African Network of Basin Organisations

Global Water Partnership

GROUNDWATER
DEVELOPMENT OPPORTUNITIES & MANAGEMENT RESPONSIBILITIES
the Mission for African Basin Organisations

KEY MESSAGES:

- **groundwater is the preferred (and sometimes only) source to meet new water-supply demands, and is vital for rural life and livelihoods**
- **basin organisations provide a unique platform to explore beneficial conjunctive management of groundwater and strategic use of aquifer storage for climate-change adaptation**
- **sound groundwater management is of paramount importance for the conservation of important aquatic and terrestrial ecosystems**
- **groundwater systems and their surface water interactions, need to be better understood – and appropriate training provided for water resource professionals**
- **leadership is much needed to strengthen the institutional framework for managed ground water development and thus improve water-security for urban centres and irrigated agriculture**
- **transboundary cooperation on groundwater will reduce potential conflict, promote rational development, and share the costs of investigation and monitoring**

WHAT IS THE ROLE OF GROUNDWATER IN SOCIAL AND ECONOMIC DEVELOPMENT?

Improving Rural Water-Supply — The Continuing Need

Groundwater is **critical for human survival and livelihoods** across very extensive drought-prone areas of Africa. Traditionally it was access to groundwater in springs, seepages and dugwells that controlled the extent of human settlement beyond the main riparian tracts. But the introduction of drilling rigs and borehole pumps from the 1970s **enabled human settlement to expand** greatly.

Today the **dependence of rural water-supply on groundwater** (for domestic use, livestock rearing, vegetable plots and village industry) is put at over 75%. It is the presence of successful waterwells that allows villages, clinics, schools, markets and livestock posts to function over very large land areas. This **critical social function** cannot be overstated. In the future it will be essential that groundwater be further developed to meet the basic need of the growing rural population for a secure and safe water-supply. For this better use of hydrogeologic expertise and improved community maintenance will be needed to reduce **waterwell failure levels** due to insufficient yield and/or inadequate quality.

The New Agenda — Expanding Use for Urban Supply & Agricultural Irrigation

In numerous countries of Sub-Saharan Africa the strategic water agenda is already undergoing rapid change - due to demographic pressure, climatic variability and economic transformation. New policy questions are widely having to be faced :

- What is the scope for a major increase of **groundwater use in irrigated agriculture** (at both subsistence and commercial scale) with associated investment risks minimised and sustainable outcomes assured?

- How can the demand to **expand urban groundwater use** (to supplement municipal water-supply and for in-situ domestic and commercial use) be channelled to maximise benefits and minimise risks?

This 'new agenda' poses a new challenge – to improve the knowledge base and institutional provision for properly managed groundwater development. Groundwater is also critical for the economical development of some major mining sites, whilst at others groundwater water drainage is a big issue.

At present the intensity of groundwater resource use remains generally low (except around some major conurbations and in the more arid valleys and coastlines). But **managed groundwater development** is becoming a vital 'cog-in-the-wheel' of the overall development process to meet a range of demands (with priorities varying considerably with differing national socio-economic trajectories).

Although groundwater occurrence is now reasonably mapped for this purpose, information on aquifer characteristics, recharge rates, flow regimes, quality controls and current use remains patchy. In 'developmental circles' this has tended sometimes to result in groundwater being the subject of 'unreasonable expectation' and at others to not being taken into serious consideration.

Resource Resilience for Climate Adaptation and Drought Mitigation

Groundwater resources generally have notable drought resilience, even in drier areas where recharge only occurs on the 'decadal time-scale' of major rainfall episodes. **Aquifer drought resilience** varies with the accessible volume of its drainable storage. Given the correlation between drought propensity and persistent poverty in tropical Africa, there is pressing need for investment in **drought preparedness**, including the proactive management of groundwater storage to 'buffer' drought impacts. Improved drought-proofing of rural livelihoods is required (as opposed to mitigating drought impacts), and this will necessitate systematic appraisal of drought preparedness, with action on waterwell deepening and pump re-dimensioning.

In the deeper aquifer systems of what today are the more arid parts of Africa, most stored (and sometimes still flowing) groundwater was recharged more than 5,000 years ago, when the climate was wetter and cooler. It is thus termed **'fossil groundwater'** – which widely has to be regarded as 'non-renewable' since only a tiny fraction of the total volume in aquifer storage is contemporary recharge. **Non-renewable groundwater resources** can provide a very reliable source of water-supply, which is completely resilient to current climate variability, but its use in the end will be time-dependent and as such deserves careful consideration in terms of efficient utilisation and intergenerational equity.

IN WHAT OTHER WAYS IS GROUNDWATER RELEVANT TO BASIN ORGANISATIONS?

Groundwater Interaction with River Systems

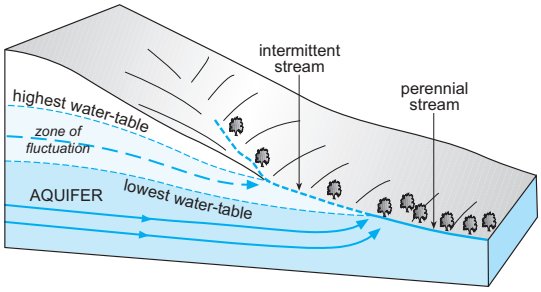
Shallow groundwater and surface water are usually **intimately linked facets of the natural water cycle,** with groundwater discharging into surface water bodies or receiving recharge from them – according to local conditions. The precise dynamic of interaction exhibits wide spatial, and significant seasonal, variation along the length of major alluvial basins and between humid and arid climatic settings. Many facets of riverflow behaviour have their roots in the underlying groundwater system.

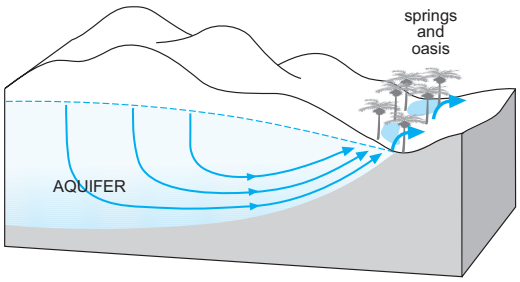
Surface water systems tend to be flow-dominated, whilst most **aquifers are characterised by very large storage and much lower flow rates.** These differences have important practical implications for water resources management, with **very different time-scales** having to be contemplated – decades or more for groundwater compared to months or less for rivers. Integrating groundwater into broader water resources management has to respect the above differences, and at least four different spatial configurations are recognised :

- important aquifers underlying only part of a river basin – requiring separate groundwater management plans within overall river basin planning
- river basins underlain by extensive shallow (but sometimes thick) aquifer systems – requiring a fully integrated approach
- extensive deep sedimentary aquifers in arid regions – where the 'aquifer basin' (and not the river basin) is the rational unit for water resource management
- shallow minor aquifers of patchy distribution – for which groundwater development impacts will be very localised compared to river basin dynamics.

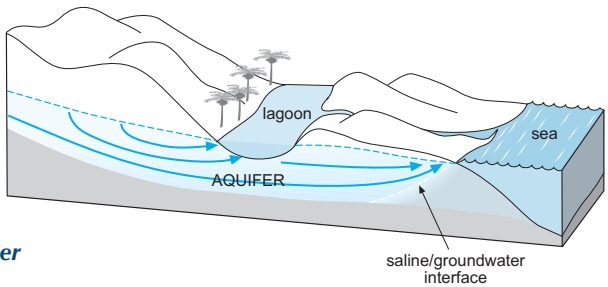
GROUNDWATER-DEPENDENT ECOSYSTEMS — SOME TYPICAL EXAMPLES

HUMID STREAM-BED ECOSYSTEM
along upper reaches of river fed by perennial and intermittent groundwater discharge





ARID WETLAND ECOSYSTEM
dependent upon deep groundwater flow system, sometimes with only fossil groundwater



COASTAL LAGOON ECOSYSTEM
dependent upon slightly brackish water generated by mixing of fresh groundwater and limited sea water incursion

Groundwater Ecosystem Linkages and Dependencies

Groundwater systems are in many areas **critical to river and stream baseflow.** Furthermore many important **aquatic ecosystems depend upon groundwater discharge** (eg. the Nech Sar of Ethiopia). This aspect of 'groundwater service provision' is just beginning to be appreciated – the **'water-for-nature'** factor.

Conversely, some surface-water ecosystems (eg. the Okavango Swamps in Botswana) are **naturally groundwater recharging**, as a result of local geological structure, and can be equally critical to groundwater system 'health'– the **'nature-for-water'** factor. However, they also rely upon the maintenance of very shallow groundwater levels for phreatic plants, and inadequately-controlled groundwater use can also cause ecosystem degradation. Balanced approaches to development and conservation are urgently needed in this regard.

Soil compaction and/or soil erosion can lead to reduced rates of infiltration to groundwater, both reducing (environmentally and socially) important spring-flow and baseflow to smaller rivers, and discharge to vegetation in 'valley-bottom lands'. There is a need to halt such processes, and to find ways of enhancing groundwater recharge through agricultural land management and small-scale engineering measures.

WHAT SHOULD BASIN ORGANISATIONS BE DOING ON GROUNDWATER ?

Basin Organisation Scale and Mandate

The existing basin organisations of the African landmass **vary widely in geographical scale and political mandate**. The range is well illustrated by comparing :

- the Kenya Water Resources Management Authority–Tana Basin Office or Tanzania Ministry of Water–Wami Rivu Basin Office, whose catchment areas are in the order of 100,000 km^2 and population less than 5 million,
- the Niger Basin Authority, with a catchment area of about 2,000,000 km^2 across 9 countries and a population in excess of 100 million.

When at the **sub-national level**, basin organisation staff can undertake most of the groundwater management and protection responsibilities embodied in a national ministry or department on a subordinate decentralised basis. At the other end-of-the-scale, large **transnational basin organisations** are mandated by participating national governments to perform specific coordinating and advisory functions, but at the same time their staff need to have a clear overview of how these same groundwater responsibilities are being managed nationally and locally.

Groundwater — the Essential Role for Government

Broad international consensus now exists that the **primary government function** must be to act on behalf of civil society as 'custodian', 'guardian' or 'trustee' of natural resources like groundwater – and that the related legislation should be flexible, enabling and enforceable. The essential role of government is thus best defined in terms of certain fundamental concepts, responsibilities and powers, which many countries have already embodied in their legislative framework, with the detail being handled as and where appropriate through associated regulations and implementation plans. However, the institutional capacity required for implementation is still all too often lacking, because of serious lack of well-trained staff, inadequate budgets and insufficient attention to priority setting.

GROUNDWATER RESOURCES — SUMMARY OF KEY GOVERNMENT ROLES

FUNCTIONS	MAIN COMPONENTS
Catchment/Aquifer Level Resource Planning and Allocation	• establishing sensible boundaries for groundwater management • translating national plans to the appropriate territorial level • providing a unified vision of groundwater and surface water resources
Land Surface Zoning for Groundwater Conservation and/or Protection	• making provision for declaration of 'special control areas' (critical in resource terms or especially vulnerable in pollution terms) where exceptional measures to avoid degradation can be implemented
Facilitating Stakeholder Participation and Engagement	• since active involvement of groundwater users and potential polluters, and other interest groups, will be necessary to promote balanced management on-the-ground with enforceable regulations
Administration of Groundwater Use	• according to an over-arching allocation plan (including waterwell drilling/construction activity, waterwell registers and abstraction rights/permits/charges (together with sanctions for non-compliance)
Licensing of Wastewater and Waste Discharge to the Ground	• subject to conditions that prevent or limit groundwater pollution (with effective sanctions for non-compliance)
Groundwater Monitoring and Information Provision	• ensuring appropriate standards for monitoring (aquifer water-levels, groundwater use and quality) with periodic status evaluation • arranging open exchange of data and provision of information

Groundwater is essentially a 'local resource' (when it comes to use and protection), and to be effective its **day-to-day management has to take place close to its users and potential polluters**, but within a sub-basin or aquifer, national and (where appropriate) international basin framework. However, such decentralisation also poses concern as regards 'professional leadership' and 'critical mass' – and pragmatic compromises will often be necessary to get the organisational balance right. Moreover, local action to manage groundwater will also always require direction and **facilitation on a 'top-down basis'**, so as to provide an effective basis for management, empowerment to take necessary action and an 'overview capacity' to review progress towards agreed objectives.

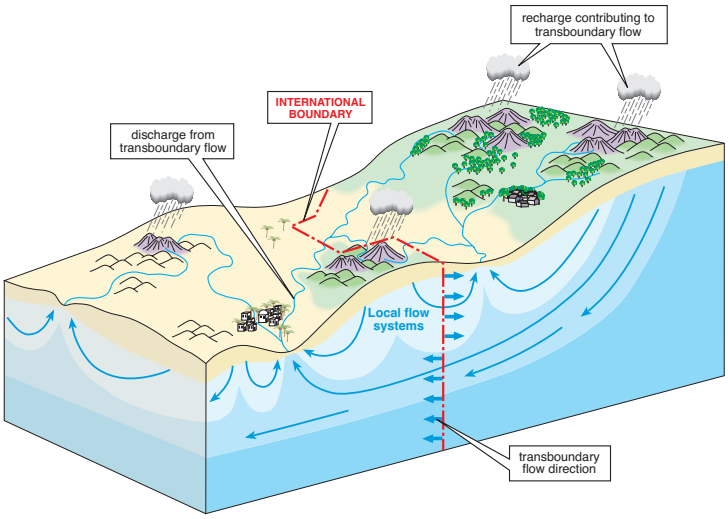
Transboundary Dimensions — the Benefits of Cooperation

Many basins and/or underlying aquifers extend over more than one country, and these present unique challenges. Historically, the **transboundary nature of flowing water has generally encouraged cooperation**, but there is the risk that with increasing scarcity there will be potential for discord. However, the 'UN Convention on the Law of Non-Navigational Uses of International Watercourses' as well as the 'UN Law of Transboundary Aquifers' provide guidance on how to address shared water resource issues in harmony.

As regards groundwater, transnational basin organisations will need to pay careful attention to :

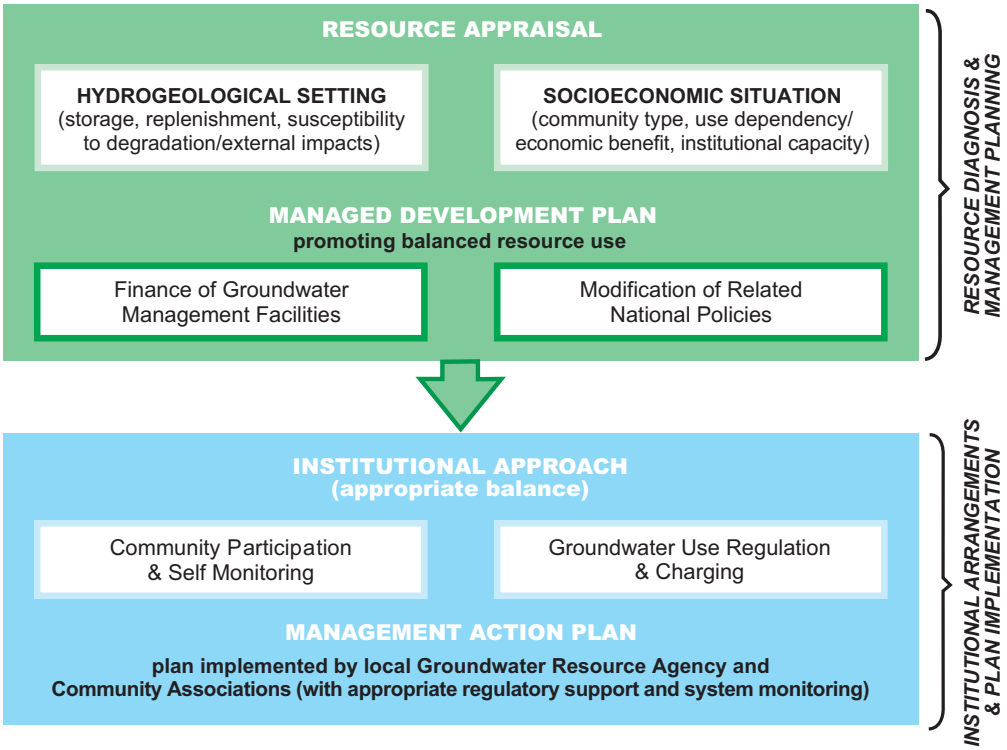
- **land conservation and pollution prevention** in major recharge areas of basin-scale importance in replenishing aquifer systems
- **avoiding excessive groundwater abstraction** from those aquifers (a) providing an important contribution to the baseflow of international rivers and (b) underlying international boundaries directly.

GROUNDWATER FLOW ACROSS INTERNATIONAL BOUNDARIES — AN ILLUSTRATION



This whilst concomitantly stimulating dialogue, fostering cooperation and providing leadership on approaches to key groundwater development issues that the riparian nations have in common.

PROMOTING MANAGED GROUNDWATER USE — A PRAGMATIC FRAMEWORK



The Pressing Need for Leadership

The emerging developmental agenda will require much greater emphasis on **strategic assessment and investment planning for groundwater resources, as a platform for managed groundwater development**. It will be necessary to achieve a sensible (and in some cases delicate) balance between:

- **promoting** (or providing an enabling framework for) much needed groundwater development
- **regulating** groundwater abstraction and potentially-polluting activities to avoid resource degradation in critical areas
- **integrating** groundwater assessment, development and recharge enhancement programmes with land-use and river basin management.

Moreover, the integration of groundwater into national and regional policy, such that the resource can make an appropriate, effective and sustainable contribution to economic development plans (relating to food security, urban services and rural livelihoods) requires developing an **adequate cross-sector dialogue**. The promotion of this **IWRM process** can make political awareness of groundwater at the highest level essential.

Africa does not yet widely experience the 'classical problems' associated with excessive groundwater development, other than on a local basis in the more arid areas. But **leadership by basin organisations** in respect of managed development of groundwater resources will contribute greatly to improving human welfare and economic development – and this will require **basin organisations to promote action on :**

- focusing on and overviewing priority groundwater issues
- providing reference frameworks for managed groundwater development
- stimulating best practice in groundwater protection
- harmonising land management with the need to 'harvest' groundwater.

In this context their professional staff will require supplementary training through an intensive short course (see box).

GROUNDWATER MANAGEMENT TRAINING
Needs of River Basin Organisation Staff

The specific training needs of professional staff in African River Basin Organisations have already been assessed through an ANBO Consultation Meeting hosted by the VBA in Ouagadougou (Feb 2013), which was organised by BGR-Germany and IGRAC-The Netherlands, and supported by GWP, following a preparatory meeting at UNESCO-IHE in Delft (Dec 2012). These meetings were made possible through the facilitation of the following projects :

- the EU-SPLASH/BMZ-Germany Project on ANBO Development, implemented by BGR-Germany & GEUS-Denmark
- the EU-SITWA Programme of ANBO, coordinated by GWP.

The outcome of this coordinated effort has been the preparation of a pilot version of a UNDP-CAPNET/AGW-Net Manual of a modular intensive Groundwater Management Training Course of 3-5 day duration, whose preparation was led by IGRAC/IHE (drawing heavily on GW-MATE knowledge products), in cooperation with UNDP-CAPNET/AGW-Net, BGR & IWMI. Course presentation to individual African River Basin Organisations is now planned on demand, subject to agreement on venue and other organisational costs.

FURTHER READING

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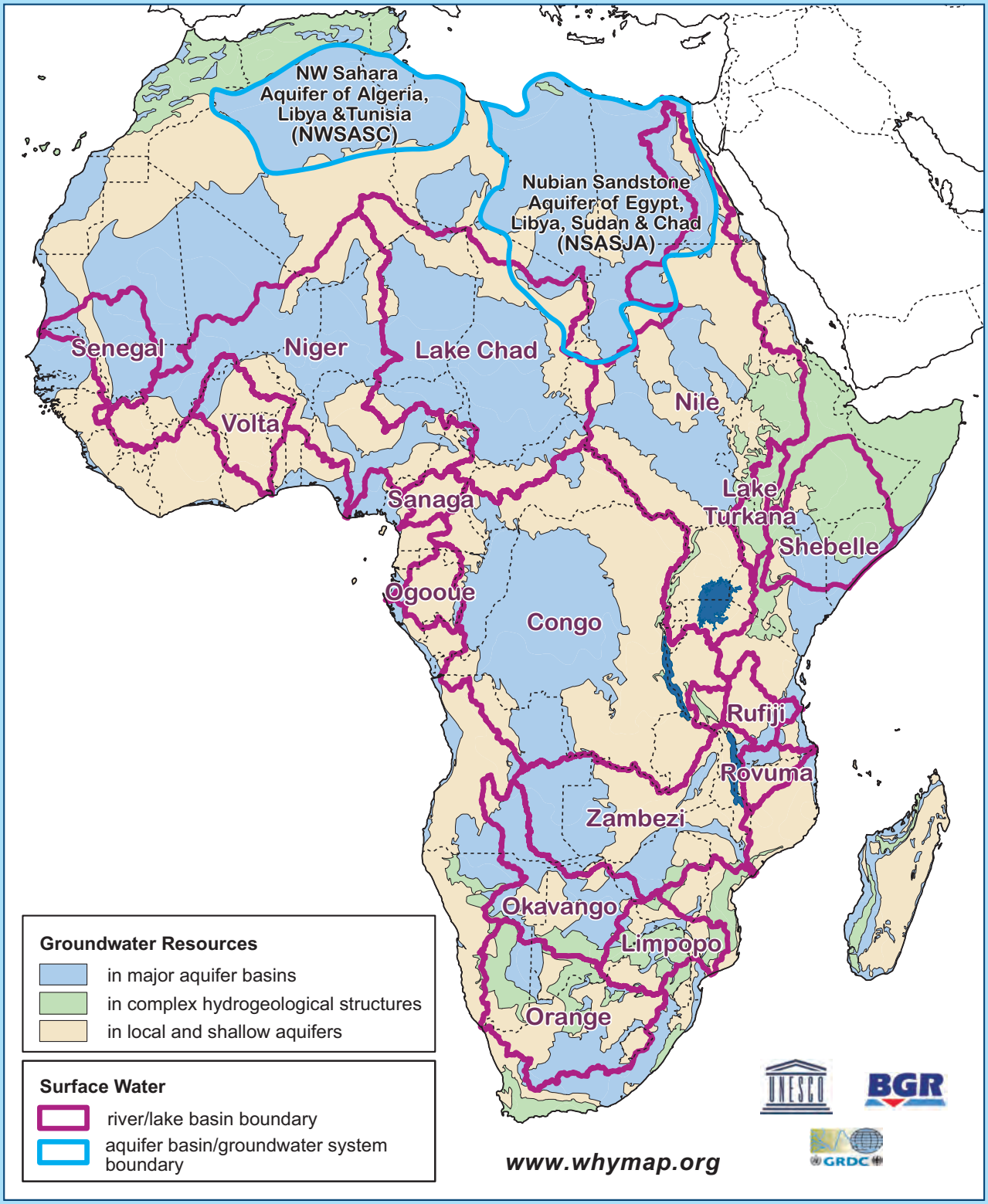
RIVER AND GROUNDWATER BASINS OF AFRICA



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BGR (Germany) **UN - IGRAC (The Netherlands)**

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