ERA-net)
SW	Surface water
SWOT	Strengths, Weaknesses, Opportunities, Threats
TAC	Technical Advisory Committee
TBA	Transboundary aquifer
UNECE	United Nations Economic Commission for Europe
UNESCO-IHP	United Nations Educational, Scientific and Cultural Organisation - International Hydrological Program
UNGA	United Nations General Assembly
UNILC	United Nations International Law Commission
VBA	Volta Basin Authority
WHYMAP	World-wide Hydrogeological Mapping and Assessment Programme
WRC	Water Research Commission
WRPMP	Water Resources Planning and Management Project

Executive summary

This report presents results from a survey of nine selected international river and lake basin organisations (IBOs) in Africa on the present status, progress, and limitations of incorporating groundwater management into the mandate and practices of these organisations. The work links to ongoing efforts by the riparian states and the international community to strengthen the IBOs as main actors in integrated and transboundary water resources management in Africa.

Given the present frame of incorporating transboundary groundwater management into the mandate of IBOs, as promoted by the Work plan of the African Ministers Council on Water (AMCOW), Southern Africa Development Community (SADC), and International Network of Basin Organisations (INBO), the present drivers and limiting forces are analysed in a SWOT (Strengths, Weaknesses, Opportunities, Threats) framework, built on individual basin profile studies and surveys of the basin organisations and other relevant riparian state institutions.

The study shows that despite incipient awareness, adoption of international legal frameworks and international promotion, actual transboundary GW management in the IBOs has not been fully addressed. Encouraging factors, like international advocacy, financial and technical support need to be backed by emphasis on political commitment and capacity development at all levels. The fact that IBOs are still struggling with their present mandates primarily related to surface water management, the added challenges of groundwater management need to be incorporated gradually, enhancing the integrated approach and overall added benefits to water resources management (IWRM).

With groundwater attaining an increasingly important role in human development, water security and environmental protection in Africa, should inevitably and gradually receive the required recognition and attention. It is essential to build on international advances in terms of transboundary aquifer assessment and management, e.g. by Internationally Shared Aquifer Resource Management Project (ISARM), International Association of Hydrogeologists (IAH), International Groundwater Resources Assessment Centre (IGRAC), UNESCO, Global Water Partnership (GWP), United Nations Economic Commission for Europe (UNECE), and adapt approaches to the African context, and indeed individual basins. Further, promoting groundwater attention at the political level is required to leverage commitment and African ownership, policy incorporation of groundwater and secured resources for the IBOs.

Capacity development should focus on building understanding of the integrated role and strategic importance of groundwater, of the present issues and conceptual functioning of groundwater in the basins, and the associated required monitoring and data collection needs. It is critical that groundwater management becomes an integral part of water management, and not an isolated exercise. Hence, acquiring

hydrogeological expertise in the IBOs is as relevant as updating expertise of already associated personnel. Furthermore, it is critical to build networks and transparent collaboration on groundwater in the basins as well as across the basins in the region, to optimize resources and knowledge produced, and to build African ownership of the process. Likewise, it is important to strategically enhance capacity of riparian states with less capacity, larger stakes in groundwater and higher risks of potential transboundary impacts in order to facilitate equal participation in decision making and enhance mutual trust development across borders.

Background

The prevailing transboundary character of water resources have been acknowledged and catered for since the previous century through inter-state agreements and organisations for the joint management of shared water resources (Kilot et al., 2001). In Africa, 18 international river basins (the major ones out of 59, see Annex 1) today count on formal inter-governmental agreements and associated organisations[1]. Historically, focus of these institutions has been on surface waters (SW) (rivers and lakes). However, with increasing pressure on water resources, groundwater (GW) is progressively utilized, causing further potential cross-boundary impacts[2]. Hence, GW needs to be considered in international cooperation over water resources following the logic and fundamental principles of IWRM (Braune and Xu, 2008).

Steps in this direction have been taken with the UNESCO-IHP and IAH programme on Internationally Shared Aquifer Resource Management (ISARM), initiated in 2000, which fostered policy dialogue and awareness on transboundary aquifers (TBAs[3]) and as a significant output produced a global inventory and mapping of transboundary aquifer systems (IGRAC, 2012; BGR, UNESCO, 2006) (Annex 2). This initiative was also instrumental in the formulation of 19 draft articles on the UNILC Law of Transboundary Aquifers, adopted by resolution of the UN General Assembly in 2008 (UNESCO, 2009). This laid the legal basis for adopting GW into international water law.

Africa has a minimum of 40 major TBA systems, in combination underlying parts of most of continental African states, and most of them not coincident with the transboundary river basins (Annexes 2, 3, 4[4]). There is a general consensus that transboundary GW resources in Africa should be managed within existing transboundary water management organisations, in effect the river or lake basins to which the GW resources geographically belong, or alternatively, if such do not exist for a particular TBA, by a dedicated aquifer basin organisation (INBO and GWP, 2012; Scheumann and Herrfahrdt-Pähle, 2008). This has been further endorsed by the Groundwater Resolutions of AMCOW at its 6th Session in Brazzaville, Congo, May 2007, stating the aim to '*promote the institutionalisation of groundwater management by river basin organisations'* (Braune and Xu, 2011).

The present survey is part of an initial support to the process of integrating GW into transboundary water management in Africa. It is recognized that while the foundation for joint GW management across borders have been laid there is limited progress in

[1] http://transboundarywater.geo.orst.edu/research/RBO/RBO_Africa.html
[2] From intensive pumping as well as intensive and uncontrolled land uses
[3] A transboundary aquifer or transboundary aquifer system means respectively, an aquifer or aquifer system, parts of which are situated in different states (UNESCO, 2009).
[4] The WHYMAP (BGR, UNESCO, 2006) is used as the base map for the TBAs. All TBAs are shown as ellipses to make the representation consistent across all IBOs.

the implementation of these processes on the ground (Altchenko et al. 2011; Braune and Xu, 2011).

1. Introduction

Increasing populations, industrialisation, urbanisation, and intensified agriculture are putting enormous pressure on existing water resources, aggravated by accelerating climate change. The accumulating stress on water resources has negative impacts on public health, economic production, and the natural environment. By 2025, more than 3 billion people could be living in water-stressed countries (UNDP, 2006). Adopting an integrated approach to water resources management (IWRM) is critical to a sustainable future.

Looking at river basin management worldwide, much progress has been made. However, it is also evident that the subsurface water resources have often been neglected. Therefore the interactions and interdependence between surface water and groundwater should be included in an integrated river basin management approach. The 'Convention of the Law of the Non-Navigational Uses of International Watercourses[5]' and the 'Law of Transboundary Aquifers' provide guidance to countries on how to share water resources through transboundary cooperation (BGR WHYMAP, 2012).

River and lake basin organisations play an increasingly important role in transboundary water management on the African continent. One of the entry points of enhanced GW management is through support to the existing or emerging African transboundary lake, river and aquifer basin organisations (IBOs)[6] that have institutionalised mandates on integrated water resources management in areas of internationally shared water resources. It is expected that enhancing capacities of these organisations will promote greater overall collaboration and coordination of GW management internationally as well as nationally, in addition to integrating GW management into overall water resources management.

2. Objectives

The immediate objectives of the needs assessment were to:

1. Assess the present framework (legal, institutional), practices, experiences, and capacity for GW management in selected IBOs in Africa
2. Identify and assess shortcomings and strengths for integrated GW management as part of integrated national and transboundary water resources management

[5] U.N. GEN. ASSEMBLY 51st Sess., 99th mtg., U.N. Doc. A/RES/51/229 (Aug. 7, 1997).

[6] Including groundwater bodies as a potential delimiting basis for transboundary water management and denoting these as 'aquifer basins', the term 'basin' has been broadened to not only encompass river and lake basins but also groundwater units. On the same token, 'riparian states', denoting states sharing a common river, 'aquifer states' can be used to signify states sharing a common aquifer.

3. Recommend immediate and longer term strategic steps for supporting a capacity-enhancing process through which GW is gradually and permanently included and integrated into the mandate of existing IBOs, based on consultations with the IBOs
4. Initiate a process and a network of partners (institutions, experts, decision makers, donors, and NGOs) for building and sustaining capacity for transboundary GW management in IBOs in Africa.

3. Beneficiaries and partners

The primary beneficiaries of the needs assessment included the IBOs and the national (ground)water authorities of the member states. In addition, the assessment targeted donors and capacity building organisations in an effort to take the recommendations forward in collaboration with the IBOs and other stakeholders.

4. Methodology

Nine selected IBOs (on Senegal River (OMVS), Niger River (NBA), Volta River (VBA), Lake Chad (LCBC), Nubian Sandstone Aquifer (NSAS), Nile River (NBI), Okavango River (OKACOM), Orange-Senquu River (ORASECOM), and Limpopo River (LIMCOM) entered into the survey, comprising personal interviews with acting representatives of the basin organisations as well as water management organisations of the respective member states.

The needs assessment consisted of three parts:
1. Desktop studies to develop individual **basin profiles** for the basins;
2. **Interviews** with key personnel involved in GW mgt. in the basins; and
3. **SWOT analysis**[7] based on the outcomes of the first two parts.

Three regions and nine basins of continental Africa were covered in the study: Southern Africa (ORASECOM, LIMCOM, OKACOM), North-eastern Africa (NBI, NSAS), and Western Africa (OMVS, NBA, VBA, LCBC) (Fig.1 and Table 1). Together, the river basins intersect with 25 recognized TBAs (Annex 4, note ellipses are indicative only of extent of the TBAs). The basins and their organisations were selected to represent diversity in terms of hydro-geopolitical conditions on the continent, various types of basins (lake, river (endorheic[8], non-endorheic) and aquifers) as well as different management levels.
Subsequently, a consultation process, involving a review of the report and a workshop with the IBOs will take place, through which recommendations of this study will be discussed and further refined. The overall aim of the study is to determine bottlenecks for further progress in transboundary GW management, identify

[7] A SWOT analysis is a tool that identifies the strengths, weaknesses, opportunities and threats of an organisation. The method of SWOT analysis is to take the information from an organisational analysis and separate it into internal (strengths and weaknesses) and external issues (opportunities and threats).
[8] An endorheic basin , or an internal or closed drainage basin, means that water (from precipitation falling within it) does not drain to the ocean, but rather is left to leave the basin through evaporation and seepage.

significant lessons learned, and to identify ways forward through concrete and agreed recommendations related to legal, institutional, financial and capacity constraints.

5. Results

In the following, results from the survey are presented in a condensed and synthesized form, comparing the nine IBOs.

5.1 Basin profiles

5.1.1 Geographical and hydrogeological context

Most rivers in the survey originate in mountainous, high-rainfall areas and end in semi-arid or arid areas (Nile, Orange-Senqu, Senegal). This implies great dependence on the rivers in downstream areas adjacent to the rivers (with relatively higher population densities and many urban centres), while the arid areas further away from the rivers (> ~10 km distance) are mostly dependent on GW or are not significantly developed. Agriculture, including fisheries, is the most dominant economic activity in the less wealthy states, while other activities become increasingly more important in other states, like industry, mining and tourism. Historic economic disparity between states is also reflected in the degree of present water infrastructure development, with more wealthy states generally having more dams and reservoirs and consequently higher water security. Many rivers and lakes have a direct interaction with GW (e.g. Niger River and Lake Chad), and the water balance is only understood when taking the GW component into consideration. Some rivers pass through significant open water bodies or wetlands where the interaction with GW could be very critical for the sustenance of flows and water storage in dry seasons, but this is often less well understood (Nile, Niger, Okavango).

The level of interaction between surface and groundwater tends to decrease in volume and change radically from humid to arid climate settings and in deeper confined aquifer systems. In humid areas shallow aquifers are annually replenished and have shallow water tables, with multiple surface water discharges. However, in more arid regions significant groundwater replenishment to deeper water tables can have a return-time of decades or centuries (and in some cases GW resources can be essentially non-renewable) and GW discharge is limited to isolated oases and salt marshes. An important outcome of this is the areal extant of surface water drainage basins and the underlying groundwater systems often differ radically in such regions (extract from BGR, WHYMAP (2012), see Fig. 1). In these arid regions of the world the more rational basis for IWRM is then the groundwater basin.
Successful integrated water resources management can only be achieved if both surface and GW systems data are available and are comparable. Nevertheless there remains a lack of adequate information on GW in many parts of the world.

Consequently there is a distinct need for investment to improve capacity for GW assessment and monitoring (extract from BGR WHYMAP (2012)).

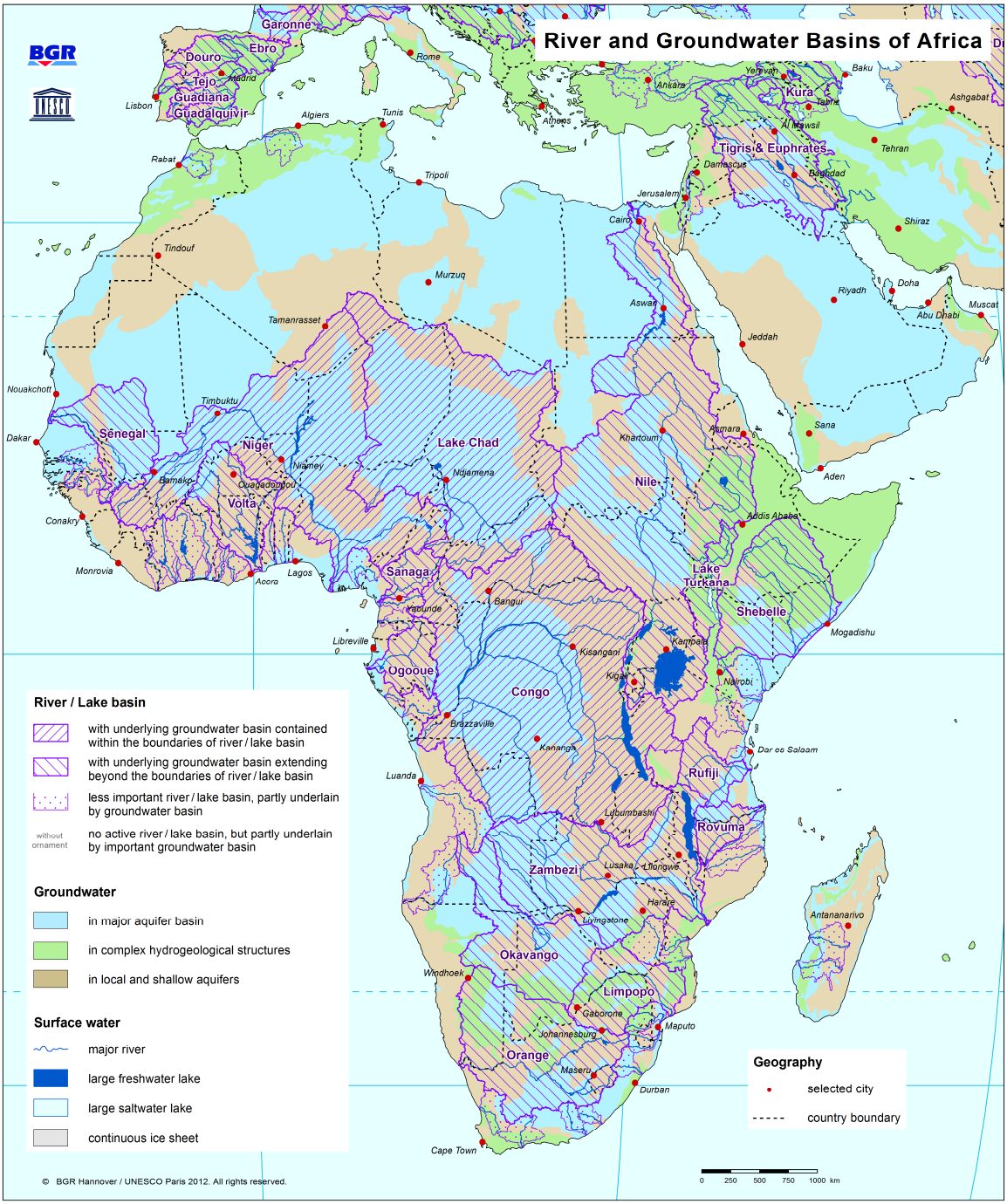

Figure 1

Individual reports for the IBOs have been produced as part of the survey (Annex 8). These are available at:
http://www.splash-era.net/downloads/D8-6_Transboundary_River_Basins.pdf

Table 1. Key data on the basins and their joint organisations

Basin	Riparian countries	Area (km^2)	Population (mill.)	IBO (formed when)	Mandate[a]	No. of associated TBAs[b]	Ref. to basin profile report[c]
Orange-Senqu	Botswana, Lesotho, Namibia, South Africa	896,000	19	ORASECOM (2000)	Cons, A, Coo, I	4	Abiye, 2012
Limpopo	Botswana, Mozambique, Zimbabwe, South Africa	410.000	14	LIMCOM (2003)	Cons, A	3	Owen, 2012
Okavango	Angola, Botswana, Namibia, (Zimbabwe)[d]	430,000	0.7	OKACOM (1994)	Cons, A, Coo, R	2-5	Mapani, 2012
Nile	Burundi, Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda	3,100,000	160	NBI (1999)	Cons, A, Coo, I	7	Mirghani and Tindimugaya, 2012
Nubian	Chad, Egypt, Libya, Sudan	2,200,000	67-140[h]	NSAS (1999)	Cons, A	-	Mirghani, 2012
Senegal	(Guinea)[e], Mali, Mauritania, Senegal	300,000	5	OMVS (1972)	Cons, A, Coo, I, R, Conf, P	2	Diene, 2012
Niger	(Algeria)[f], Benin, Burkina Faso, Cameroon, Chad, Guinea, Ivory Coast, Mali, Niger, Nigeria	2,000,000	109	NBA (1980)	Cons, A, Coo, I, R	3	Menge and Jäger, 2012
Volta	Benin, Burkina Faso, Ghana, Ivory Coast, Mali, Togo	400,000	19	VBA (2006)	Cons, A, Coo, I, R	1	Jäger, 2012
Chad	(Algeria), Cameroon, Chad, Central African Republic, (Libya), Niger, Nigeria, (Sudan)[g]	2,300,000	30	LCBC (1964)	Cons, A, Coo, R	2	Vassolo, 2012

[a] Cons: consultative, A: advisory, Coo: coordinating, P: policy-making, I: implementing, R: regulatory, Conf: conflict arbitration
[b] Acc. to WHYMAP (BGR, UNESCO, 2006). Uncertainties exist due to uncertainty of extent of TBAs (e.g. Okavango)
[c] See Annex 8
[d] Zimbabwe is part of the inactive part of the basin, not member of OKACOM
[e] Guinea is full member of OMVS, but was not signatory of treaty creating IBO
[f] Algeria is not a full member of NBA but does have observer status
[g] Nations in parenthesis are not signatories to the LCBC treaty
[h] Population within the of NSAS area is uncertain due to uncertainty related to the area of the aquifer and the number of people dependent on it

A typical geological setup includes shallow alluvial aquifers along the course of, and hydraulically connected to, the river. This may overlie deeper older and more regional geological formations (whether aquifer-forming or not). The regional formations, often transboundary in character, may comprise several overlying or overlapping hydraulically connected or unconnected aquifers. In the downstream arid areas, alluvial GW is typically seasonally and alternately recharged and drained by the river (Nile, Orange-Senqu, Senegal). In coastal areas, relatively recent, but important and extensive aquifers are also found. For lake basins, which are endorheic (like Chad

and Okavango), drainage patterns and aquifers are more governed by internal low topography, good underground hydraulic drainage and high evaporation rates.

TBAs may be of a quite diverse nature in terms of geographic location and extent, depth, vulnerability, productivity, water quality, flow, storage and replenishment properties, with implications for development interests, impacts and management issues. Accounting for GW and TBAs in transboundary water management is generally more complicated than just looking at surface water. This is because the traditional concept that hydrological boundaries are governed by topography (water divides in mountainous areas) and that all water within a common basin flows towards and discharges in one point, is challenged (Fig. 2).

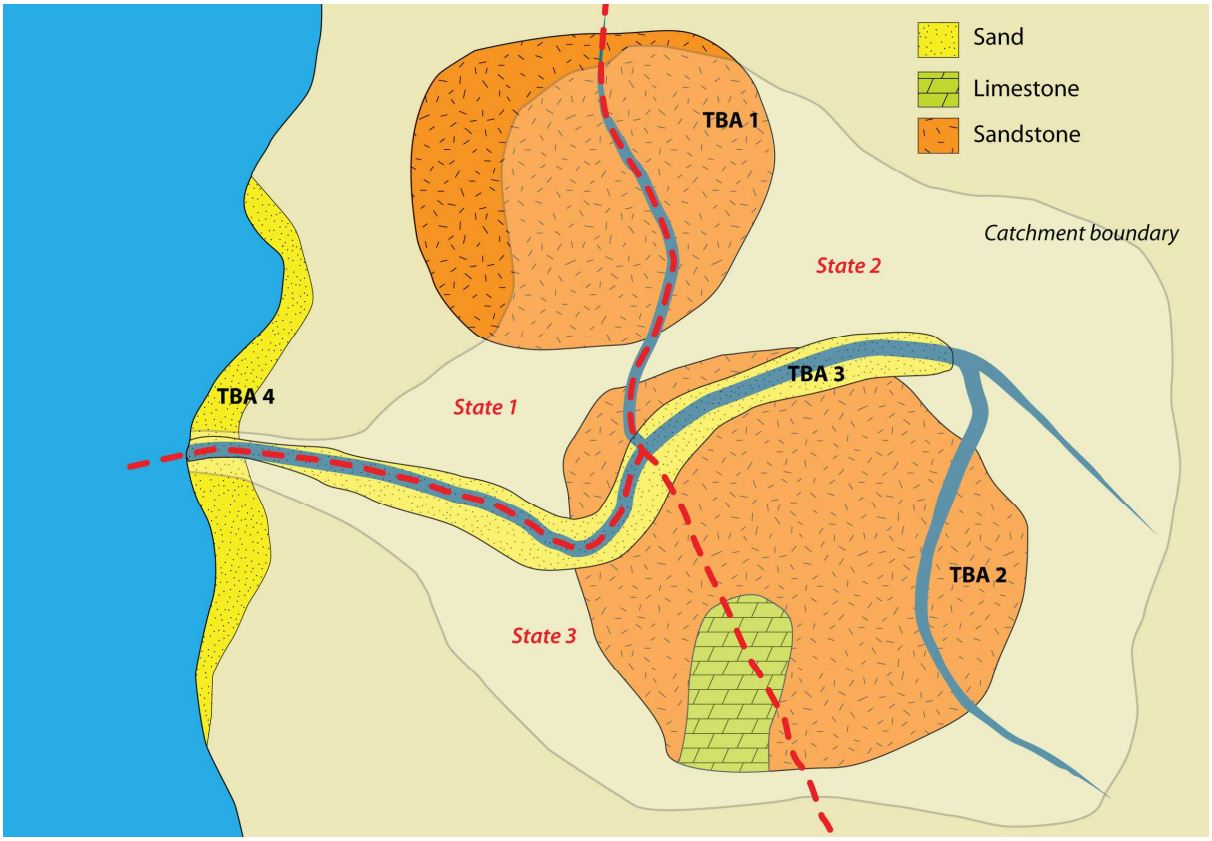

Figure 2. Conceptual sketch of a possible configuration of an international river basin and associated TBAs

The delineation of some river basins, especially in arid areas, includes areas that are 'hydraulically inactive' because of limited present precipitation (Niger, Nile, Orange-Senqu, Okavango, Nubian Sandstone Aquifer). However, these areas may still be important in terms of GW flow and storage and potential interaction with river flows. In such areas, aquifer systems and previous/historic climate may be more important than topography in defining active basin areas. As an example, the Orange-Senqu river basin includes a large part of southern Botswana due to underground GW reserves though no present day river flow occurs in the area (Anton Earle, personal communication).

Including GW in water management requires an expansion of the typical upstream-downstream approach to river basin management. With aquifers entering the equation, the water unit attains a third dimension where GW resources may be held in layers with various degree of connection with the river system and different retention times. Including GW may significantly change the conceptual model of the hydrological functioning of a river basin. Furthermore, traditional river management involves determining minimum flow requirements to sustain environmental benefits and services. This includes considerations of baseflow contributed partly by GW. However, when including considerations of GW, it becomes equally important to address minimum requirements for GW levels in the catchment, for the sustained access to GW in dry periods, e.g. by humans having shallow drinking water wells, by wetlands depending on GW outflow and by plants extracting water from shallow or deeper GW.

5.1.2 Transboundary groundwater uses, users, and conflicts

Where GW is not significantly developed, populations concentrate along the rivers (Senegal, Orange-Senqu, Nile, Okavango). Conversely, development of GW, particularly in rural areas, provides means of subsistence and economic development. As of now, there are very few formal 'schemes' that draw water resources from larger and deeper transboundary aquifers, apart from the most prominent one's such as in the Nubian Sandstone Aquifer System (NSAS) in Libya and related schemes in Egypt. Generally speaking, local impacts of GW development are recognized, while transboundary impacts are not. This is partly explained by relatively low level of development, lack of monitoring and data sharing across borders, and lack of awareness of potential problems. This entails relatively little present incentives for joint management. Potential or emerging conflicts were encountered in large TBAs (LCBC, NSAS), in riverine aquifers (LIMCOM) or in coastal aquifers (OMVS).

5.1.3 Water governance framework and institutions

The nine IBOs[9] have been established over the period from 1964 to 2006, with the oldest and newest being LCBC and VBA, respectively (Table 1). The institutions are based on joint inter-governmental agreements (also called treaties or conventions) related to the management of water resources in the basin. In addition, the intent of these agreements are effectuated and executed through staffed and funded basin organisations (IBOs).

Often, the development of cooperative agreements and associated organisations has followed a historic, ongoing process, with the tendency to become progressively

[9] Recognizing that NBI and NSAS are not formalized IBOs at present, but rather interim institutional setups with prospects of becoming legally established basin entities. As such, no aquifer basin organisation (ABO) does yet configure on the African continent. Yet, we have maintained the A in the abbreviation for the lake, river, aquifer basin organisations (IBOs).

more comprehensive, with respect to inclusion of riparian/lacustrine states and the mandate of the organisation and realm of governance (e.g. from principles of 'equitable water access' to more explicit codes on e.g. water allocation, joint agreements on water development projects, environmental protection, water user participation and lately focus on benefit sharing).

Typically, SW resources management has taken precedence over GW management, in the agreements as well as in implementation. For the majority of the institutions (agreements as well as IBOs), the primary objective is to **advise** riparian governments and its constituents reg. management of joint water resources (Table 1). Typically, the IBOs are responsible for advising the member states on (NEPAD et al., 2011):

- Measures and arrangements to determine the long-term safe yield of the water available from all potential water resources in the basin
- Reasonable demands for water by consumers in the basin
- Criteria to be adopted in the conservation, equitable allocation and sustainable utilisation of water resources in the basin
- Investigations, separately or jointly by the contracting parties, related to the development of any water resource in the basin, including the construction, operation and maintenance of any water works
- Prevention of pollution of water resources and control over aquatic weeds in the basin
- Measures that can be implemented by one or all of the contracting parties to alleviate short-term difficulties resulting from water shortages in the basin during periods of drought, taking into consideration the availability of stored water and the water requirements within the territories of the respective parties at that time
- Joint monitoring, data and information exchange

A typical organisational setup of a IBO is depicted in Fig. 3. Although different organisational models exist, the commissions usually have a superior **political decision making organ** (called e.g. Conference of Heads or Council) defining policies and governance principles for the IBO, a **technical organ** (often termed technical task team) where technical management issues are discussed before presentation of technical recommendations to the political decision-making organ (this may also be an executive arm, which is in charge of implementing the decisions of the superior unit), as well as a **Secretariat** that provides administrative support and overall coordination of the IBO's activities. In addition, one or more **consultative units** may be in place, tasked with advising the superior unit (or other units) reg. e.g. financing and investment or technicalities/modalities for water allocation. At present, in most IBOs, only the Secretariat position is staffed and full-time, whereas the members of the political and technical organs are delegates from member states' ministries whose IBO duties form only a part of their job description. Finally, the IBOs

may include **national units** (e.g. OMVS, ORASECOM) or representatives in each member state, which play the role of interface between national water mgt. departments and the basin organisation. This national unit may, or may not, have GW expertise. In cases, national level responsibilities for GW are split between the national authority for water and the geological surveys (Botswana). Often, collaboration of national water mgt. authorities and IBOs are not at the operational level yet.

The costs of the IBOs are typically shared among the member states, either equally or according to a defined formula depending on ability or interest in the arrangement. As an example for LCBC, Nigeria contributes 52%, Cameroon 26%, Chad 11%, Niger 7%, and Central African Republic 4%, towards the annual budget (AMCOW and ANBO, 2007). Significant funding is also coming from external sources, mostly donors.

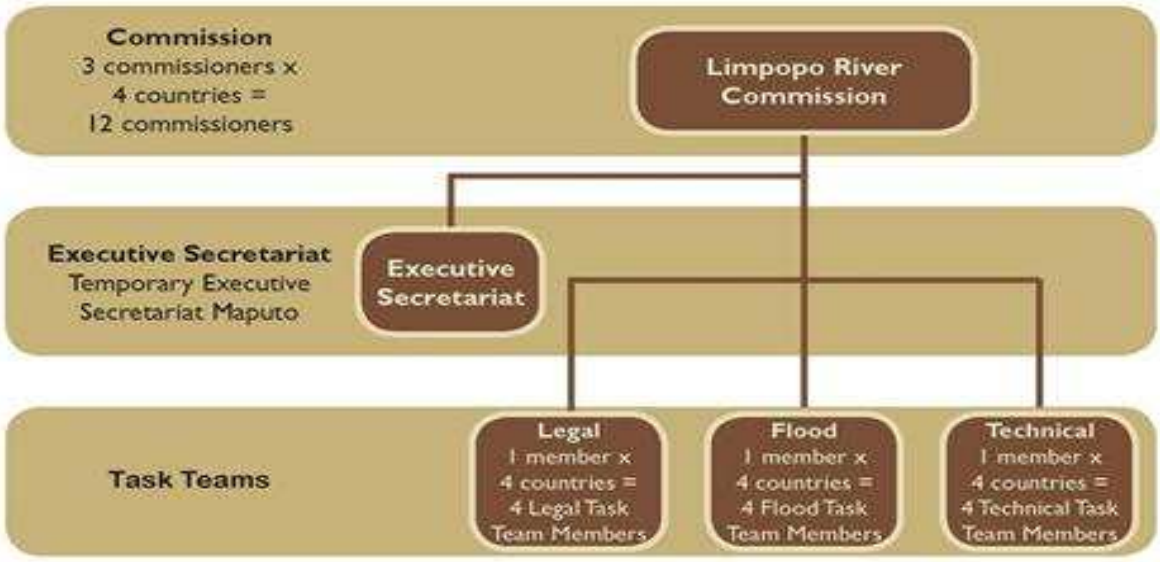

Fig.3 Example of a setup of a IBO (example is from LIMCOM[10])

5.2 Interviews

The interviews supporting the needs assessment were carried out in the period Nov. 2011 to March 2012. They addressed three categories of water management staff in the basins: 1. Staff at the HQ (Secretariat) of the IBO; 2. Staff representing the IBO in the riparian states; and 3. Staff from the national water management authorities, responsible for GW management. Separate interview schedules were used for these categories (Annex 5). A listing of the personnel interviewed as part of the survey are given in Annex 6 and summarized in Table 2 below. Finally, the transcripts of the questionnaires can be found in the individual basin profile reports (Annex 8).

[10] http://www.limcom.org/en/About/Structure.aspx

Table 2. Number of interviewees for the IBOs

IBO	No. of interviewees
ORASECOM	9
LIMCOM	8
OKACOM	5
NBI	22
NSAS	3
OMVS	8
NBA	**3**
VBA	**3**
LCBC	**3**

5.3 SWOT analysis

The interviews formed the basis of individual SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis for the IBOs (see basin profile reports). Synthesizing these, the underlying general strengths, weaknesses, opportunities and threats of the IBOs, generating the observed reality on the ground, are found to be the following (Table 3 and Annex 7).

6. Overall analysis

In the following, the SWOT analysis is further qualified.

6.1 Groundwater governance in river, lake, aquifer basin organisations

According to the findings of the survey, emphasis and efforts accorded to GW management, and success in addressing it, vary among IBOs and individual states. The importance given to GW is related to:

- the dependence (present or future expected) on GW of the society
- general economic development and population density
- environmental problems perceived to be linked to GW (e.g. salinisation of soils in lower Senegal River due to raising GWLs or seawater intrusion)
- the political power of the decision-making body of the IBO
- the age of the IBO
- the degree of legal formalisation of GW management
- the support from external sources, e.g. multilateral donors
- location and relative strength of individual basin states
- number of basin states in the IBO

Table 3. SWOT analysis

Strengths

1. Strong political support from riparian states for IWRM
2. AMCOW is supporting integration of GW management into IBOs
3. Regional development communities (e.g. SADC) are strongly promoting regional cooperation on GW management
4. ISARM has provided tools and networks for further enhancing action on TBA management
5. Multi-governmental agreements exist on the joint management of water resources and the benefits derived from their use
6. Most, though not all, IBOs have a permanent Secretariat and established organisational structure with agreed shared budget allocations for carrying out their mandate
7. GW generally recognized as supporting the hydrological system
8. Experience with collaboration with various international and bilateral and multilateral partners (e.g. ANBO, INBO, SADC, UNESCO, GWP, etc.) can foster further joint riparian collaboration and financial capacity

Weaknesses

1. No explicit mandate to address GW in legal framework
2. GW development associated mostly with incremental and often private informal, development, not large infrastructure projects, which normally fall in the realm of IBOs
3. Little understanding of the TBAs and their potential for human development, as well as their physical extent, connection with other aquifers and SW and their vulnerabilities to development
4. Most IBOs do not have a water resources strategy or action plan that explicitly considers GW
5. Limited cooperation between IBOs and national authorities on GW issues
6. Limited collaboration between IBOs on similar water management issues
7. Lack of tradition in applying data for management of joint GW-SW resources
8. Few resources put into data and knowledge management
9. Unclear data sharing agreements make riparian states reluctant to share data
10. Data monitoring on GW not coordinated across borders => limited concerted knowledge on transboundary impact
11. Understaffing of IBOs with respect to hydrogeology expertise
12. Most knowledge is generated through commissioned experts
13. Little stakeholder involvement at all levels

Opportunities

1. IBOS provide a suitable platform for integrating management of GW into IWRM
2. With GW becoming of increasing interest to the states for other uses than dispersed domestic use and with already emerging GW issues of overuse and degradation, there will be greater emphasis on GW management
3. GW and TBAs management receives increasing attention from multilateral donors
4. There is expressed interest in IBOs to get more understanding of SW-GW interaction
5. Joint research projects and results on the TBAs are emerging
6. Present organisational frameworks provide for permanent IBOs for NBI and NSAS
7. ANBO, AMCOW, GWP, UNECE can foster further awareness, focus and capacity on transboundary GW management
8. Regional development communities in various parts of Africa (e.g. ECOWAS) can emphasize GW in their regional IWRM framework
9. Better tools for assessing SW-GW interaction and interdependencies are being developed (e.g. through IAEA on isotopes and tracers)
10. TBA focus may enhance collaboration at local, national and international level on GW, improving overall management
11. Joint GW capacity in IBOs may level the disparate present national GW capacities
12. Using the international attention to TBAs to raise the national attention to GW

Threats

1. Too little national political commitment and support
2. Duplication or confusion of roles and responsibilities of existing (national) organisations, e.g. on data management
3. General under-capacity of IBOs for addressing transboundary water management
4. Disparities among riparian states on the capacity and commitment towards joint (ground)water resources management
5. Financing is not continuous and secured
6. Conflicting interests between riparian states
7. Riparian states may reject the role of IBOs in managing TBAs
8. Science/technology is not integrated into management. Functions independently of policies and regulation
9. Not all riparian states comply with their financial duties
10. Funding requirements for GW management is seen as a competitor to same for SW
11. IBOs too surface water-centered
12. Little collaboration between the international SW and GW community

Arid countries, like Botswana, South Africa, and Namibia in southern Africa have devoted understandably relatively more attention to GW resources exploration, assessment, development and monitoring. Likewise, in northern Africa, the unilateral reliance on GW and the enormous stores of non-renewable GW in Libya and parts of Egypt have given rise to the creation of the predominantly GW-centred entity for understanding, using, sharing and managing the Nubian Sandstone Aquifer (NSAS). With greater GW dependence and degree of non-renewability, the issues also tend to become more politicised and flawed with in-transparency, due to the larger stakes involved for the various parties (NSAS).

In addition, there is disparity between the member states of the IBOs in terms of how far they are in considering GW in their national water management structures and this is reflected in their present involvement and contribution to TBA management. The level of national GW consideration can be ranked on a scale from incipient awareness of the importance of GW to a verified understanding and pro-active management of the resource (Box 1).

While basin commission conventions generally refer to water resources in a comprehensive sense, the realm of management is traditionally the river basin and GW is typically not catered for explicitly. An exception is OMVS, where GW is mentioned explicitly in the treaty. Management and attention have progressed to a certain extent, due to maturing of the organisation, existence of technical and scientific capacity and acknowledgement of the significant role of GW in environmental issues, and the fact that the IBO has as their highest decision-making structure the Heads of State of the respective countries.

Box 1. Various levels of national-scale GW consideration, as a chronological sequence of a staged process towards pro-active and adaptive management of GW

1. Incipient awareness among decision makers
2. Identification of pertinent GW issues
3. Recognition in policy dabate
4. Accounting in policies and strategies
5. Gradual understanding, through delineation, diagnosis and integrated conceptual hydrological modeling of the aquifers and associated systems
6. Implementation of regulations related to use, allocation and protection of GW as well as regulation related to land use
7. Stakeholder involvement
8. Enforcement of regulation
9. Iterative review and revision of existing strategies and regulations as new knowledge becomes available

Some IBOs have advanced more on the institutional/programmatic level (ORASECOM, LIMCOM), while others have progressed mostly on the technical level (NSAS). This is partly a function of the roles of the IBOs, where NSAS is engaged to primarily and initially derive the knowledge base necessary for decision making on the Nubian Sandstone Aquifer. An important factor for the awareness of GW in ORASECOM and LIMCOM is related to the heavy engagement of SADC (the

regional development organ supporting cooperation and coordination in the Southern African region) in promoting IWRM and management of shared watercourses, building and strengthening the associated IBOs and focusing on GW. SADC has a revolving Regional Strategic Action Plan for IWRM (RSAP-IWRM) from 1998 (SADC 2005), which since 2006 started implementing a dedicated program on groundwater management, which has focus at a range of levels, from local to regional. Furthermore, in 2000, SADC adopted the international protocol on Shared Watercourses (includes GW), which mandates the IBOs to be in charge of international cooperation. SADC is presently considering how the UNGA Resolution 64/124 on draft articles on the law of TBAs can be implemented (UNESCO-IHP, 2009). ORASECOM has, as the only surveyed IBO, established a task force/technical committee on groundwater (in 2007) to facilitate the dialogue between the respective basin states on transboundary aquifer management.

Present experience with project implementation on TBAs relate primarily to the characterisation and conceptual understanding of the hydrogeological functioning of the aquifers, and less on implementation of infrastructure of GW (UNESCO, 2010, 2004).

A global trend for multilateral donors to encourage and support regional cooperation, recognizing the transboundary aspects of many development and natural resource management issues, is increasingly apparent for water resources management in Africa. Many of the IBOs are funded partially by donors, significantly promoting and enhancing the progress of operationalizing their mandates. However, this involvement may also add to the complexities of implementing sustainable GW mgt. through the IBOs:

- Various donors do not coordinate efforts on these issues, limiting the optimisation of resources
- Donors may take advantage of the limited capacity of the IBOs to approve strategic projects, which have not been properly assessed in terms of potential socio-economic and environmental impacts (LCBC)

Due to high international interest in preserving environmental and tourist values in the Okavango Delta, OKACOM has been subject to substantial funding and technical support.

LCBC is facing many problems despite a relatively long-established IBO. This is related to the basin's generally low development level, widespread poverty, degraded land resources, and probably the fact that downstream nations (Niger, Chad) are relatively weaker than their upstream counterparts (Nigeria, CAR). There is a legacy of unilateral upstream water development (dams) with consequent downstream negative impacts. Also, the fact that primary water supply still is a priority entails a limited interest in entering into management of the GW resources, which may be considered a second order requirement.

Overall, there is a lack of human, technical and financial capacity in the IBOs at present to address GW management. This is partially a reflection of the lack of political priority, awareness and shared vision and due to an entrenched priority of surface water management. This results in limited action on the ground (such as monitoring, regulation, allocation, data sharing, stakeholder involvement, etc.). Limited exchange of knowledge and experience across the IBOs is taking place, despite the fact that many TBAs cut across more than one IBO (e.g. the Nubian Sandstone Aquifer reaches to the Lake Chad basin, the Iullemeden Aquifer cuts across both the Lake Chad basin and the Niger River basin). Finally, the two interim IBOs, NBI and NSAS, need to be formalised as fully-fledged IBOs, as present setup, while contributing to knowledge and progress, also creates uncertainty on future options.

Stakeholder involvement regarding GW management is hardly developed at present, while some IBOs do have significant ongoing initiatives to build public awareness and participation in decision processes related to water development and management (NBI, ORASECOM, OMVS).

All IBOs rely on external donor support to fund their activities (except e.g. OMVS who has some means from infrastructure funds (GTZ, 2008)). Financial dependence, however, endangers their long-term sustainability and effectiveness.

6.2 Groundwater data management and sharing

GW monitoring efforts in the basins are presently at a low level. In addition, monitoring of GW occurs primarily at the national level, with little consideration of the potential transboundary nature of GW resources, let alone transboundary impacts. As a result, little collaboration occurs across borders on GW monitoring. Efforts in the IBOs on joint aquifer characterization projects (e.g. LCBC (Zairi et al., 2010) and ORASECOM (ORASECOM, 2009)), data harmonization and sharing are emerging, and some experiences gained, but in most cases procedures are not institutionalized sufficiently, leading to lack of clarity regarding roles and responsibilities. Most monitoring occurs on a project-by-project basis and often by consultants rather than the respective authorities, which while giving some insight, breaks the continuity and anchorage of information. Data are often not collated in central systems and mostly not digitized and geo-referenced, which makes it difficult to obtain relevant data. Finally, data may be available to various extents, but are often not applied into the management and decision making processes. In many countries of Africa, the management of aquifers is assigned to Geological Surveys and their hydrogeological departments and monitoring is conducted primarily for research purposes and do not feed the process of managing the resource. Jointly assessing GW resources across borders contribute to enhance understanding, optimize resources, built networks and ensure equitable and similar development of the resource, thereby preventing e.g. migration in times of drought, even if transboundary flow impacts are non-existing or limited (Braune and Xu, 2011).

In addition, GW quality monitoring needs a lot more emphasis due to potentially high environmental risks. Also, focus on monitoring of large-scale (commercial) users is required. Finally, GW management is to be reconciled with land and waste management.

In data scarce environments with limited resources, it becomes important to optimize the means of getting relevant information on GW resources. The use of space technology, which has been acquired by NBA is a strong asset to water resource development in the Niger River Basin. Also, the use of tracers and isotopes yields great potential for characterisation of GW resources, recharge and interaction with SW and wetlands, e.g. in LCBC, NSAS and NBI (Zairi et al. 2010, Verhagen, 2003). Also, airborne geophysics, though not cheap, may prove very valuable for GW exploration in inaccessible areas of Africa (Meier et al., 2008).

6.3 Capacity building

In addition to political attention, capacity is the major constraint for GW management to move forward in the African context. This relates to human, technical as well as financial resources, and more so in the IBOs than in the national counterparts. Even loss of existing human capacity to the private sector was reported as a problem for the national and IBOs (ORASECOM, LIMCOM). GW expertise is generally missing in the IBOs, though in certain areas significant research results on e.g. aquifer extent (NSAS), recharge mechanisms and water quality (ORASECOM) exist, but principally from academic institutions. As expertise to IBOs is expected to derive partially from the expertise pool of the national authorities, it becomes important to also re-enhance the national capacities.

7. Conclusions and perspectives

Human GW dependence varies across the African continent, but everywhere is it significant and growing. However, the commitment to address GW resources in the IBOs of Africa, although ratified, and despite an incipient awareness at decision-making level about the importance of GW, is not fully translated into policies and operational management actions. Existing initiatives and efforts of cooperative management of TBAs in Africa are in an early stage of development, whether in the form of established IBOs or dedicated aquifer basin organisations (ABOs). Many of the IBOs are relatively new and still struggling with their present mandate, which is primarily related to SW management. The added challenge of incorporating GW into their function is at present overwhelming, especially considering their capacity. Also, many issues and constraints are not particularly related or specific to GW management, but more generally related to governance and the functioning of the IBOs (GTZ, 2008). Hence, it is imperative to address these concerns as well as build in those particular requirements for addressing GW management.

Managing GW in an international context, in particular TBAs, are in principle similar and congruent to managing rivers and lakes. Furthermore, due to the integrated nature of the water resources, congruence and alignment in management are required. It is a matter of reconciling unilateral (national) interests with bi- and

multinational interests, through cooperation at the most appropriate level and adhering to general principles put down in international law, pertaining to all water resources and benefits derived from them, e.g. (UNESCO, 2009):

- Acknowledging sovereignty of individual states
- Not causing significant harm to other parties
- Reasonable and equitable sharing of benefits
- Establish joint mechanisms of cooperation
- Regular exchange of data and information
- Prior notification of planned activities to other parties

However, with progressing emphasis on GW, principles and institutions developed on the basis of rivers (and lakes) and associated basins need revision and adjustments due to the distinctive properties of GW resources:

- Their geographical extent is not coinciding with river basins (Fig. 2)
- They do not have a common terminus of outflow (Eckstein and Eckstein, 2003)
- Their presence underground make them difficult to observe
- They do not always have simple upstream-downstream relations
- They are often accessed in a dispersed manner
- They are closely linked with and dependent on land use
- They slowly restore after degradation due to overdraft and pollution

So, while general principles above apply equally to GW and SW, and resources are linked and interdependent in nature, the differing characteristics entail complexities in addressing GW management in general, and integrated SW-GW resources in particular, when resources transverse political boundaries. There is a need to reformulate and adapt the legal basis to include explicit mentioning of GW, not as a new and separate domain, but rather an integrated part of existing systems, but with particular management requirements. There is accentuated need for participatory processes and preventive, precautionary and adaptive management, addressing the above-mentioned peculiarities of GW. As stated: '*The above considerations on the applicability of the [UNECE] Water Convention to surface and groundwaters*[11] *alike do not exclude the appropriateness of, or even the need for, further normative guidance addressing the highly specific issues concerning the implementation of the Convention with respect to groundwaters*' (INBO and GWP, 2012).

Still, there is no doubt that the assessment, development, protection and management of TBAs as unitary water bodies, should be part of an IWRM approach. And defining optimal boundaries and geographical and institutional units for transboundary and IWRM management should take the GW resources into account.

Knowledge and awareness of GW come with the need, but parallel facilitation and support are required. Ideally, GW mgt. should be pro-active, anticipating the various challenges ahead of time and preventing problems and conflicts. Generally, there is a balance between the driving forces that prompt responsive measures and the anticipative planning. Typically, political and financial priorities allow for limited pro-

[11] The 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, which has been ratified by 36 UNECE countries and the European Community. http://www.unece.org/env/water/text/text.html

active management, and arguments for investment rely on evidence of actual need in terms of specific problems or conflicts. This justifies and argues for offensive and defensive monitoring strategies (GW-MATE, 2006). Data collection should be highly prioritized and problem-oriented, in order to optimize resources. Finally, processes should move in parallel, on awareness raising, advocacy, training, institutional strengthening, support to existing legal and regulatory frameworks, and implementation of actual projects.

Regional development cooperation frameworks with adopted regional water policies (SADC, ECOWAS, e.g.) present a strong opportunity for supporting and strengthening cooperation on TBAs and GW in general in Africa.

Finally, the emphasis on TBA management driven by international donors is expected to raise the profile of neglected local GW resources management, especially in low development countries (Braune and Xu, 2011). Conversely, focus at the international level should not preclude intensification of GW mgt. at national and local level. Finally, there needs to be a clear political decision on the degree of responsibility of IBOs to manage GW: Should they be limited to address TBAs, or should they also address GW in general. Should their role be only advisory or also implementing? The first question relates to the distribution of roles between the national and the international institutions, as indicated schematically below.

Share between roles:

	Groundwater	TBAs
National authorities	xxx	x
IBOs	x	xxx

8. Recommendations

No blueprint for GW management with transboundary implications in the African context exists. Hence, while management of GW in TBAs, and GW with potential cross-border impacts has been proposed integrated in the realm of existing international IBOs (e.g. by AMCOW and INBO) and this is an emerging global contemporary trend, the legal and institutional frameworks are still under development and improvement, and many deficiencies are apparent, especially in terms of financial, human and technical capacity as seen from the survey.

Based on the needs assessment, the following generic recommendations for progressing GW management in the international IBOs can be put forward.

With regard to the legal basis:

1. The IBOs should, if not already done, adopt the UN draft articles on the UNILC Law of Transboundary Aquifers as a basic document for transboundary groundwater management
2. The particular properties of GW resources need to be specifically addressed in the legal frameworks, e.g. the relative delay in response, the relative vulnerability of the aquifers, and the ubiquity and diffuse use of the resource

3. Like for international cooperation on SW resources, the integrated approach to GW should be broader, and include benefit sharing aspects, e.g. related to land use planning, managed aquifer recharge, drought protection

With regard to the institutional framework and decision making:

1. GW committees of the IBOs should be formed (with at least one GW/hydrogeological expert in each), to give increased emphasis and weight to GW issues in the organisations
2. IBOs should function as (donor) coordinating units with respect to GW-relevant projects and activities with transboundary implications
3. EIAs of all development and infrastructure projects of the IBOs should include a component on (transboundary) GW benefits and impacts (e.g. for water storage dams)
4. Centralised databases of TBAs should be maintained at the IBOs and clear data sharing protocols that include GW be developed
5. All IBOs should develop strategic GW action and investment plans for their basin
6. Establish regional level GW policies for TBAs across governments
7. Create a permanent agenda item on transboundary aquifers for all IBO board meetings

With regard to financial viability:

1. Regional development communities (SADC, ECOWAS, IGAD) should be further engaged in transboundary GW management, enhancing GW focus and facilitating multilateral donor support and support from international water organisations (e.g. UNESCO-IHP, UNECE, IAH, IAEA)
2. Attention of parliamentarians should be enhanced in order to promote political interest and commitment for GW management, which should facilitate financial support to the IBOs
3. The model of the Water Research Commission (WRC) of South Africa, where water fees and levees from major groundwater users are partly channelled to fund water research, could be applied. In this sense, the user-pay-principle is adhered to

With regard to capacity building and awareness raising:

1. Generally, there is need for soft investments (capacity building) rather than big GW infrastructure programs
2. Experiences and tools developed by international organisation, e.g. UNECE (e.g. their guidelines for TBA monitoring and assessment (UNECE, 2000)), the European Water Framework Directive (the GW component from 2006), and guidelines from INBO (INBO and GWP, 2012) should be applied and adapted to the African contexts
3. Existing coordinating and facilitating organisations (like AMCOW, INBO) should be further prompted to advocate for increased GW focus in IWRM and transboundary water management in Africa

4. Newly developed regional GW knowledge centers, like the GEF-funded Groundwater Management Institute of Southern Africa (GMISA) at Bloemfontein, South Africa and the UNESCO-funded Regional Centre for Shared Aquifer Resources Management (RCSARM) at Tripoli, Libya should also enable further enhancement of GW management transnationally
5. Collaboration and networking between IBOs is to be encouraged and facilitated, especially if sharing TBAs, but also beyond Africa (e.g. Europe, Middle East and South America). Local networks should be encouraged to enhance African ownership of the processes
8. A staged approach is recommended, in which agreed most pressing transboundary GW issues are addressed first, significant TBAs are identified and delineated, monitoring of selected and critical areas prioritized, a conceptual understanding of the integrated SW-GW systems are generated, and large-scale (commercial) GW users and polluters are targeted first in monitoring and licencing
9. Apply multi and inter-disciplinary assessment approaches to GW assessment and management (e.g. UNESCO-IHP, 2011), not just technical and hydro-geological. This also applies to cross-sectoral analysis, recognizing the many roles GW plays (for water supply, food production, climate change adaptation, environmental integrity, etc.)
10. Incorporate socio-economic and cost-benefit analysis of GW development to prioritize use and valuation of GW resources (Bann and Wood, 2012)
11. As well as increasing staff with hydrogeological background in the IBOs it is essential to upgrade existing personnel with respect to GW knowledge and skills
12. Enhance liaison with GW expertise existing in national units and academia
13. Prioritize the building of capacity of the weaker states with respect to GW skills, in order to promote equal and competent participation in decision making
14. Greater use of remotely sensed data, airborne geophysics, and tracer and isotope technologies should be promoted and implemented
15. Use existing CB organisations and programmes in Africa to strengthen the capacity among the IBOs (like GWP, WaterNet, AGW-Net, Cap-Net, WRC, CoE on Water, NEPAD Water CoE, and IW:LEARN)
16. Rather than starting from scratch, use, replicate, and expand existing frameworks for enhancing public participation and awareness raising to address GW issues in the basins (as e.g. in NBI and ORASECOM)
17. Package information, awareness material and arguments on groundwater issues to assist the basin cooperation and policy dialogue, through increasing visibility of benefits (to politicians and public) of managing groundwater in river basin organisations (Box 2)

As follow up to this report, a consultative joint workshop with the implicated IBOs will be arranged. This will be used to further amend and consolidate the

recommendations put forward. In addition, a training manual on integrating GW management into the IBOs will be developed.

Box 2. Twenty arguments for addressing GW in IWRM and transboundary water management

1. Conflicts over a shared GW resource can be avoided
2. Costs and results of monitoring can be shared
3. Benefits of GW development can be equitably shared
4. General collaboration and goodwill can be enhanced
5. Impacts of GW development and use in one member state may affect another
6. GW impacts across borders may not be obvious without joint monitoring
7. Developing GW in connection with transboundary SW (conjunctive use) may provide a lot of benefits, e.g. flood waters may be used to replenish GW in overdrawn aquifers, and to flush and dilute GW pollution
8. Options for conjunctive use of GW and SW may alleviate water problems, in terms of both quantity and quality (e.g. through RBF for better drinking water quality, and MAR for water banking and salinity control)
9. GW may both function to alleviate droughts and floods, if properly managed
10. Many terrestrial ecosystems are GW-dependent and cannot be properly managed without knowledge on the GW resources
11. GW is paramaount in preserving significant ecosystems and biodiversity
12. GW should not be considered as a single and unlimited resource
13. An integrated approach creates better understanding of water flows and water balances within the basin
14. An integrated approach makes it possible to better delineate the basin, including active and connected aquifers
15. SW issues involve or even have root in GW related activities and impacts
16. Water from the river may be lost through GW abstraction in the vicinity of the river
17. Lake, river, wetland, estuary water quality may be threatened by GW pollution in adjacent areas (mining, intensive agriculture)
18. Further GW development may threaten traditional GW-based drinking water supply
19. GW development and proper management has a lot to do with achieving MDGs, poverty alleviation, food security, climate change adaptation, and drought mitigsation
20. No action and transboundary cooperation may result in dis-benefits, e.g. hap hazardous and chaotic exploitation of aquifers

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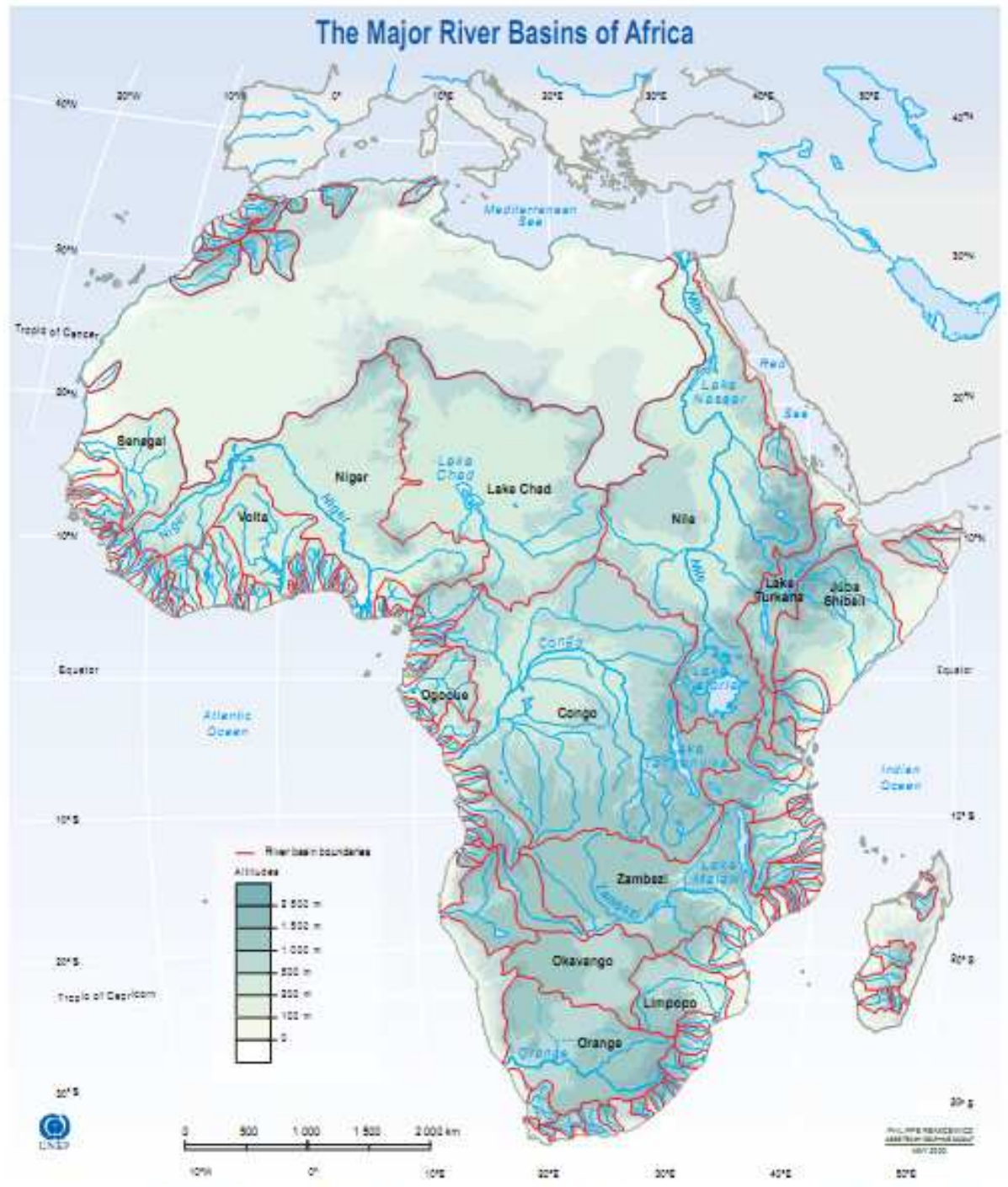
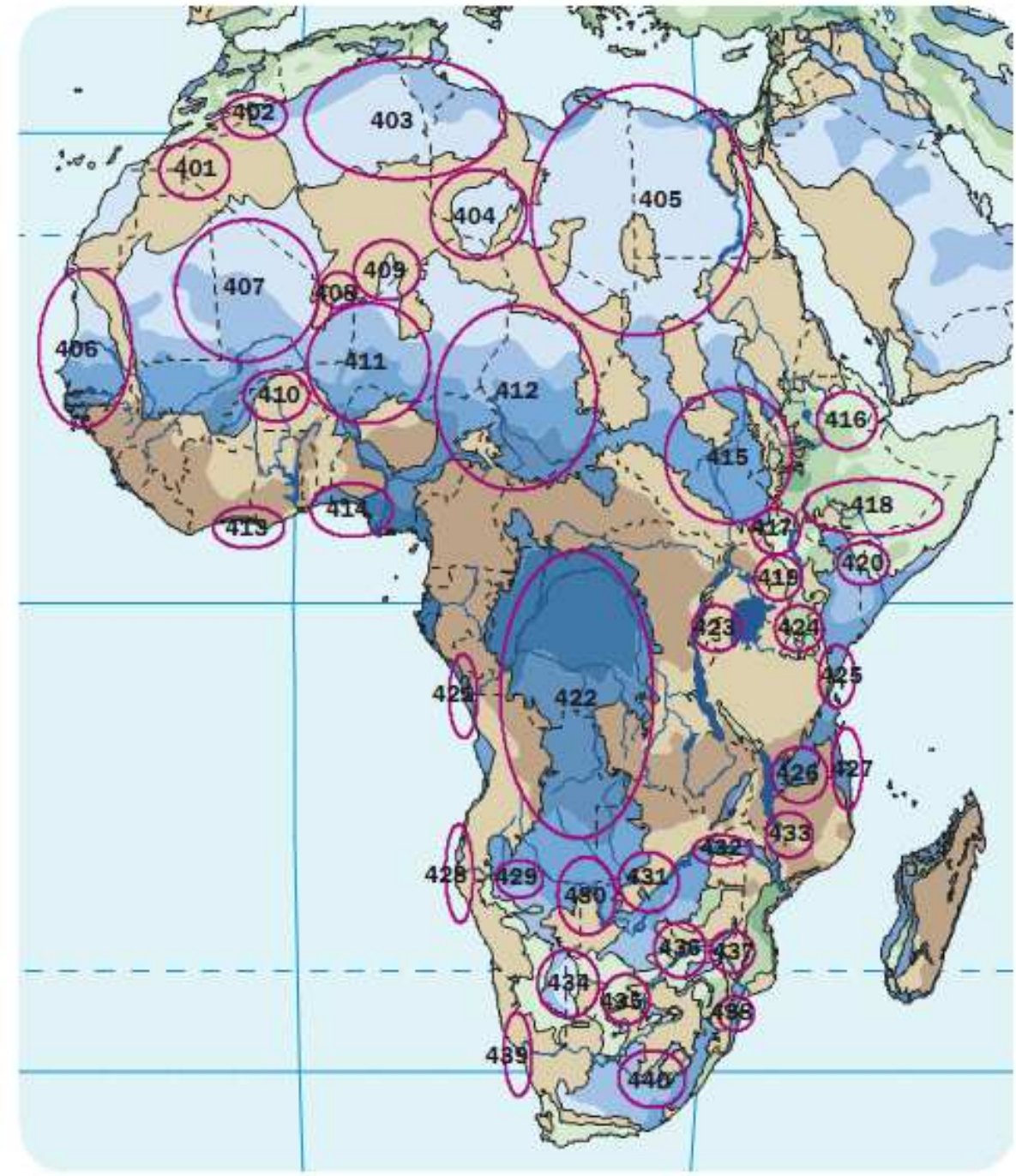
Annex 1. Map of major river basins in Africa



Source: Aaron T. Wolf et al., 1999; Revenga et al., *Watersheds of the World*, World Resources Institute (WRI), Washington DC, 1998; Philippe Rekacewicz, *Atlas de poche*, Livre de poche, Librairie générale française, Paris, 1996 (revised in 2001).

Annex 2. Map of transboundary aquifers in Africa (For names of TBAs, see ANNEX 3)



From Struckmeier et al., 2006

Annex 3. WHYMAP names and numbers of TBAs in Africa

WHYMAP Number	Name	Countries
401	Tindouf Aquifer	Algeria-Morocco
402	Errachidia Basin	Algeria-Morocco
403	Northwest Sahara Aquifer System	Algeria-Libya-Tunisia
404	Mourzouk-Djado Basin	Chad-Libya-Niger
405	Nubian Sandstone Aquifer System	Chad-Egypt-Libya-Sudan
406	Senegalo-Mauritanian Basin	Gambia-Guinea-Bissau-Mauritania-Senegal
407	Taoudeni Basin	Algeria-Mali-Mauritania
408	l'Air Cristalline Aquifer	Algeria-Mali-Niger
409	Tin-Seririne Basin	Algeria-Niger
410	Liptako-Gourma Aquifer	Burkina Faso-Niger
411	Iullemeden Aquifer System	Mali-Niger-Nigeria
412	Chad Basin	Central African Rep.-Chad-Cameroon-Niger-Nigeria
413	Coastal Sedimentary Aquifer	Ghana-Côte d'Ivoire
414	Coastal Sedimentary Aquifer	Benin-Nigeria-Togo
415	Upper Nile Basin	Ethiopia-Sudan
416	Awash Valley Aquifer	Djibouti-Ethiopia
417	Rift Aquifers	Kenya-Tanzania-Uganda
418	Ogaden-Juba Aquifer	Ethiopia-Kenya-Somalia
419	Mount Elgon Aquifer	Kenya-Uganda
420	Merti Aquifer	Kenya-Somalia
421	Coastal Sedimentary Basin	Dem. Rep. of Congo-Angola
422	Congo Intra-cratonic Basin	Dem. Rep. of Congo-Angola
423	Kagera Aquifer	Tanzania-Uganda
424	Kilimanjaro Aquifer	Kenya-Tanzania
425	Coastal Sedimentary Basin	Kenya-Tanzania
426	Karoo Sandstone Aquifer	Mozambique-Tanzania
427	Coastal Sedimentary Basin	Mozambique-Tanzania
428	Coastal Sedimentary Basin	Angola-Namibia
429	Cuvelai Basin	Namibia-Angola
430	Northern Kalahari/Karoo Basin	Angola-Botswana-Namibia-Zambia
431	Nata Karoo Sub-basin	Botswana-Namibia-Zimbabwe
432	Medium Zambezi Aquifer	Zambia-Zimbabwe-Mozambique
433	Shire Valley Aquifer	Malawi-Mozambique
434	SE Kalahari/Karoo Basin	Botswana-Namibia-South Africa
435	Ramotswa Dolomite Basin	Botswana-South Africa
436	Tuli Karoo Sub-basin	Botswana-South Africa-Zimbabwe
437	Limpopo Basin	Mozambique-South Africa-Zimbabwe
438	Incomati/Maputo Basin	Mozambique-Swaziland-South Africa
439	Coastal Sedimentary Basin	Namibia-South Africa
440	Karoo Sedimentary Aquifer	Lesotho-South Africa

From Struckmeier et al., 2006

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

Figure A4.1 Map of Orange-Senqu River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

Figure A4.2 Map of Limpopo River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

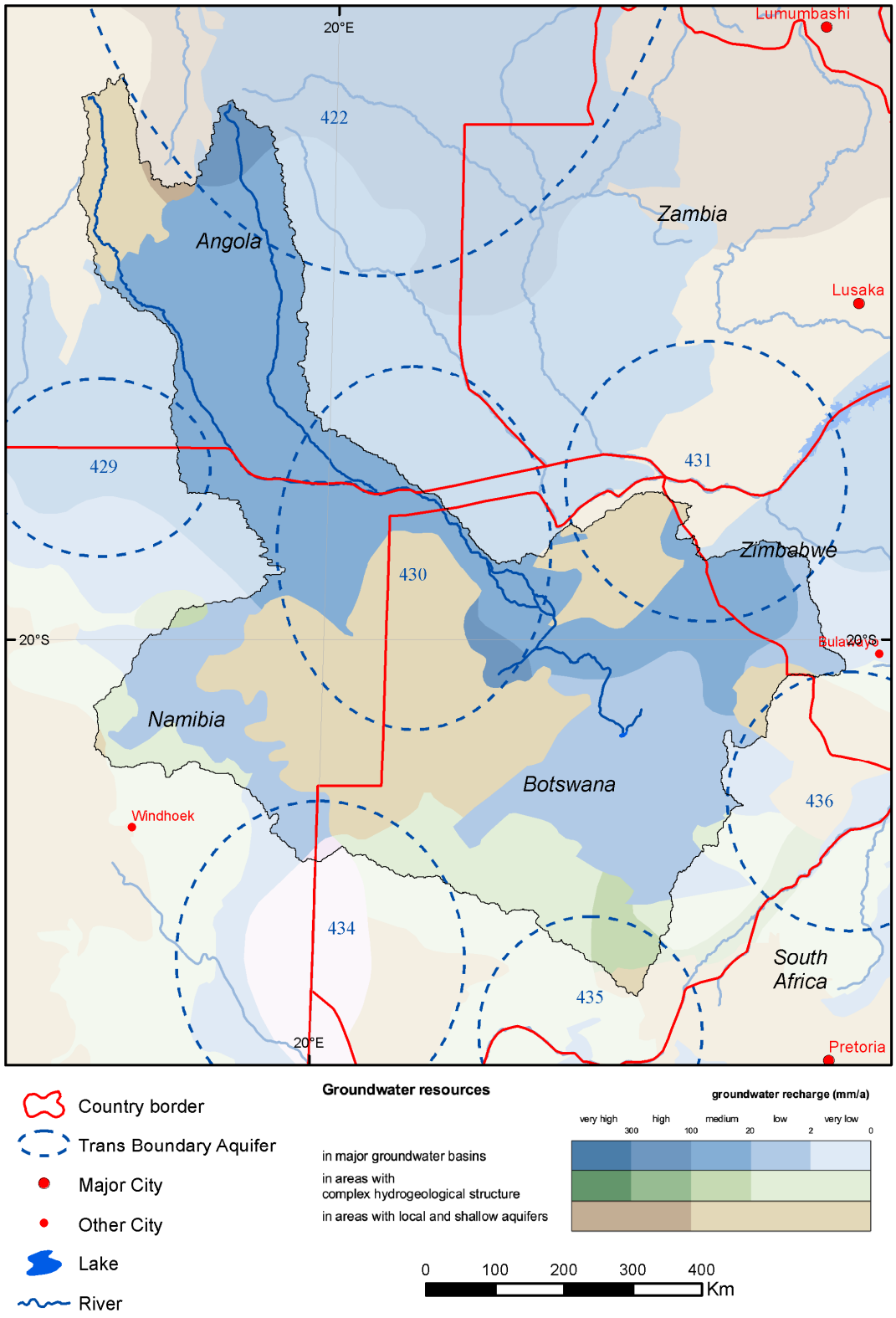


Figure A4.3. Map of Okavango River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

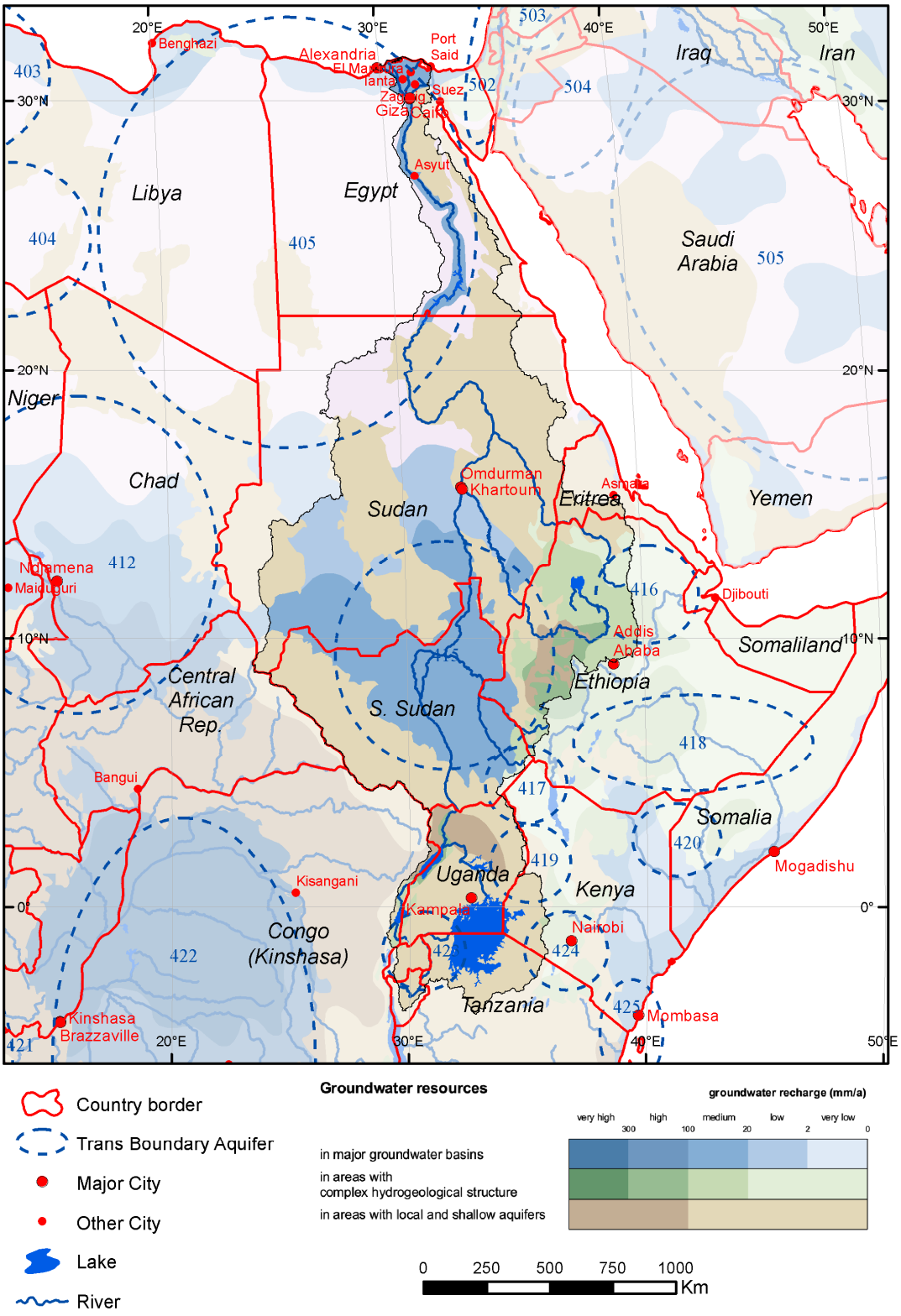


Figure A4.4. Map of Nile River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

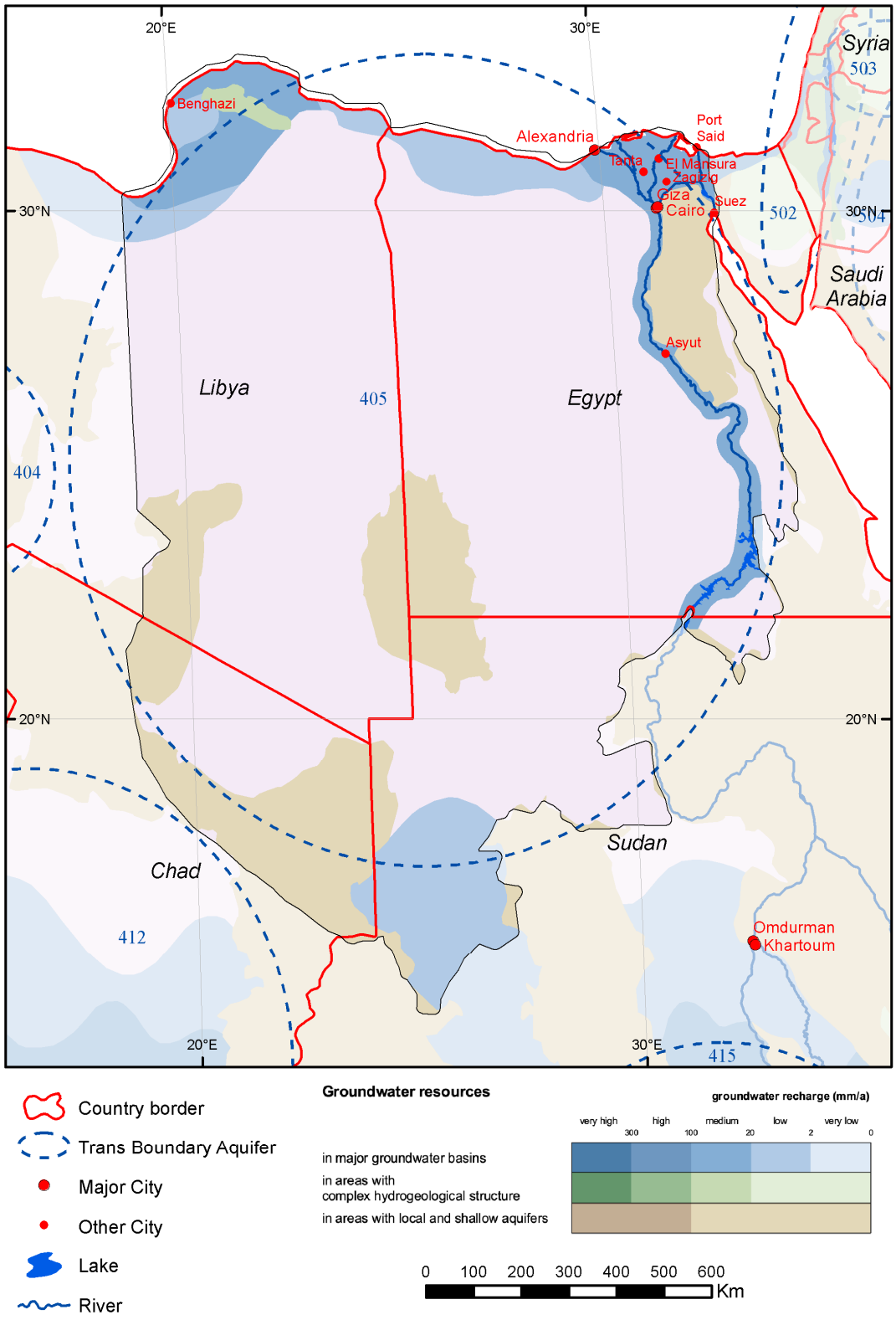


Figure A4.5 Map of Nubian Sandstone Aquifer System

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

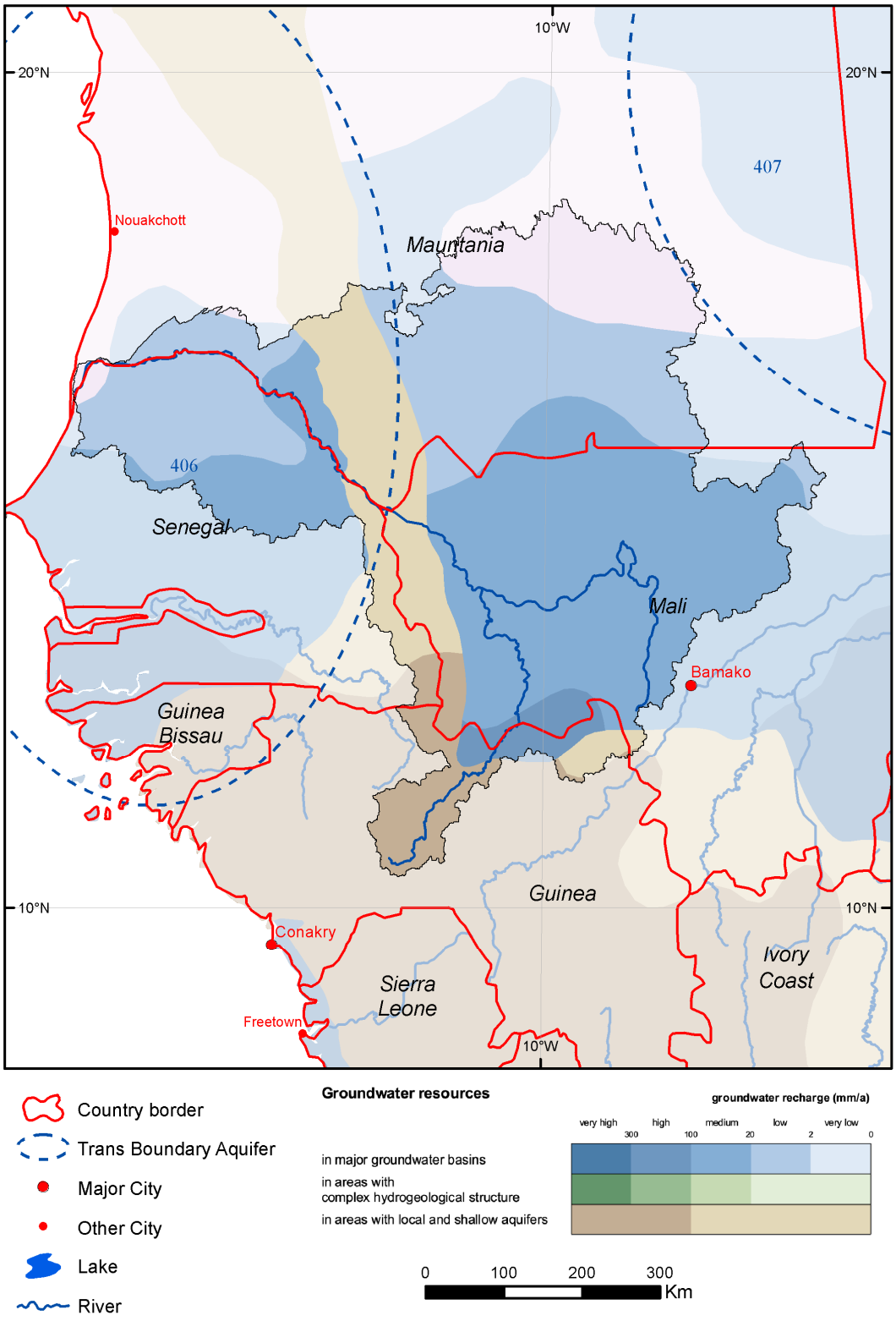


Figure A4.6 Map of Senegal River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

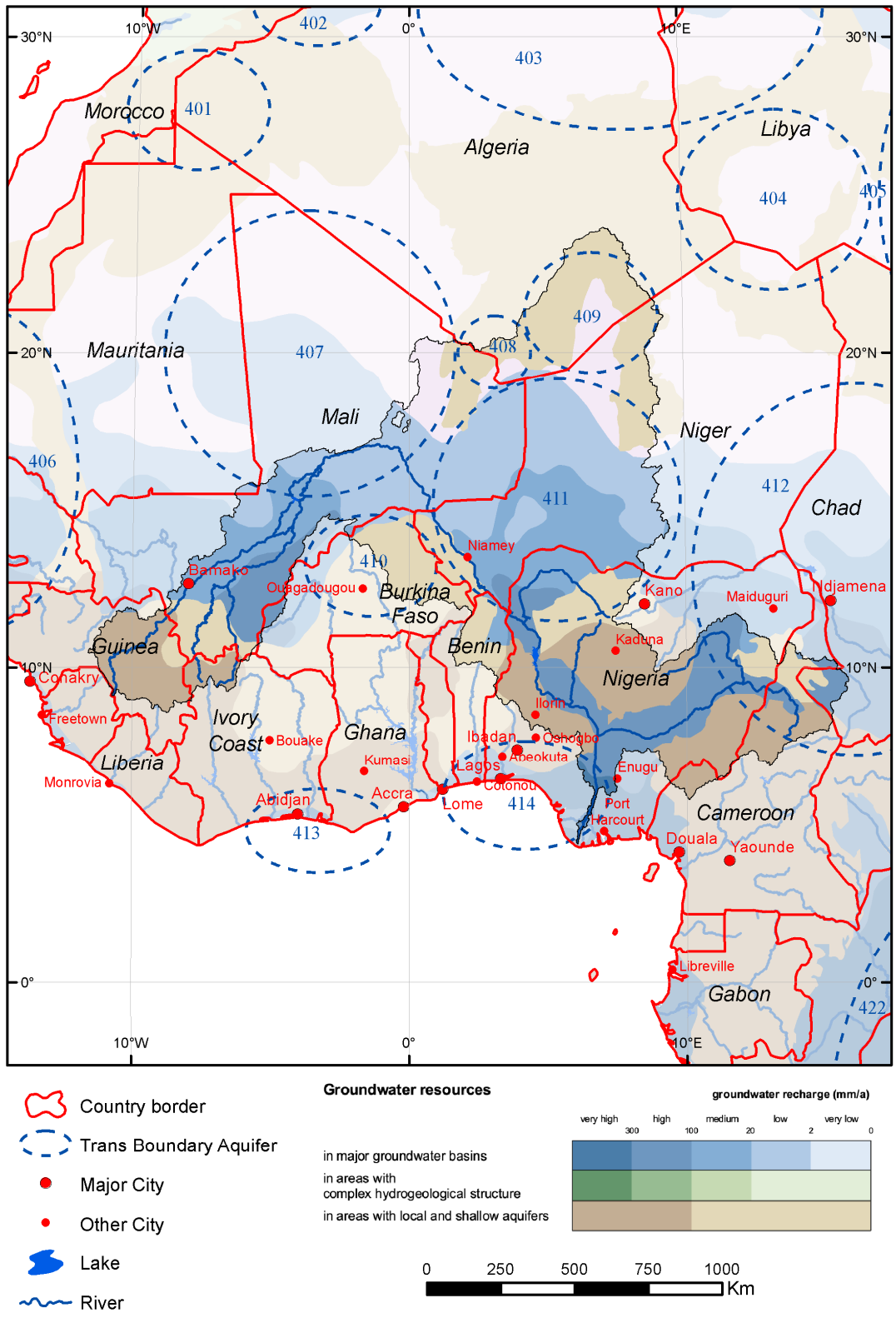


Figure A4.7 Map of Niger River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

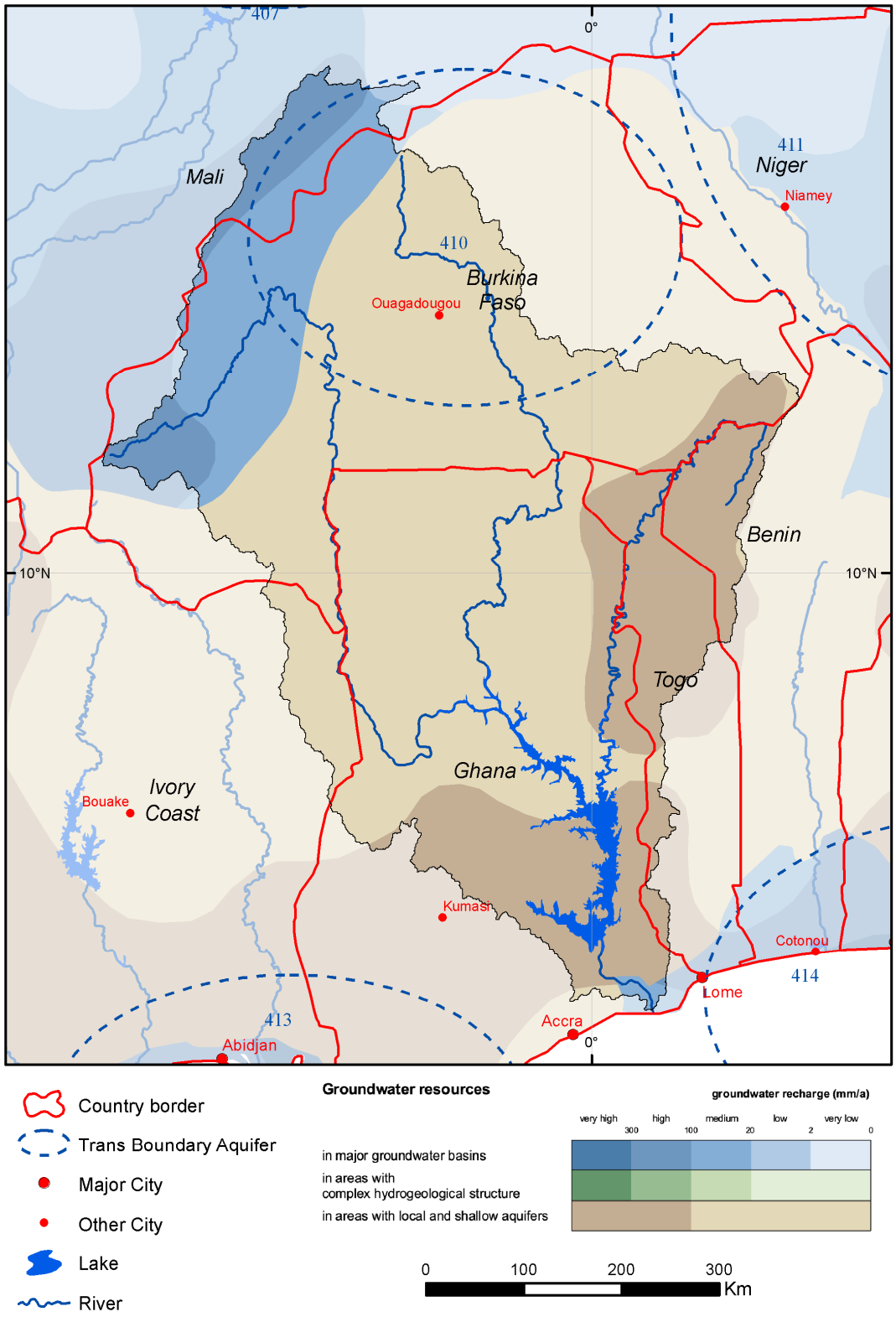


Figure A4.8 Map of Volta River basin and associated TBAs

Annex 4. Maps of river, lake and aquifer basins included in the survey, and their associated TBAs (For names and numbers of TBAs, see ANNEX 3)

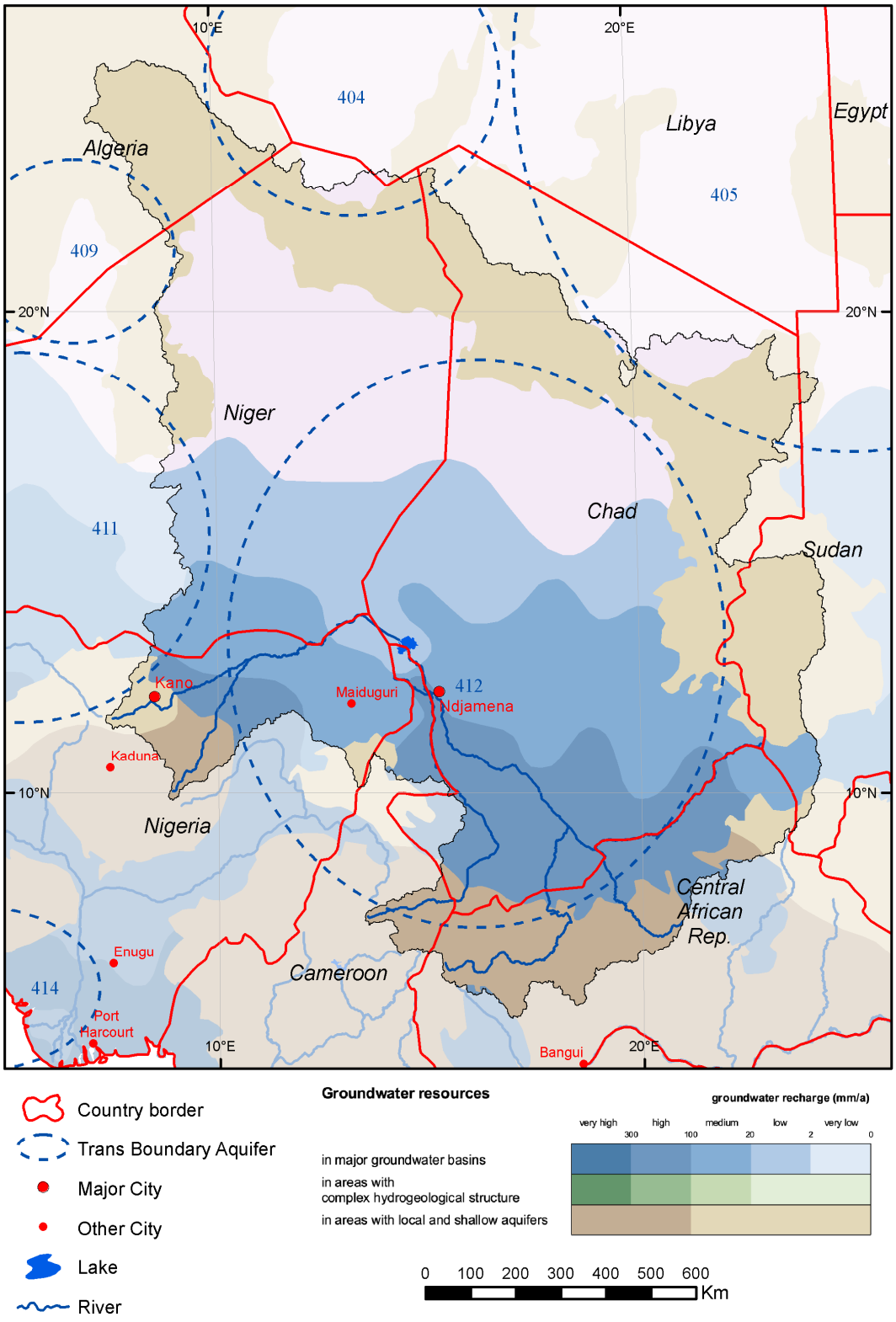


Figure A4.9 Map of Lake Chad basin and associated TBA

Annex 5a. Questionnaire format, for IBO HQ team

Questionnaire for which IBO: _____

Name: _____

Institution (if different from IBO):
_____

Function - please let us know your job title, role and main responsibilities:

Title:
_____
Role and responsibilities:

_____

How many years in present position:
_____

Background education:
_____

Country: _____

E-mail address: _____

Gender: Female:_____**Male:**_____

Telephone number for possible follow up phone call:
+_____

Date of Interview: _____

Interview performed by: _____

Place of interview: _____

Or if done by telephone: _____

Questions:

1. **Governance:**

    a. What is the principal and legal role/mandate of your IBO **wrt. groundwater**:

        i. To allocate GW: Yes □ No □
        ii. To oversee GW mgt.: Yes □ No □
        iii. To monitor TBAs in basin: Yes □ No □
        iv. To advise riparian states on issues related to GW: Yes □ No □
        v. To implement joint GW development projects: Yes □ No □

Annex 5a. Questionnaire format, for IBO HQ team

vi. Other. Specify:

_____
_____
_____

b. Does your IBO have a staffed permanent Secretariat? Yes □ No □

c. Does the constitution/agreement establishing your IBO specifically/explicitly address GW and groundwater issues? Yes □ No □

d. If yes, how?

_____
_____
_____
_____

e. Which water management instruments/schemes do you use? (e.g. management plans, action programs, monitoring and information systems, etc.)

_____
_____
_____
_____

f. To what extent is groundwater already considered in your water management structure and what actions/initiatives/programmes are you using to foster groundwater management within your organisation? (e.g. groundwater working group at ORASECOM)

_____
_____
_____
_____

g. Do you collaborate with organisations/programmes/institutes/projects that have a groundwater component? (African networks, policy decision makers (e.g. AU, AMCOW, AGWC, etc.) and international donors)

_____
_____
_____
_____

h. Are you aware of the AMCOW work plan? Yes □ No □

i. If yes: Are there any activities you have taken on board due to the AMCOW work plan?

_____
_____

Annex 5a. Questionnaire format, for IBO HQ team

_____
_____

j. Do you know about the existence of the UN resolution on transboundary aquifers? Yes □ No □
Comments:

_____
_____
_____
_____

2. **Society/collaboration/inclusion:**

a. What are the major uses of groundwater within the basin?

_____
_____
_____
_____

b. What are the main water challenges your basin/lake is confronted with? (e.g. groundwater pollution, (ground-) water shortage, institutional, etc.)

_____
_____
_____
_____

c. Are there great disparities between the water conditions and challenges in the riparian states?

_____
_____
_____
_____

d. Also in the level of groundwater development and management?

_____
_____
_____
_____

e. How is the exchange of knowledge/data and cooperation between the IBO and the riparian states' water mgt. structures?

Annex 5a. Questionnaire format, for IBO HQ team

f. Do you find the commitment of the riparian states to include GW on the political agenda sufficient? Yes □ No □

g. Does this influence your functionality?

h. What are you doing to strengthen the participation of the riparian states? (e.g. are formal structures, like stakeholder forums, in place with clear roles and responsibilities in water resources management and in the decision making process, are regular meetings taking place, etc.)?

i. Do you exchange knowledge, experience with other IBOs? Yes □ No □

j. If yes, which?

3. **Science/data/capacity building:**

a. Is there a good understanding to which extent groundwater-surface water interaction determines water balance and water quality in your basin and across riparian territories? Yes □ No □

Comments:

b. Where are you in the process of managing TBAs (also fill in Table 3 for individual TBAs)?

Annex 5a. Questionnaire format, for IBO HQ team

i. Identification □
ii. Delineation □
iii. Diagnosis □
iv. Conceptual/numerical model □
v. Allocation principles □
vi. Implementation of joint infrastructure projects □

c. Which data, if any, do you collect related to groundwater in the basin?

_____
_____
_____
_____

d. What data bases, information portals, and monitoring networks exist in your organisation, where groundwater is (or could simply be) added?

_____
_____
_____
_____

e. What is the process/mechanism for data sharing with the riparian states' national groundwater dept.?

_____
_____
_____
_____

f. How many hydrogeolgogists, or staff with hydrogeological background, are working in your organisation? Are all allocated posts filled?

_____
_____
_____
_____

g. Do you find your present capacity (in terms of human and financial resources) sufficient to address groundwater management appropriately? Yes □ No □

h. How is prioritisation made in your organisation to meet the limited resources (e.g. human, financial, technical resources)?

_____
_____
_____
_____

i. What capacity building on groundwater is ongoing or planned?

Annex 5a. Questionnaire format, for IBO HQ team

_____
_____
_____
_____

j. What in particular is lacking regarding capacity on GW management

_____
_____
_____
_____

Annex 5b. Questionnaire format, for IBO representative in riparian states

Questionnaire for which IBO: _____

Name: _____

Institution (if different from IBO):
_____

Function - please let us know your job title, role and main responsibilities:

Title:
_____
Role and responsibilities:

_____

How many years in present position:
_____

Background education:
_____

Country: _____

E-mail address: _____

Gender: Female:_____**Male:**_____

Telephone number for possible follow up phone call:
+_____

Date of Interview: _____

Interview performed by: _____

Place of interview: _____

Or if done by telephone: _____

Questions to IBO Country Representatives in the Riparian States;

a. What is your position in the principal government water management structure(s) in the riparian state where you reside?

_____
_____
_____
_____

Annex 5b. Questionnaire format, for IBO representative in riparian states

b. Are decisions taken within these structures first ratified by the IBO board at HQ before they are implemented? Yes □ No □

c. Do you find that groundwater management is strongly and adequately addressed and integrated into overall water management of your country?
Yes □ No □

Comments:

_____
_____
_____
_____

d. What is the level and effectiveness of cooperation between the IBO and the national groundwater management authorities?

_____
_____
_____
_____

e. Is there an operational protocol between the L/ IBO and the countries on GW data/information sharing? Yes □ No □

Comments:

_____
_____
_____
_____

f. What are the procedures and costs involved in groundwater data sharing between the national groundwater management authority and the IBO?

_____
_____
_____
_____

g. Do you acknowledge/value the work done by the IBO in terms of groundwater management? Yes □ No □

Comments:

_____
_____
_____
_____

Annex 5b. Questionnaire format, for IBO representative in riparian states

h. Are there cooperative activities between the IBO and national groundwater authorities, for instance monitoring activities? Yes □ No □

Comments:

_____
_____
_____
_____

i. What are your key concerns with regards to transboundary groundwater issues?

_____
_____
_____
_____

j. How important, in your professional opinion, is the interaction between surface water and groundwater in terms of i) transboundary water balance and ii) transboundary water quality?

_____
_____
_____
_____

Annex 5c. Questionnaire format, for Chief Government Hydrogeologist or GW focal point in the riparian states

Questionnaire for which IBO: _____

Name: _____

Institution (if different from IBO):
_____

Function - please let us know your job title, role and main responsibilities:

Title:
_____

Role and responsibilities:

_____

How many years in present position:
_____

Background education:
_____

Country: _____

E-mail address: _____

Gender: Female:_____Male:_____

Telephone number for possible follow up phone call:
+_____

Date of Interview: _____

Interview performed by: _____

Place of interview: _____

Or if done by telephone: _____

Questions to Chief Government Hydrogeologist or GW focal point in the Riparian States:

a. Do you share national groundwater data with the IBO? Does the IBO also share groundwater data from the other parts of the basin with your department?

_____
_____
_____

Annex 5c. Questionnaire format, for Chief Government Hydrogeologist or GW focal point in the riparian states

_____

b. What are the procedures and mechanism of data sharing and funding?

_____
_____
_____
_____

c. Are there joint programs and activities with the IBO in terms of groundwater management and protection? Yes □ No □

Comments:

_____
_____
_____
_____

d. In terms of national groundwater allocation, at what level are you required to obtain IBO approval?

_____
_____
_____
_____

e. Is the linkage to surface water flows, surface water quality and environment considered when you allocate groundwater both internally (within the country) and in the transboundary situation? Internally: Yes □ No □
Transboundary: Yes □ No □
Comments:

_____
_____
_____
_____

f. What is the formal relationship between your groundwater department and the country representative of the IBO?

_____
_____
_____
_____

Annex 6. Personnel interviewed

ORASECOM

No.	Title	Name	Position	Interview schedule[a]	Representation/ organisation	Country	Email	Telephone
1	Mr/Eng	Lenka Thamae	Executive Secretary, ORASECOM	A	ORASECOM HQ	South Africa	Lenka.thamae@gmail.com	+27126636826
2	Mr/Eng	Rapule Pule	Water Resources Specialist, ORASECOM	A	ORASECOM HQ	South Africa	rapule.pule@orasecom.org	+27126636826
3	Mr	Leshoboro Nena	Hydrologist, DWA	B	Lesotho-DWA	Lesotho	nena@dwa.gov.ls	+26622317991
4	Ms	Maria Amakali	Deputy Director and ORASECOM Technical Task Member	B	Namibia-DWAF	Namibia	amakalim@mawf.gov.na	+264612087167
5	Mr	Greg Christelis	Hydrogeologist, DWAF	C	Namibia-DWAF	Namibia	christelisg@mawf.gov.na	+264612087089
6	Mr	Othero Mulele	Hydrogeologist, DWAF	C	Namibia-DWAF	Namibia	muleleo@growas.org.na	+264612087123
7	Ms	Matsolo Migwi	Hydrogeologist, DWA	C	Lesotho-DWA	Lesotho	migwimatsolo@gmail.com	+26622313602
8	Mr	Thato Setloboko	Hydrogeologist, DWA	C	Botswana-DWA	Botswana	tssetloboko@gov.bw	+26771490378
9	Dr	Eddy van Wyk	Hydrogeologist, DWA	C	South Africa-DWA	South Africa	vanwyke2@dwa.gov.za	+27828011740

[a] A. ORASECOM HQ B. National ORASECOM GW Focal Point C. National GW Mgt. Authority

LIMCOM

No.	Title	Name	Position	Interview schedule[a]	Representation/ organisation	Country	Email	Telephone
1	Eng	Sergio Sitoe	Executive Secretary	A	LIMCOM HQ	Mozambique	sbsitoe69@yahoo.com.br	+258-823291980
2	Eng	Ronald Inguane	IWRM Officer, International Rivers Office	B	National Directorate of Water (Direcção Nacional de Águas)	Mozambique	ringuane@gmail.com	+258-21309621
3	Eng	Gilbert Mawere	Director, Water Resources Mgt.	B	Ministry of Water Resources Development &. Management (MWRD)	Zimbabwe	-	+263-4-700596
4	Mr	Sam Sunguro	Groundwater Manager	C	Zimbabwe	Zimbabwe	sunguro@zinwagwd.co.	+263-4-250786

Annex 6. Personnel interviewed

					National Water Authority (ZINWA)		zw	
5	Dr	Eddy van Wyk	Groundwater Manager	C	DWAF	South Africa	vanwykE2@dwa.gov.za	+27828011740
6	Mr	Willem du Toit	Groundwater Manager	C	Limpopo Provincial Office	South Africa	-	+27 152901262
7	Mr	Oteng Lekgowe	Principal Hydrogeologist	B	Botswana LIMCOM Representative	Botswana	olekgowe@gov.bw	+267 5330327
8	Mr	Oteng Lekgowe	Principal Hydrogeologist	C	GSB	Botswana	olekgowe@gov.bw	+267 5330327

[a] A. LIMCOM HQ B. LIMCOM Representative Riparian States C. GW Focal Person Riparian States

OKACOM

No.	Title	Name	Position	Interview schedule	Representation/ organisation	Country	Email	Telephone
1	MS	Monica Morrison	Communications Secretary	1 Some questions answered by e-mail	OKACOM HQ		monica@okacom.org	+2676800023
2	Ms	Laura Namene	Water Resources and Environment Specialist	2	OKACOM country representative, Namibia, DWAF	Namibia	namenel@mawf.gov.na	-
3	Ms	Winnie Kambinda	Geohydrologist and OKACOM Technical Task Member	3	OKACOM country representative, Namibia-DWAF	Namibia	kambindaw@mawf.gov.na	+264612087167
4	Mr	Greg Christelis	Hydrogeologist, DWAF Similar interview given to OKACOM	4	Namibia-DWAF	Namibia	christelisg@mawf.gov.na	+264612087089
5	Ms	Aina Iileka	Chief Hydrogeologist, DWAF	5	Namibia-DWAF	Namibia	iilekaa@growas.org.na	+264612087102

NBI

No.	Title	Name	Position	Interview schedule	Representation/ organisation	Country	Email	Telephone

Annex 6. Personnel interviewed

1	Dr	Wael Khairy	Executive Director	A	Nile Basin Initiative	Entebbe, Uganda	wkhairy@nilebasin.org	
2	Eng	Emmanuel Olet	Programme Officer, Water Resources Development	A	Nile Equatorial Lakes Subsidiary Action program (NELSAP)	Kigali, Rwanda	eolet@nilebasin.org	
3	Mr	Fred Mwango	NBI TAC –Technical Advisory Committee member/representative of Kenya to NBI. Also former Head of Groundwater Department in Kenya	B&C	Ministry of Water and Irrigation	Nairobi, Kenya	fredmwango@yahoo.com	
4	Mr	Odilo Mukiza	NBI TAC –Technical Advisory Committee member/representative of Rwanda to NBI. Also Head of Groundwater Section in Rwanda	B &C	Ministry of Natural Resources/ Rwanda Natural Resources Authority	Kigali, Rwanda	odilonrw@yahoo.com	
5	Ms	Rinelde Ndayishimiye	NBI TAC –Technical Advisory Committee member/representative of Rwanda to NBI. Also Director General, Geographic Institute of Burundi (IGEBU)	B	Geographic Institute of Burundi (IGEBU)	Bujumbura, Burundi	renildend@yahoo.fr	
6	Mr	Lister Kongola	NBI TAC –Technical Advisory Committee member/representative of Tanzania to NBI. Also Head of Groundwater Section in Tanzania	B&C	Ministry of Water Resources	Dar es Salaam, Tanzania	Irek52@yahoo.com	

Annex 6. Personnel interviewed

7	Ms	Rose Mukankole	NBI TAC - Technical Advisory Committee member/representative of DR Congo to NBI	B&C	Ministry of Environment and Nature Conservation	Kinshasa, DR Congo	mayelerose@yahoo.fr	
8	Mr	Aloys Ndugaritse	Coordinator of project on Adding Groundwater Dimesnion in Nile Basin water resources	C	Ministry of Energy and Water	Bujumbura, Burundi	aloysndugaritse@yahoo.fr	
9	Dr	Callist Tindimugaya	NBI TAC - Technical Advisory Committee member/representative of Uganda to NBI	B&C	Ministry of Water and Environment, Uganda	Entebbe, Uganda	callist.tindimugaya@mwe.go.ug	
10	Mr	Johnson Pule	Senior Hydrogeologist	C	Ministry of Water and Environment, Uganda	Entebbe, Uganda	johnson.pule@mwe.go.ug	
11	Ms	Deborah Mwesigwa	Principal Hydrogeologist	C	Ministry of Water and Environment, Uganda	Entebbe, Uganda	deborah.mwesigwa@mwe.go.ug	

a

Interviewed ENTRO regional and national affiliated staff and members of working groups

No.	Title	Name	Position	Interview schedule	Representation/ organisation	Country	Email	Telephone
1	Dr	Ahmed Khalid Eldaw	Executive Director	A	ENTRO	Addis Ababa, Ethiopia	akhalid@nilebasin.org	+251 11 6461130
2	Mr	Michael Abebe	JMP regional Project Coordinator	A	ENTRO	Addis Ababa, Ethiopia	mabebe@nilebasin.org	+251 11 6461130
3	Mr	Yosif Ahmed Ibrahim	Senior Water Resources Planner	A	ENTRO	Addis Ababa, Ethiopia	yibrahim@nilebasin.org	+251 911 486047

Annex 6. Personnel interviewed

4	Dr	Seifeldin Hamad Abdalla (*Became the Minister a week after the interview*)	Member, NBI TAC - Technical Advisory Committee, and NELTAC	B	Ministry of Irrigation &Water Resources, Sudan, Hydraulic Research Station	Khartoum, Sudan	seifeltwaim@yahoo.com	+249 912152563
5	Mr	Ibrahim Salih Adam	Member, NBI TAC - Technical Advisory Committee, and ENSAPT; Chair, WRTO	B	Ministry of Irrigation &Water Resources, Sudan. Water Resources Technical Organ (WRTO)	Khartoum, Sudan	ibradam75@yahoo.co.uk	+249 9123 29760
6	Mr	Fekahmed Negash	Director, Basin Management Directorate	B	Ministry of Water & Energy, Ethiopia	Addis Ababa, Ethiopia	fnegash@nilebasin.org	+251 911 688696
7	Mr	Tesfaye Tadesse c/o TAC member	Director, Groundwater	A & C	Ministry of Water & Energy, Ethiopia	Addis Ababa, Ethiopia	twtesfaye@gmail.com	+251 911 688696
8	Mr	Mostafa Abdel Rahim	Director Groundwater	C	Ministry of Irrigation &Water Resources, Sudan	Khartoum, Sudan	mayousif52@yahoo.com	+249 912 147907
9	Ms	Nadia Ibrahim Shakak	Member Working Group, NTEAP- Water Quality Project	B	Ministry of Irrigation &Water Resources, Sudan	Khartoum, Sudan	shakak63@gmail.com	+249 122 335413
10	Ms	Widad Mutwakil	Counterpart, WRPMP-DSS Project	B	Ministry of Irrigation & Water Resources, Sudan	Khartoum, Sudan	widadsaadalla@yahoo.com	+249 122 094605
11	Mr	Joel Nobert	NBI-DSS working group member, Lecturer at the University of Dar es Salam	B	University of Dar es Salam	Dar es Salaam, Tanzania	nobert@udsm.ac.tz	255 752 546259

a

Annex 6. Personnel interviewed

NSAS

No.	Title	Name	Position	Interview schedule	Organisation	Address	Email	Telephone
1	Mr	Osman Mustafa Ahmed	National Coordinator, andBoard member	A	JASD-NSAS	Khartoum, Sudan	omaburi@hotmail.com	+249 912 910034
2	Mr	Mostafa Abdel Rahim	Board Member; Director Groundwater	A	Ministry of Irrigation & Water Resources, Sudan	Khartoum, Sudan	mayousif52@yahoo.com	+249 912 147907
3	Ms	Miyada Monjid	Database Officer, Nubian Sandstone Basin country office	B	Ministry of Irrigation &Water Resources, Sudan	Khartoum, Sudan	miyada@gmail.com	-

OMVS

No.	Title	Name	Position	Interview schedule[a]	Representation/ organisation	Country	Email	Telephone
1	Mr	Tamsir Ndiaye	Head of Dept. of Environment and Sustainable Development	A	OMVS HQ	Senegal	ndiayetamsir2002@yahoo.fr	+221774500520
2	Mr	Cheikh Taliby Sylla	Director of Administration and General Resources	A	OMVS HQ	Senegal	cheikhtaliby@yahoo.fr	+221774924014
3	Mr	Malang Diatta	Water resources management Expert,	A	OMVS HQ	Senegal	diattamalang@live.fr	+221775362827
4	Mr	Fadel Ould Saad Bouh	Water resources Expert	B	OMVS National Unit in Mauritania	Mauritania	fadelsb56@yahoo.fr	+22022622156
5	Mr	Lamine Diop	Water resources management Expert	C	OMVS National Unit in Senegal	Senegal	iseld2004@yahoo.fr	+221772204744
6	Mr	Abraham Sogoba	Rural development expert	B	National focal point in Mali	Mali	abrasogoba@yahoo.fr	+22376603718
7	Mr	Assane Gaye	Senior Hydrogeologist	B	Groundwater focal point in		ass2005gaye@yahoo.fr	+22246716862

Annex 6. Personnel interviewed

					Mauritania			
8	Mr	Alpha Tougué Diallo	Senior Hydrogeologist	B	Head of Studies and Planning Division, SNAPE - Guinea		pnaepa2015@hotmail.com	+22464383781

[a] A. OMVS HQ B. By telephone C. OMVS National Unit in Senegal

NBA

No.	Title	Name	Position	Interview schedule	Representation / Organisation	Country	EMail	Telephone
1	Mr	Abdou Guéro	Technical Director	1	NBA HQ	Niger	abdou.guero@gmail.com	+227-20315239; +227-96994610
2	Mr	Bréhima Coulibaly	Coordinator of GIRE 2, NIGER-HYCOS	1	NBA HQ	Mali	bremacoul@yahoo.fr	+227-90507756
3	Mr	Robert Dessouassi	Leader of the Niger Basin Observatory (ABN)	2	NBO within the NBA HQ	Benin	dessouassi@abn.ne; dessouassi2003@yahoo.fr	+227-93934557
4	Mr	Garba Radji	Assistant Director of Water Resources	3	Water Ministry of Niger, NBA, NFS Niger	Niger	garbaradji@yahoo.fr	+227-20722363; +227-20203031
5	Mr	Sanoussi Rabé	Chief Hydrogeologist	4	Water Ministry of Niger	Niger	rsanoussi2001@yahoo.fr	+227-20203848; +227-96592204
6	Mr	Karaba Traoré	Hydrogeologist	5 & 6	NBA, NFS Mali	Mali	karabatraore@hotmail.com	+223-66782926; +223-78108818
7	Mr	Godwin O. Usifoh	Director of Hydrogeology Department	7 & 8	Nigeria Hydrological Services Agency (NIHSA)	Nigeria	ohumaobi@yahoo.com	+234-8037041510
8	Mr	Dr. Benjamin Chibuzo Aneke	HOD (Hydrology and Hydrogeology/Meteorology	9 & 10	Anambra-Imo River Basin Development Authority	Nigeria	ifcan2004@yahoo.com	+234-8036664302

Annex 6. Personnel interviewed

VBA

No.	Title	Name	Position	Interview schedule	Representation / Organisation	Country	EMail	Telephone
1	Mr	Charles Biney	Executive Director	1	VBA	Ghana	c.biney@abv-volta.org, cbiney@gmail.com	+226-50376067
2	Mr	Samuel Y. Atikpo	Deputy Executive Director	1	VBA	Benin	samuel.atikpo@gmail.com	+226-50376067
3	Mr	Jacob W. Tumbulto	Director of Observatory	1	VBA	Ghana	secretariat.abv@abv-volta.org	+226-50376067
4	Mr	Symphorien Meda	Administrator for Geoportal	2	VBA	Burkina Faso	msymphorien@yahoo.fr admin@abv-volta.org	+226-70272747; +226-76180000

LCBC

No.	Title	Name	Position	Interview schedule[a]	Representation/ organisation	Country	Email	Telephone
1	Mr	Mohamed Bila	Remote Sensing and GIS Expert, LCBC	A	LCBC HQ	Chad	mdbila@yahoo.com	+23566817311
2	Mr	Atiku Ahmed	Director of Water and Environment, LCBC	A	LCBC HQ	Chad	atiksuk@yahoo.co.uk	+23522524145
3	Mr	Balarabe Belo	Legal Advisor - LCBC	A	LCBC HQ	Chad	balanrogo@yahoo.com	+23599449901

[a] LCBC HQ

Annex 7. Summarized SWOT analysis

STRENGTHS

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Governance	*1. Good political support* *2. Presence of strong commission driven by riparian countries*	*1. Has a transboundary mandate* *2. Can provide a platform for transboundary groundwater monitoring* *3. Can provide a forum for transboundary groundwater governanc.*	1. *Formed by the common agreement between states* *2. Platform for knowledge sharing, management*	*1. Clear governance structure that includes a policy organ and a technical organ* *2. Existence of a secretariat* *3. Existence of a Decision Support System* *Resource mobilization function is relatively strong* *4. Evolving strategies and restructuring can occur within mandate and available capacity*	*1. Agreement on cooperation through the establishment of a Joint Authority for the study and development of Nubian Sandstone Basin among the four riparian states*	*1. Governed by OMVS conventions & encompasses shared groundwater resources* *2. Explicit mandate to address groundwater* *3. Operational programmes exist to implement on-the-ground actions to enhance resources development for the benefit of local population*	*1. The staff is aware of the need to strengthen groundwater integration into VBA's mandate*	*1. The NBA has a permanent executive secretariat based in Niamey* *2. The water charter that constitutes the water policy of the riparian countries clearly defines a judicial and institutional framework* *3. The political agenda in the member countries*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
								includes groundwater *4. There is a significant experience in the management of surface water inside the NBA*
Collaboration between Riparian States	*1. Good cooperation among countries and financial availability* *2. Basin states accept IWRM in their water laws, making transboundary cooperation easier*	*1. Has strong political support from riparian states* *2. Is well placed to play a facilitating role in transboundary groundwater management*	*1. Platform to source donor funding for all three states*	*1. Existence of water resources strategy that addresses demands and interests of riparian states* *2. Conducive environment for knowledge/ information sharing*	*1. JASD-NSAS has initiated technical cooperation on groundwater and raised awareness of state ministries*	*1. Decision making is by consensus & States are committed to implement actions once an agreement is reached* *2. Has long standing experience of implementing and operating joint infrastructure and programmes on the ground*	*1. VBA's role of coordinating projects and programs in the basin*	*1. Member states and organisations have trust in the NBA. The NBA has a relatively strong mandate and a legal framework to operate and also the possibility to mobilise human*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
								resources *2. There is a will to realize regional groundwater-related pilot projects in the HQ in Niamey as well as on the level of the National Focal Structures (NFS) in the member states*
Data Management and Sharing	*1. Collaborative link with SADC and donors in the information exchange of common interest areas*	*1. Has the legal and political mandate to host relevant transboundary groundwater data from the riparian states*	1. *Data sharing protocol exists*	*1. Consensus that groundwater should receive more attention, particularly on monitoring of quantity, quality and use, mapping, research, etc.*	*1. Agreements on data sharing and aquifer monitoring are in place*	*1. Mechanism of data sharing is well implemented within the river basin structure* *2. Piezometric monitoring network already exists in at least 3 member countries, which may provide*		*1. There already exists groundwater-related information in the member countries* *2. There is a regular*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
						database with reliable data. *3. A long surface water level record exists*		*collection and updating of data in some of the member countries, particularly Nigeria*
Capacity Building		*1. Is well placed to host transboundary groundwater capacity building activities and training programs*	1. *Can pool its human resources to deal with common challenges*	*1. Existence of groundwater related professionals among the Technical Advisory Committee and staff of NBI Acknowledgement of the need to extend the mandate of the regional organisation*	*1. Raising the visibility/ profile of groundwater sub-sector in member countries, bringing high professional interest in previously marginalised groundwater issues*	*1. Has permanent staff at its HQ & equipped staff in each country*	*1. Potential capacity to recruit staff that is relevant for the issue of groundwater management*	

Annex 7. Summarized SWOT analysis

IBO Strengths - Summary

Governance:

1. IBOs tend to operate within the framework of a multi-state agreement that provides for the possibility of a transboundary water management mandate.
2. IBOs generally have a permanent secretariat that can initiate and manage programs and projects such as transboundary groundwater management and monitoring activities.
3. IBOs can provide a platform for mobilizing basin-wide political support and for bringing groundwater higher on the political agenda.
4. IBOs have a good platform for raising finance to carry out transboundary groundwater actions such as monitoring.

Riparian State Collaboration:

1. IBOs can be a focal point for improved political and technical collaboration between riparian states.

Data Management and Sharing:

1. IBOs can provide a suitable platform for hosting transboundary groundwater data and for the management and use of the data.

Capacity Building:

1. IBOs can optimize groundwater management capacity building as a focal point for basin wide training programs in transboundary groundwater management.
2. IBO's can optimize capacity utilization by providing a platform for the pooling of scarce technical expertize from the riparian states.

WEAKNESSES

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Governance	*1. Prioritization of surface water over groundwater in*	*1. Is an advisory body and does not have a mandate to manage the*		*1.The Nile Basin Initiative is not an IBO and will cease in December 2012*	*1. Lack of shared vision for the management of the Nubian*	*1. Lacks a specialised group in the structural governance body to highlight*	*1. Establishment of VBA Secretariat not yet fully*	*1. The resources, both human and material, are*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
	the basin *2. There is no legal provision for transboundary groundwater regulation*	*transboundary groundwater in the basin* *2. Does not have the skills, personnel or equipment to carry out these roles effectively*		*2. Legal framework to protect groundwater is not yet in place* *3. Traditional focus on surface water* *4. Lack of clarity in the NBI shared vision and Strategic Action Program on whether NBI is focusing on both groundwater and surface water*	*sandstone basin* *2. Lack of legally binding resource management agreement among NSAS countries* *3. Limited JASD-NSAS mandate, and inadequate institutional framework* *4. Lack of involvement of stakeholder at all levels* *5. No supportive government-society- science interfaces or exchange processes (Turton, 2006) to ensure effective allocation and management*	*groundwater* *2. Commitment to address groundwater resources, although ratified, is not fully translated into operational management actions* *3. The concept of transboundary aquifer is not well perceived or acknowledged by river basin stakeholders*	*accomplished* *2. Incomplete establishment of national focal points (NFP) responsive to VBA* *3. Mismatch between technical objectives and political objectives*	*insufficient throughout the NBA. This is especially true for the hydrogeologically skilled personnel. In addition, the financial resources are scarce, especially on the level of the member countries. In general, but particularly in Nigeria, complaints have been heard about irregular policies*
Collaboration between Riparian States	*1. Insufficient understanding of transboundary aquifer systems*	*1. Does not have the knowledge base or the professional skills to identify*	*1. Communication on the ground between the*	*1. Designing of water resources projects that only deal with surface water*	*1. Emphasis on technical cooperation, with vague basin management*	*1. Disparities in groundwater challenges and context as well as groundwater*		

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
	2. Lack of activity between ORASECOM and National groundwater authorities on groundwater monitoring *3.Groundwater resources not considered during water allocation process*	*transboundary groundwater issues* *2. Is not well integrated with the groundwater management institutions in the riparian countries*	*stakeholders , OKASEC and OKACOM is weak* *2. Language difficulties exist between riparian states*	*2. National groundwater departments in member states not involved in the regional organisation* *3. No exchange of groundwater data between countries*	*framework* *2. Sole focus of JASD-NSAS on the technical aspects of the aquifer characterisation* *3. Lack of mandate in inter-state relations or policy formulation* *4. Lack of local ownership* *5. No adoption of principle of international law governing NSAS groundwater* *6. Absence of typical basin organisation institutional and legal framework*	*development and management give rise to different focus between states*		
Data Management and Sharing	*1. Lack of any monitoring activity and modelling* *2. Insufficient*	*1. Has no existing platform to host basin-wide groundwater*	*1. Exchange of information is weak and no relevant protocols*	*1. Limited information on the groundwater resources* *2. No formalized*	*1. Agreement on data sharing is limited and does not define mechanisms*	*1. Monitoring activities are irregular* *2. Piezometric network was not*		*1. Groundwater monitoring activities are weak in the Niger Basin.*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
	understanding of transboundary aquifer systems *3.Disparity in the level of assessment and diagnosis on the suggested transboundary aquifers*	*data* *2. Has no staff to allocate to such an activity* *3. Groundwater managers in the riparian states may be unwilling to release data to LIMCOM*	*exist*	*mechanism for the exchange of knowledge among riparian states* *3. Lack of infrastructure for regional / basin information management system* *4. No basin monitoring system in place yet*	*2. Information collection and sharing are project-based* *3. The NARIS databases is not operational* *4. Monitoring networks are national responsibility* *5. Sharing of data is in place, but not according to guidelines* *6. No willingness to exchange knowledge, experience with other IBOs* *7. Poor information / knowledge on surface drainage, and watershed characteristics*	*designed for groundwater management purposes*		*Hence there is only a weak knowledge of groundwater resources throughout the basin*
Capacity	*1.Lack of position*	*1. Is not*	*1. Inability*	*1. Limited*	*1. Transboundary*	*1. There is a lack of*	*1. Slow*	*1. Until now*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Building	*for an expert transboundary hydrogeologist* *2. Lack of capacity building* *3. Lack of external sponsors on transboundary aquifer projects*	*equipped to carry out capacity building activities* *2. Lacks the professional staff to identify capacity building requirements*	*to keep personnel.* *2. No permanent technical staff to implement its programs* *3. Lack of equipment and manpower to address groundwater issues*	*understanding and capacity to integrate surface water and groundwater* *2. Stakeholder platforms still at preliminary level* *3. Lack of adequate capacity both in the regional organisation and at national level* *4. No permanent post in ENTRO for Hydrogeologist*	*water management is at initial stage* *2.The present human capacity of the JASD-NSAS is not sufficient to address groundwater management appropriately* *3. Insufficient funding for capacity building plans*	*sufficient human capacity with a background in hydrogeology in executive body*	*recruitment and administrative procedure*	*the resources (human, material, financial) provided for the exploitation of surface water resources are incomparably higher than those provided for the management of groundwater resources*

Annex 7. Summarized SWOT analysis

IBO Weaknesses - Summary

Governance:

1. Many IBOs are advisory bodies only that do not have a legal mandate to manage transboundary groundwater.
2. Most IBOs have a strong traditional focus on surface water management, and hardly consider groundwater.

Riparian State Collaboration:

1. Many IBOs are not well integrated with the groundwater management authorities in the riparian states.
2. There is often insufficient understanding of transboundary groundwater issues in IBOs.
3. Disparities in groundwater challenges and context as well as groundwater development and management give rise to different focus between states.

Data Management and Sharing:

1. Many IBOs have neither groundwater data, nor trained staff, nor a suitable computer platform for a groundwater database at this time.
2. Agreements on data sharing are often limited and ill defined. Data sharing protocols are often non-existent, and riparian states may be reluctant to share their data under such circumstances.
3. Most IBO agreements do not include any legal requirement for states to share their groundwater data, even in transboundary aquifer situations.

Capacity Building:

1. Many IBOs do not have the skills, personnel or the equipment to carry out transboundary groundwater management.
2. There is often a lack of interest to develop groundwater technical capacity in IBOs due to their focus on surface water resources.

Annex 7. Summarized SWOT analysis

OPPORTUNITIES

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Governance	*1. Profound interest of International donors and development partners in the region*	*1. Can take the lead to initiate groundwater monitoring in transboundary environments* *2. Can identify the impact of alluvial groundwater abstraction on river flows and initiate basin wide collaboration to manage this issue* *3. Has an opportunity to identify transboundary groundwater quality issues*	*1. Very good rapport within the commission and between the riparian states*	*1. Groundwater and surface water co-managed by river basin in most of the riparian states, providing experience for similar strategies for the NBI* *2. Strong donor support for integrating groundwater in river basin organisations* *3. The NBI Institutional Strengthening Project (ISP) is expected to result in a functional river basin institution*	*1. Current international legal development is an opportunity to establish a Basin Commission for the Nubian sandstone aquifer*	*1.OMVS has experienced long term international partnership with river basins networks* *2. Opportunity for experience exchange, and for multilateral cooperation to meet financial capacity* *3. All these countries are engaged in poverty alleviation and water supply programmes to meet or catch up with MDGs and groundwater has a central role*	*1.Increasing awareness of the need to enhance the integration of groundwater into water management in general as exemplified by the groundwater forums in the Volta basin*	*1. There seems to be a political will on continental level (see AMCOW) to put focus on groundwater-related issue, especially the member countries in the Sahelian part of the Niger Basin (e.g. the Republic of Niger), forced by the everlasting threat of drought, worsened by climate change and population growth* *2. Main donors are becoming more and more aware of the topic*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Collaboration between Riparian States	*1. The dependence of rural population on groundwater which strengthens its strategic role as supply* *2. Interest of rural communities and larg-scale activities (irrigation, industry) as prime groundwater users*	*1. Has the opportunity to initiate collaboration between the riparian states in the field of eg. transboundary groundwater monitoring* *2. Can introduce transboundary groundwater issues as a permanent agenda item for all its regular board meetings.*	*1. Opportunity to establish joint teams from the riparian states.*	*1. The worldwide move to develop strategies and procedures for integration of groundwater in river basin organisations* *2. Multipurpose joint (JMP1) development of the Eastern Nile to cooperation and good practice.* *3. Collaboration with existing projects on a number of the Nile groundwater sub-basins*	*1. The ongoing NBI project provides a great opportunity to support integrating surface water in the NSAS management in the riparian / aquifer states*	*1. ECOWAS has IWRM framework for transboundary water governance, promoting regional integration within the water sector* *2.GWP/WA has initiated a regional dialogue for concerted (transboundary) groundwater management* *3. Collaboration with existing projects on a number of the Nile groundwater sub-basins*	*1. Various ongoing international initiatives in the area of groundwater resources management including establishment of the Africa GW Commisssion*	
Data Management and Sharing	*1.The link with SADC is a key platform to address transboundary*	*1. Has an opportunity to develop a protocol on groundwater data sharing*		*1. Ongoing collaborative project between NBI and IAEA on assessing groundwater*		*1. There's interest expressed by IBO authorities to improve understanding*		*1. The necessity to integrate groundwater to establish a complete water balance has*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
	groundwater issues where ISARM-SADC has been active since 2005	*for transboundary aquifers* *2. Has on opportunity to stimulate the creation of a basin wide groundwater database and to encourage the riparian states to share groundwater data* *3. Has an opportunity to support SADC groundwater initiatives such as the Groundwater Management Institute as a suitable host / platform for basin wide data storage and sharing*		*surface water interaction* *2. Concerns about depletion of the GW reserves and pollution threats* *3. Eastern Nile countries agreed to commission a trans-border data inventory (no groundwater)* *4. Ongoing data collection on groundwater use along the Blue Nile/ Main Nile river system*		*of river-groundwater interactions* *2. An "optimal" network was proposed for sustainable monitoring programme in Mali, Mauritania, and Senegal*		*already been perceived by many inside the NBA* *2. There is hope that artificial groundwater recharge can build an alternative to the construction of surface water dams*
Capacity Building		*1. Can identify the capacity needs within*	*1. To use experts from riparian states'*	*1. Existence of the African Groundwater*	*1.Multilateral/ bilateral projects*	*1. Active research institutions*		*1. BGR-related activities are*

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IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
		the riparian states for transboundary groundwater management *2. Has an opportunity to host / implement training courses and other capacity building activities in the field of transboundary groundwater management*	*groundwater departments to support the OKACOM structure* *2. Opportunity to synchronise programmes between the riparian states and OKACOM*	*Commission that can provide strategic support and guidance* *2. Existing work with Universities in member states to address some GW issues*	*addressing IWRM & transboundary water management* *2. AMCOW work plan to promote institutionalisation of groundwater management by river basin organisations*	*with outstanding expertise in groundwater that have carried out studies related to Senegal River basin* *2. Countries members have qualified hydrogeologists in their national departments*		*promising*

Annex 7. Summarized SWOT analysis

IBO Opportunities - Summary

Governance:

1. IBOs can promote the philosophy that groundwater should be managed within the river basin catchment management framework.
2. IBOs are well placed to take the lead in transboundary groundwater management and transboundary groundwater monitoring.
3. There is a very strong international interest to bring groundwater management into the ambit of IBOs.
4. IBOs are well placed to identify important transboundary groundwater impacts on river flow, water quality and aquifer degradation.

Riparian State Collaboration:

1. IBOs generally have very good relationships with the riparian states and can introduce the need for transboundary groundwater management.
2. IBOs can establish multi-state taskforces from the riparian states to deal with transboundary groundwater management and monitoring.
3. IBOs can promote transboundary groundwater management on the political agenda in the riparian states.
4. IBOs can link transboundary groundwater management to existing or proposed groundwater projects in the riparian states.

Data Management and Sharing:

1. IBOs have an opportunity to develop a protocol on groundwater data sharing for transboundary aquifers within their river basins.
2. IBOs have an opportunity to stimulate the creation of a basin wide groundwater database and to encourage the riparian states to share groundwater data.
3. IBOs have an opportunity to support regional groundwater initiatives.
4. IBOs are directly interested and well placed to establish the importance of the linkage between groundwater abstractions and flow and water quality variations in international rivers.

Capacity Building:

1. There is an opportunity to use experts from riparian states' groundwater departments to support the IBOs capacity.
2. IBOs can work with AMCOW to promote institutionalisation of groundwater management by river basin organisations.
3. IBOs have an opportunity to link to regional and donor supported groundwater capacity building initiatives.
4. IBOs can identify the capacity needs within the riparian states for transboundary groundwater management.
5. IBOs have an opportunity to host / implement training courses and other capacity building activities in the field of transboundary groundwater management.

Annex 7. Summarized SWOT analysis

THREATS

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
Governance	*1. Limitation on funding hinders the level of transboundary groundwater project formulation and implementation*	*1. May lack the financial resources to carry out transboundary groundwater actions* *2. Riparian states may lack the resources to carry out monitoring of transboundary aquifers* *3. LIMCOM has no legal mandate to manage transboundary groundwater*	*1. Lack of organisational structures on the ground to actually ensure that the stakeholders become the owners of the programmes of OKACOM*	*1. Absence of strategies and procedures for integration of groundwater in river basin water resources management* *2. Some traditional development partners may not be willing to fund groundwater resources management programs* *3. Endorsements required at highest political levels*	*1.Mismatched power position of riparian countries in the JASD-NSAS* *2. Absence of stakeholder involvement* *3. Lack of sufficient commitment of the riparian states to include surface water on the Authority agenda*	*1. Lack of financial resources*	*1. Global financial changes or uncertainties*	*1. The high abstraction of groundwater as well as its growing pollution increases the pressure on the resource* *2. High number of member countries (they are 9) bears the danger, that decision making processes concerning groundwater and TBA-related issues will be significantly delaye or hanmpered*
Collaboration between Riparian States		*1. Riparian client states may reject LIMCOM's role in managing*	*1. Finances: currently the riparian states are funding the IBO at 50%,*	*1. Some riparian states may object to inclusion of groundwater in*	*1.Limited recharge to NSAS, and sole resources in scarce water regions* *2. Hydro-*	*1. Lack of common interest of member states on*	*1. Slow response from riparian countries to requests made*	*1. Lack of collaboration and agerement between a member state*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
		transboundary aquifers *2. Technical complexities may limit LIMCOM's ability to resolve conflicts arising around over-pumped transboundary groundwater systems* *3. LIMCOM has no legal power to enforce transboundary groundwater management decisions*	*and this is not sufficient to actually initiate basin scale programmes*	*the Nile basin water resources management* *2. Groundwater recharge and inter-basin transfer issues may complicate negotiations*	*geological conflict between the major users on the aquifer resources is foreseen* *3.Wasteful usage of the NSAS fossil groundwater with emphasis on maximum exploitation in Egypt & Libya*	*groundwater resources*	*by VBA*	*(e.g. Mali) and a non-member state (e.g. Mauritania) sharing one aquifer (the Taoudeni aquifer in this particular case)*
Data Management and Sharing	*1. Disparity in the level of groundwater data/information capture in the basin states*	*1. Some riparian states may be unwilling to share groundwater data* *2. Riparian states have different data archive systems*	*1. The main unconfined aquifers can easily be contaminated, but aquifer users do not understand this*	*1. Limited information on the groundwater resources in the basin and the role of groundwater in the water balance of the Nile Basin*	*1. Lack of credible/ accurate information on the major uses of groundwater within the basin*	*1. Lack of knowledge of groundwater resources* *2. Vandalism of hydraulic infrastructures like piezometers is persistent*		*1. The poor attitude to collecting and handling data in member countries threatens the process of recognition and progress* *2. Non-*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
		that may be incompatible		*2. No willingness by the Nile Basin countries to share information* *3. Disparities in the status and incompatibility of national groundwater information systems*		*3. Sustainability of current mechanism of data collecting & sharing threatened by decreasing motivation*		*standardization of data lead to the fact, that groundwater-related data, which already exist, will not be exchanged, will not be known or even evaluated by other member states or agencies*
Capacity Building		*1. Riparian states may not accept the need for capacity development with regards to transboundary groundwater management* *2. Funding for such capacity development may be unavailable*	*1. Lack of human capacity expertise to actually implement all the OKACOM programmes*	*1. Limited capacity in the basin for undertaking groundwater management activities* *2. No open data policy, which is a key instrument in capacity building* *3. Lack of detailed knowledge about groundwater*	*1. Great disparity in capacity, conditions and challenges in the riparian states*	*1. Lack of human and financial capacity*	*1. Inadequately trained/qualified staff*	*1. The lack of hydrogeologically skilled personnel leads to extremely limited possibilities for groundwater-related education in the member countries* *2. The initiatives for an integration of groundwater management into the regular activities of the*

Annex 7. Summarized SWOT analysis

IBO /issue	ORASECOM	LIMCOM	OKACOM	NILE NBI	NSAS	OMVS	VBA	NBA
				occurrence and aquifer systems in the Nile basin				*NBA may fail because of lack of financing*

IBO Threats – Summary

Governance:

1. IBOs often lack the finances to carry out transboundary groundwater management and monitoring programs.
2. Many IBOs are advisory organisations and lack the legal mandate to carry out transboundary groundwater programs.
3. Many IBOs lack strategies and procedures for the integration of groundwater into river basin water resources management structures.
4. There are often mismatched resources and political power between the riparian states that can hinder smooth agreement on transboundary groundwater management.

Riparian State Collaboration:

1. Riparian states may reject the IBOs role in managing transboundary groundwater.
2. Technical complexities may make it difficult to fully understand transboundary groundwater movements and therefore to get support from the riparian states, especially in conflict situations.
3. Many IBOs do not have a legal mandate to enforce transboundary groundwater decisions.
4. There may be a lack of common interest, or conflicting interests, from member states on groundwater issues.

Data Management and Sharing:

1. Some riparian states may be unwilling to share groundwater data.
2. Riparian states have different data archive systems that may be incompatible
3. Lack of knowledge of groundwater resources.
4. Lack of credible/ accurate information on the major uses of groundwater within the basin
5. Sustainability of mechanism of data collecting & sharing is not assured.

Capacity Building:

1. Limited capacity in the basin for undertaking groundwater management activities
2. Riparian states may not accept the need for capacity development with regards to transboundary groundwater management.
3. Funding for capacity development may be unavailable.

Annex 8. Basin Profile Reports

Abiye, T.A., 2012. Basin Profile for Groundwater Needs Assessment: Orange-Senqu River Basin Commission (ORASECOM). . AGW-Net.

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