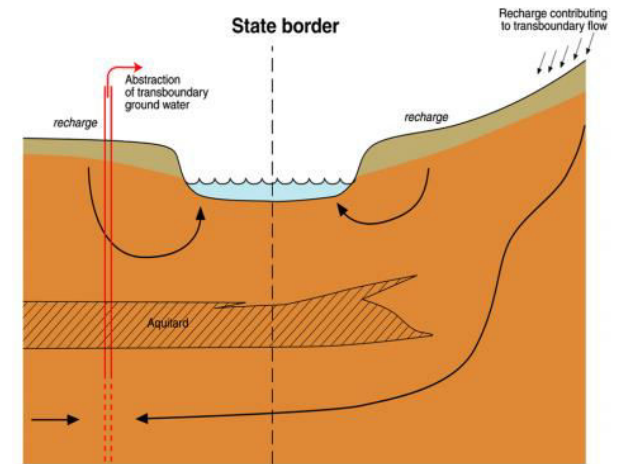
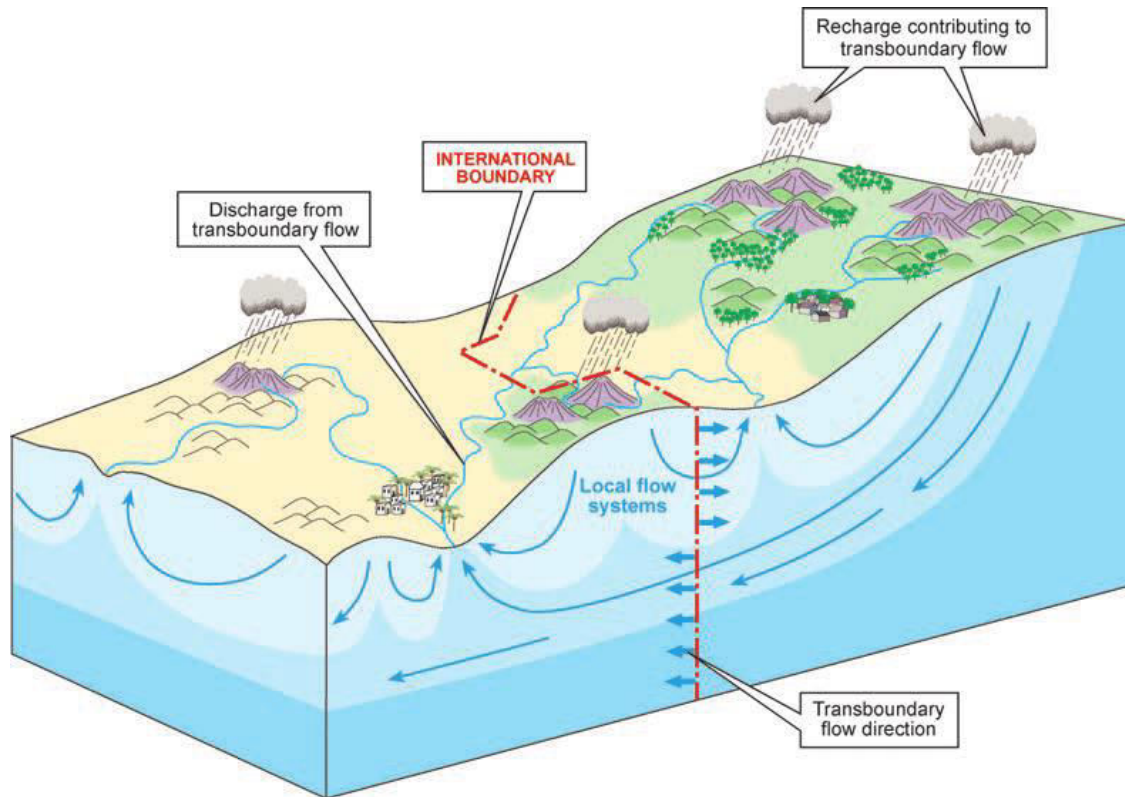


Transboundary Aquifers

Christina Fraser, IGRAC

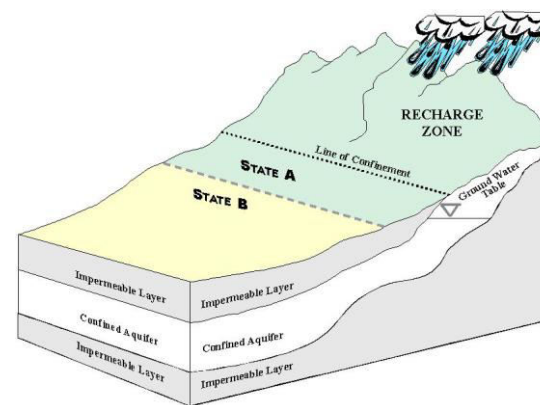
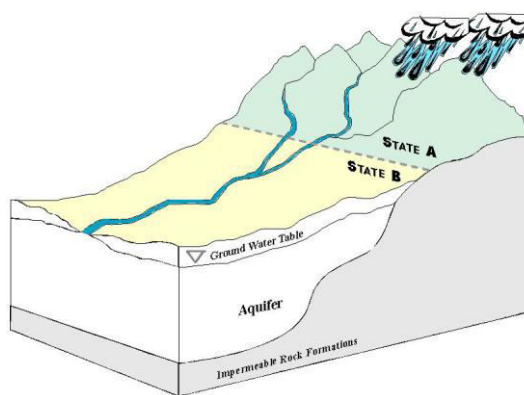
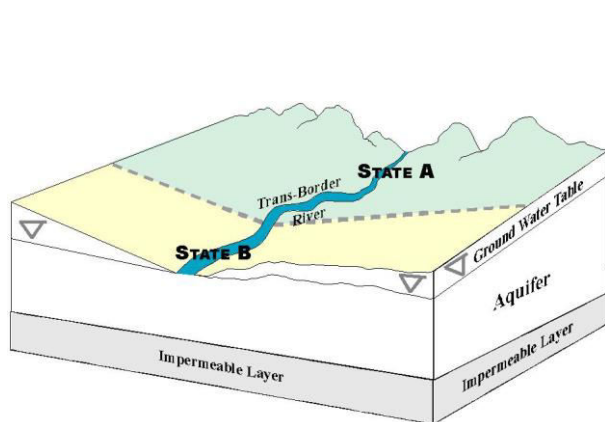
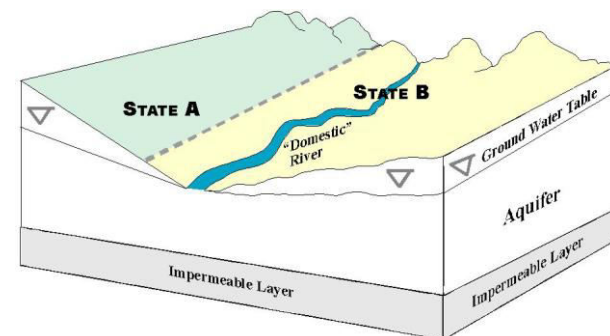
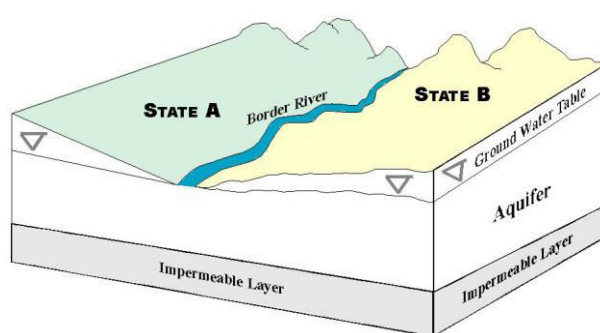
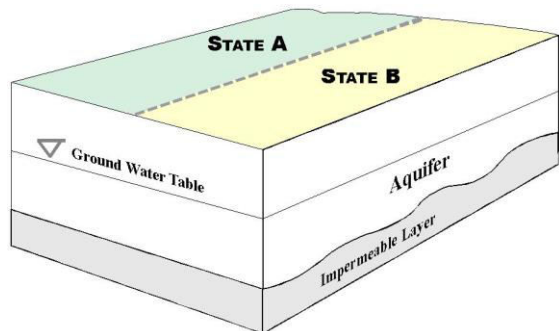
What is a transboundary aquifer?

Definition: An aquifer of aquifer system, part of which are situated in different states (UN International Law Commission)



(Puri and Naser, 2003)

Types of transboundary aquifer



(Eckstein and Eckstein, 2005)

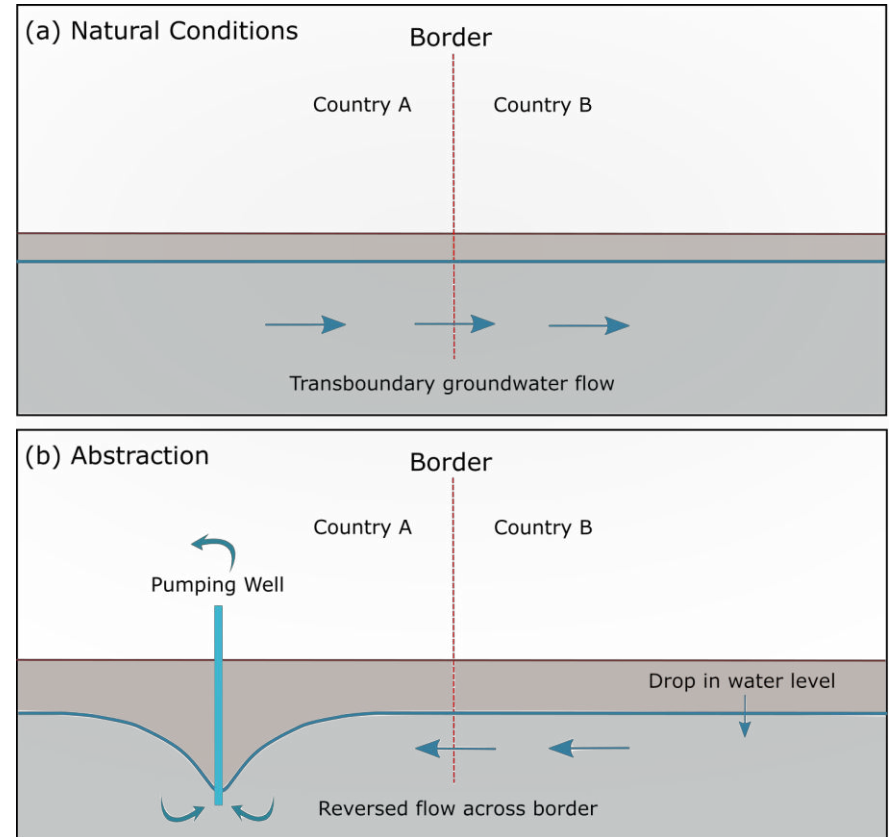
Why is it important to understand and manage transboundary aquifers?

In transboundary aquifers, the actions on one side of the border can have impacts for the other side

Impacts can include:

- A reduction in groundwater levels
- The changes of groundwater flow patterns
- Contamination of groundwater
- Reduction of surface water systems connected to the aquifer

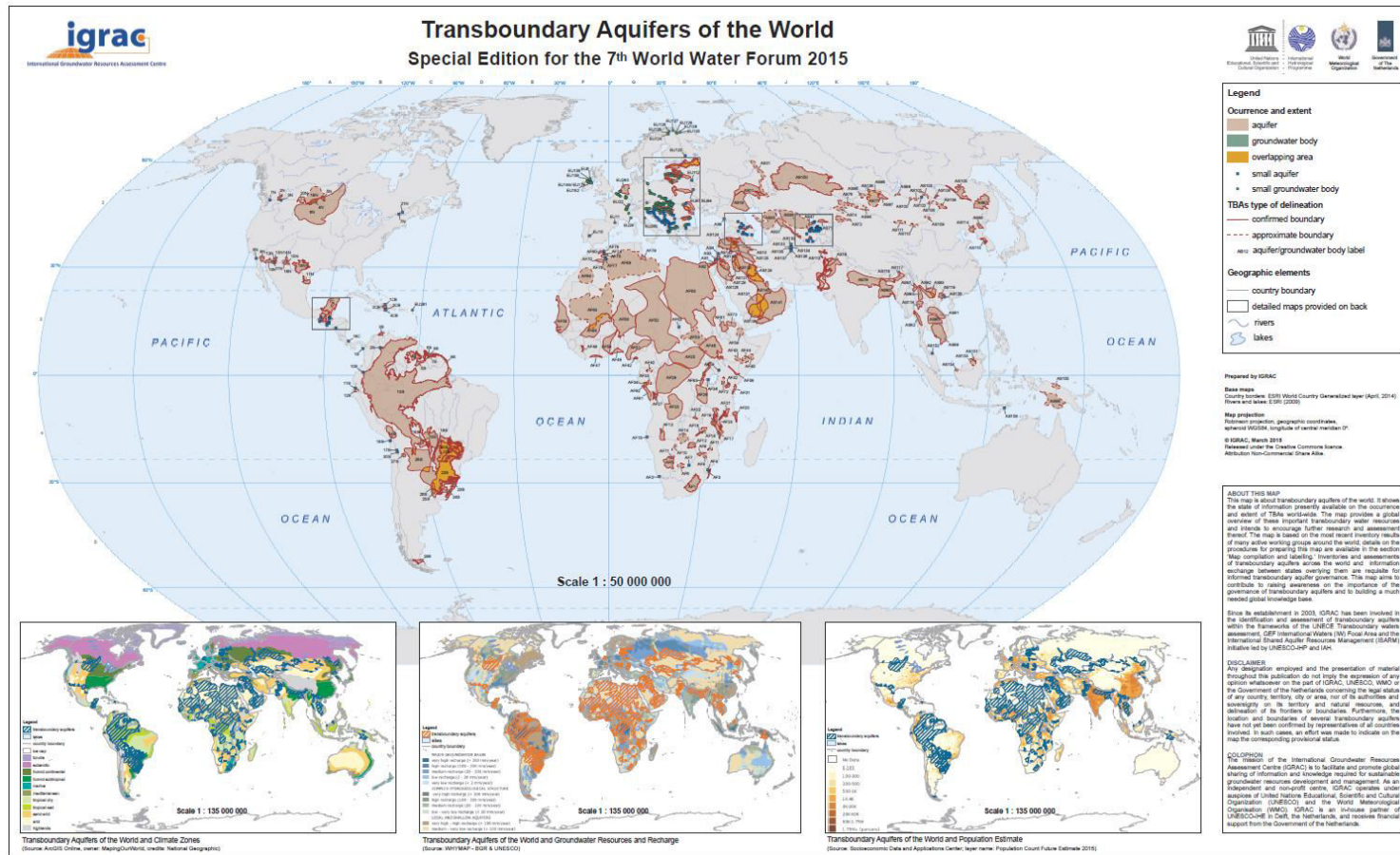
This can lead to tension and conflict



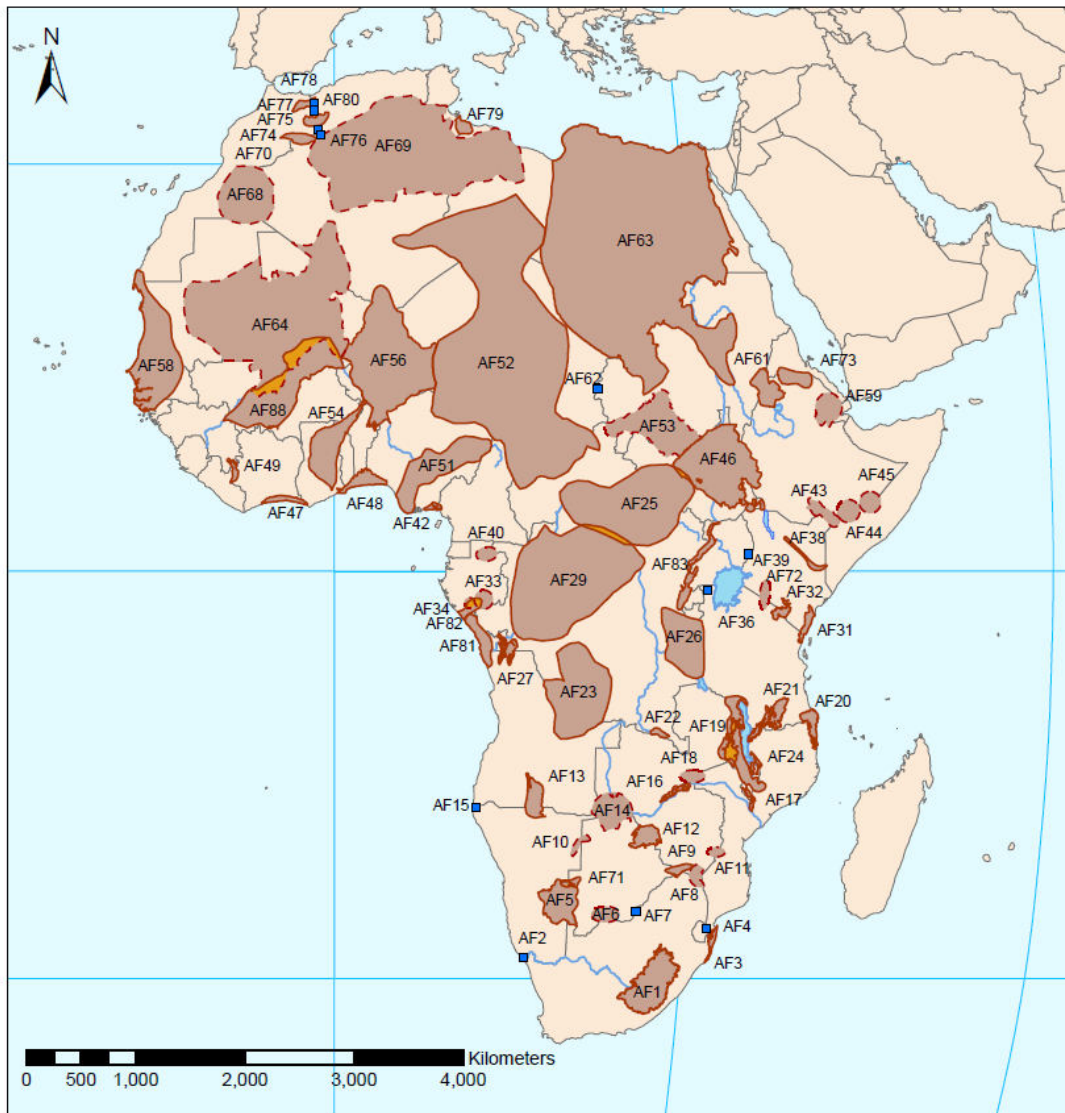
Global Understanding

366 transboundary aquifers **currently identified** globally

226 Groundwater Bodies under the EU Water Framework Directive



IGRAC and UNESCO-IHP, 2015



TBAs in Africa

72 mapped in Africa

Identified from a variety of initiatives



Global assessment of transboundary water, using indicators at a national level. Aquifer briefs developed

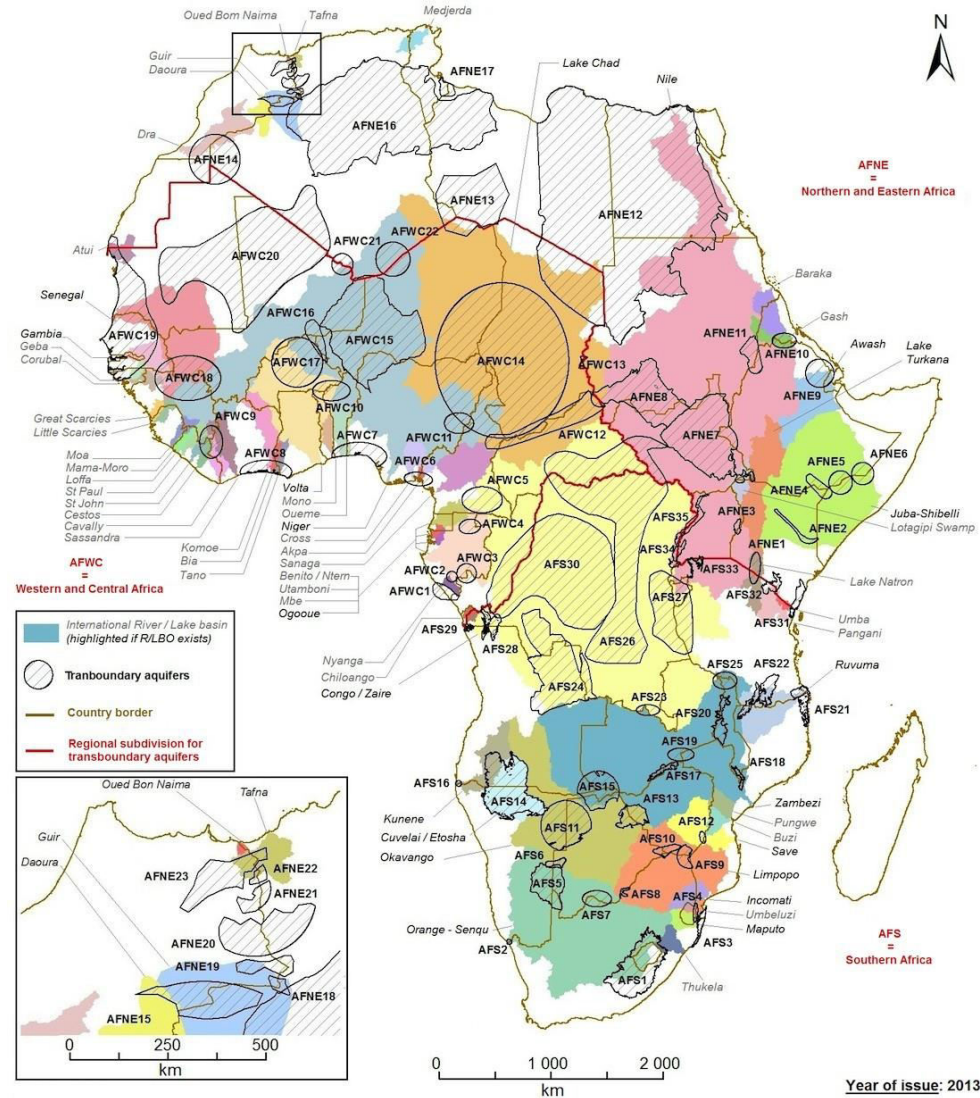
IGRAC and UNESCO-IHP, 2015

Transboundary Aquifers in Lake and River Basins

Map – Transboundary aquifers and aquifer systems superimposed on 63 international river basins across Africa

Insights – Transboundary aquifers represent approximately 42% of the continental area and 30% of the population

Some transboundary aquifers lie completely within L/RBOs...
But some don't!

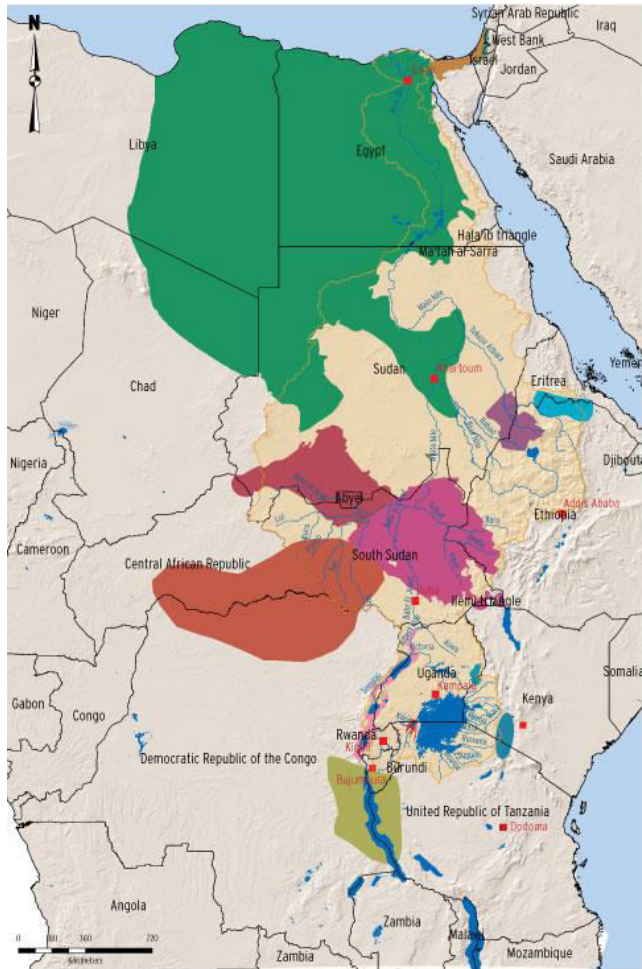


Nile River Basin

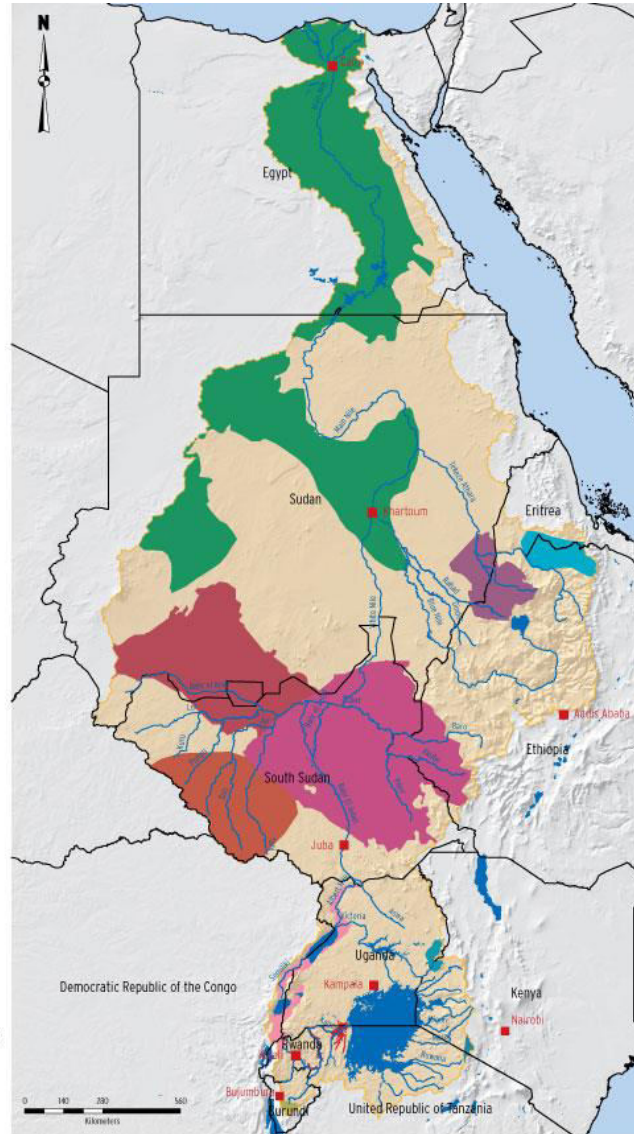
12 TBAs within the Nile River Basin

A range of hydrogeology, sizes, uses etc.

Domestic groundwater – Connected to the Nile River

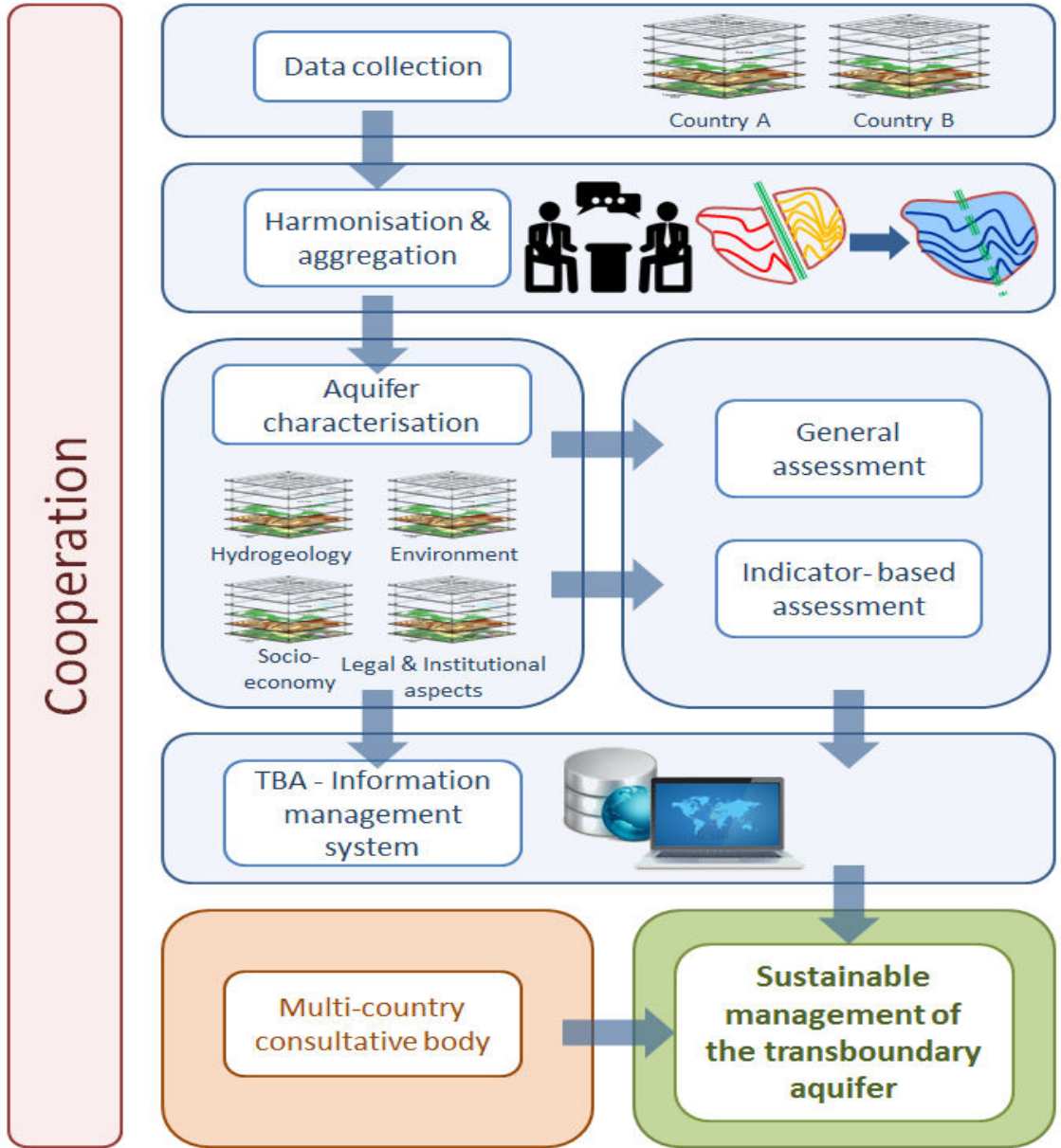
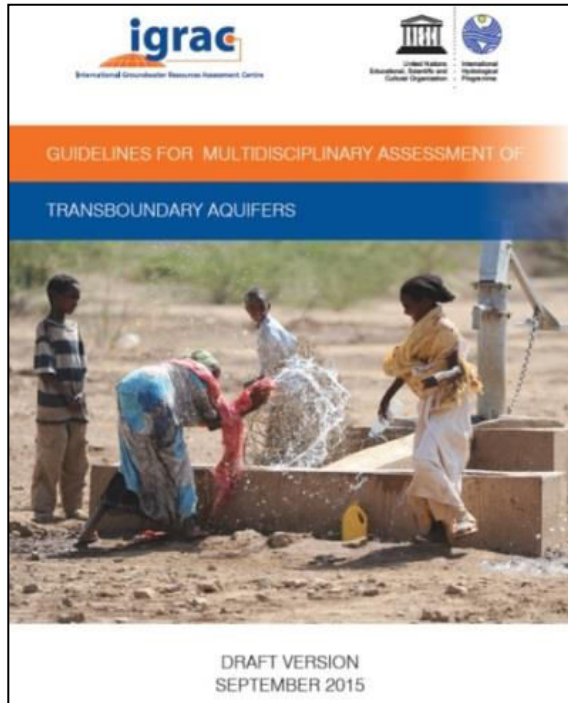


NBI Water Resource Atlas, 2017



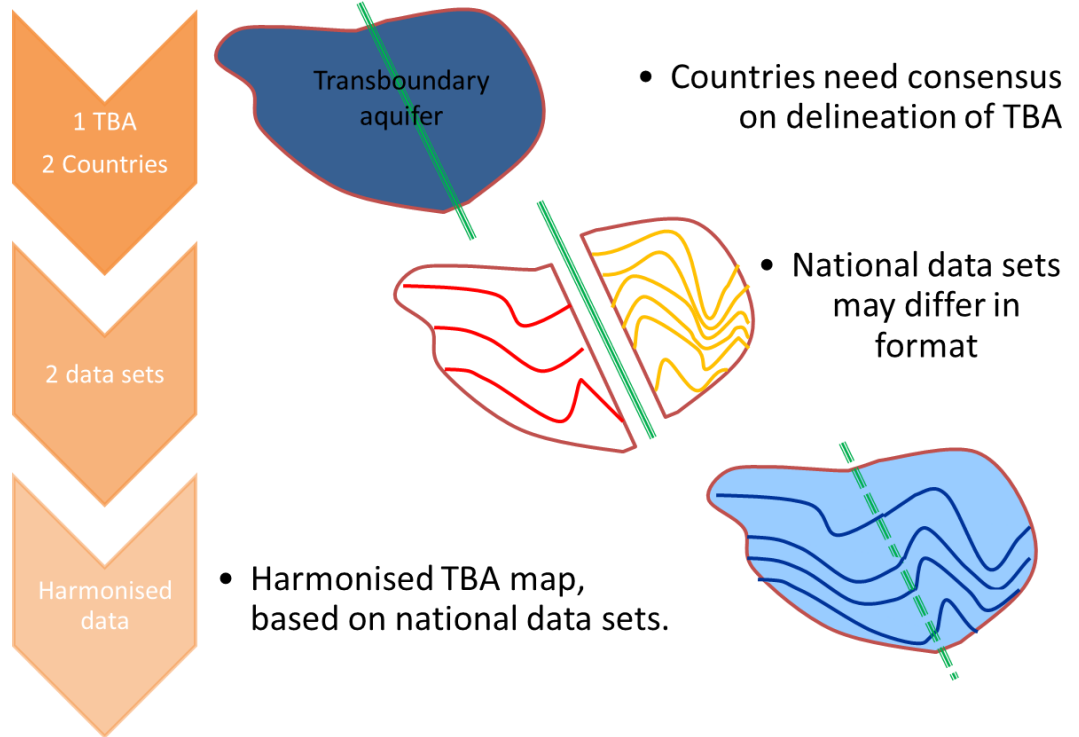
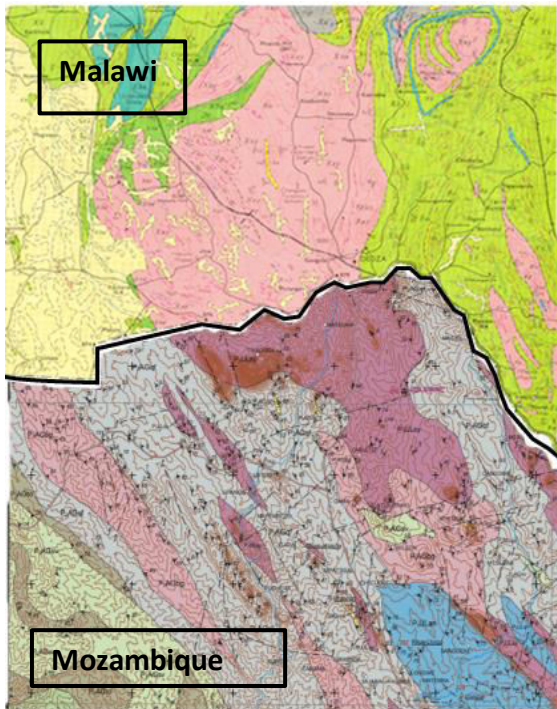
The NBI is not an authority on international boundaries.

TBA Assessment Methodology



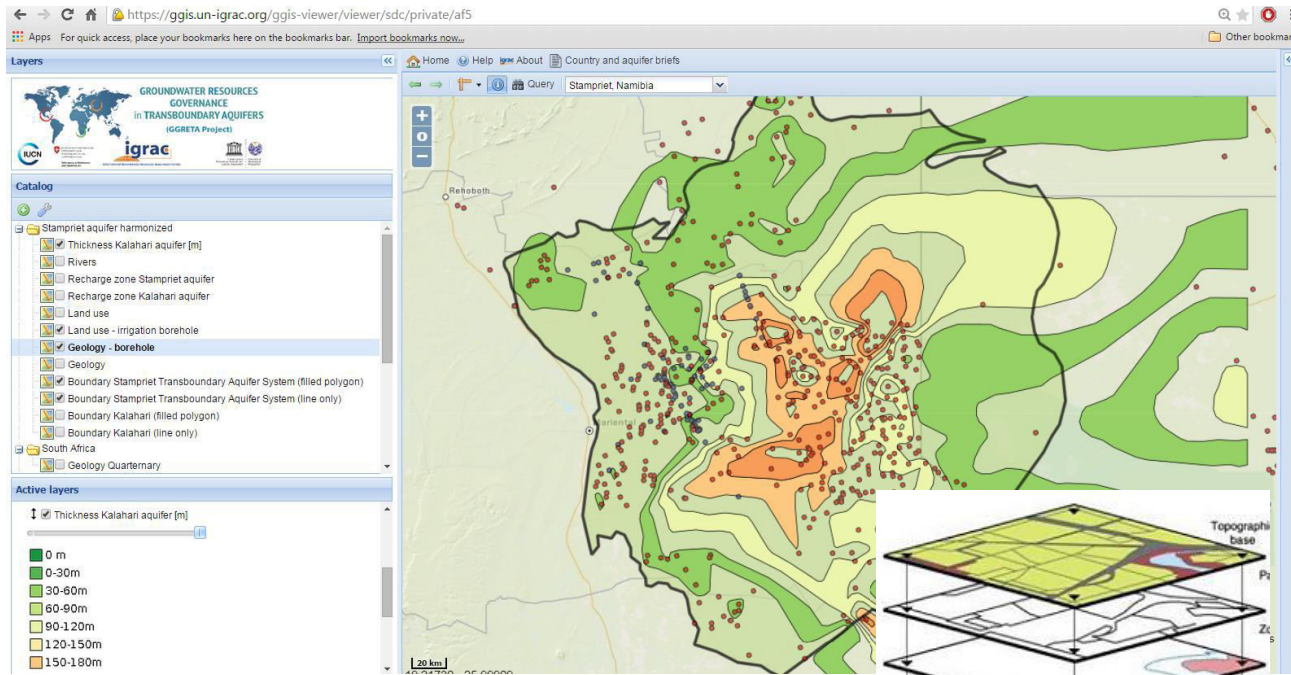
Transboundary Aquifer Assessment

Transboundary aquifer assessment must include not only hydrogeological aspects. Environmental, social-economic and governance parameters are also important



Data harmonization: IGRAC and UNESCO-IHP, 2015

Data Sharing/Management



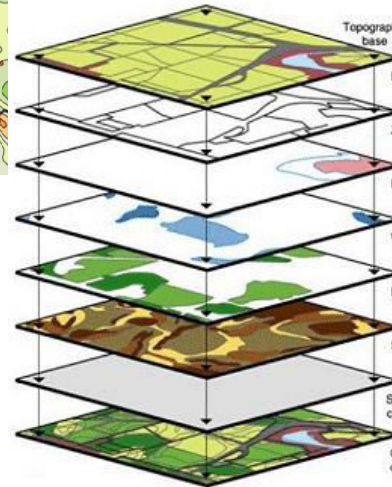
Data management: IGRAC and UNESCO-IHP, 2015

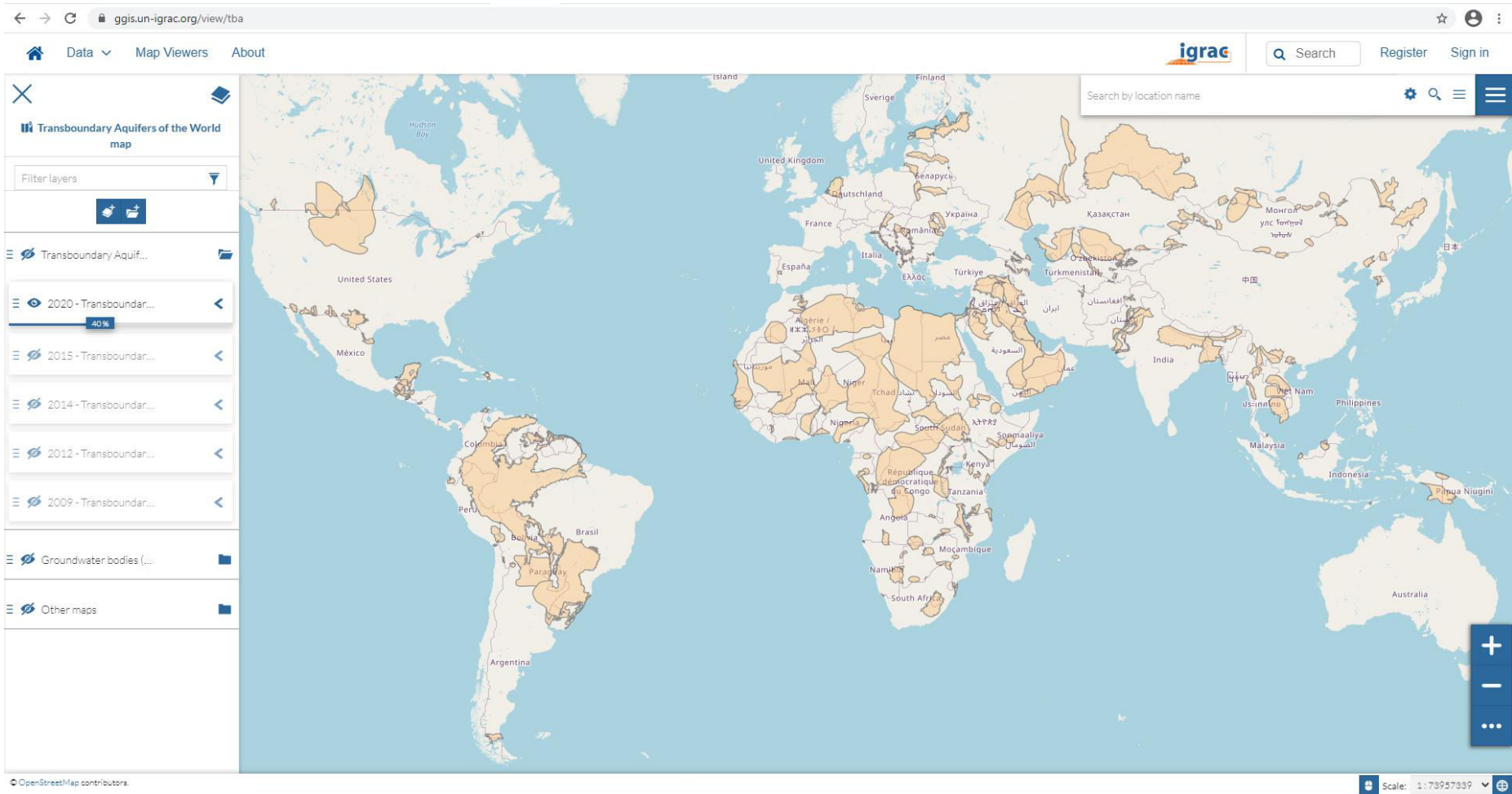
Information
Management System
(IMS)

Web-based

Open access/private

Ownership





Global Groundwater Information System (GGIS)

<https://ggis.un-igrac.org/>



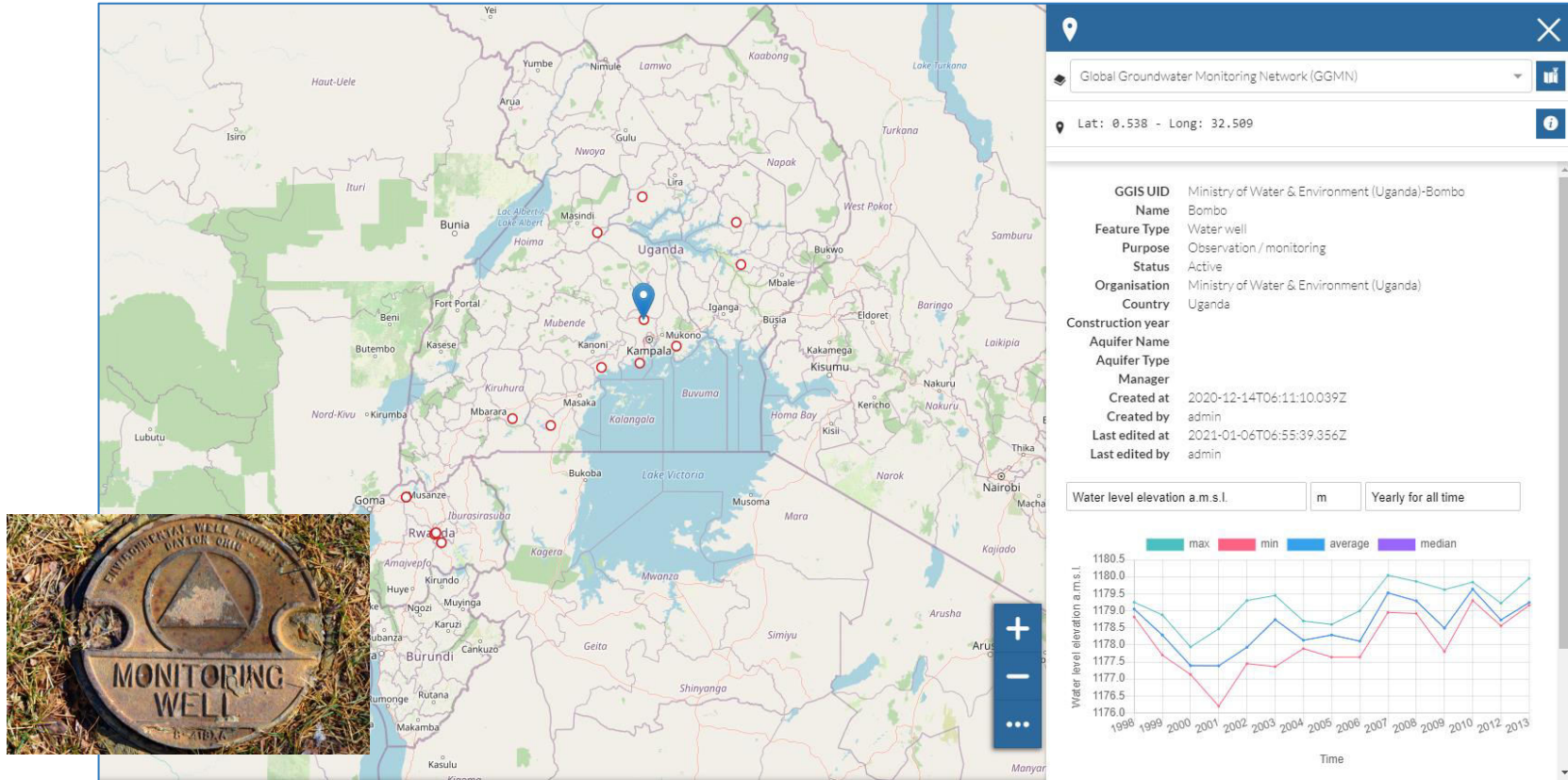
Online Course on Groundwater Management
in African Lake and River Basin Organizations



GGRETA
GOVERNANCE OF GROUNDWATER
RESOURCES IN TRANSBOUNDARY AQUIFERS

Monitoring

Essential to understand groundwater changes



Global Groundwater Monitoring Network (GGMN) - <https://ggis.un-igrac.org/view/ggmn>

Cooperation

Governance and institutional capacity is key

Sustainable development Goal 6.5 - By 2030, implement integrated water resources management at all levels, including through **transboundary cooperation** as appropriate

Insufficient knowledge on groundwater systems in order to make operational arrangements for transboundary cooperation

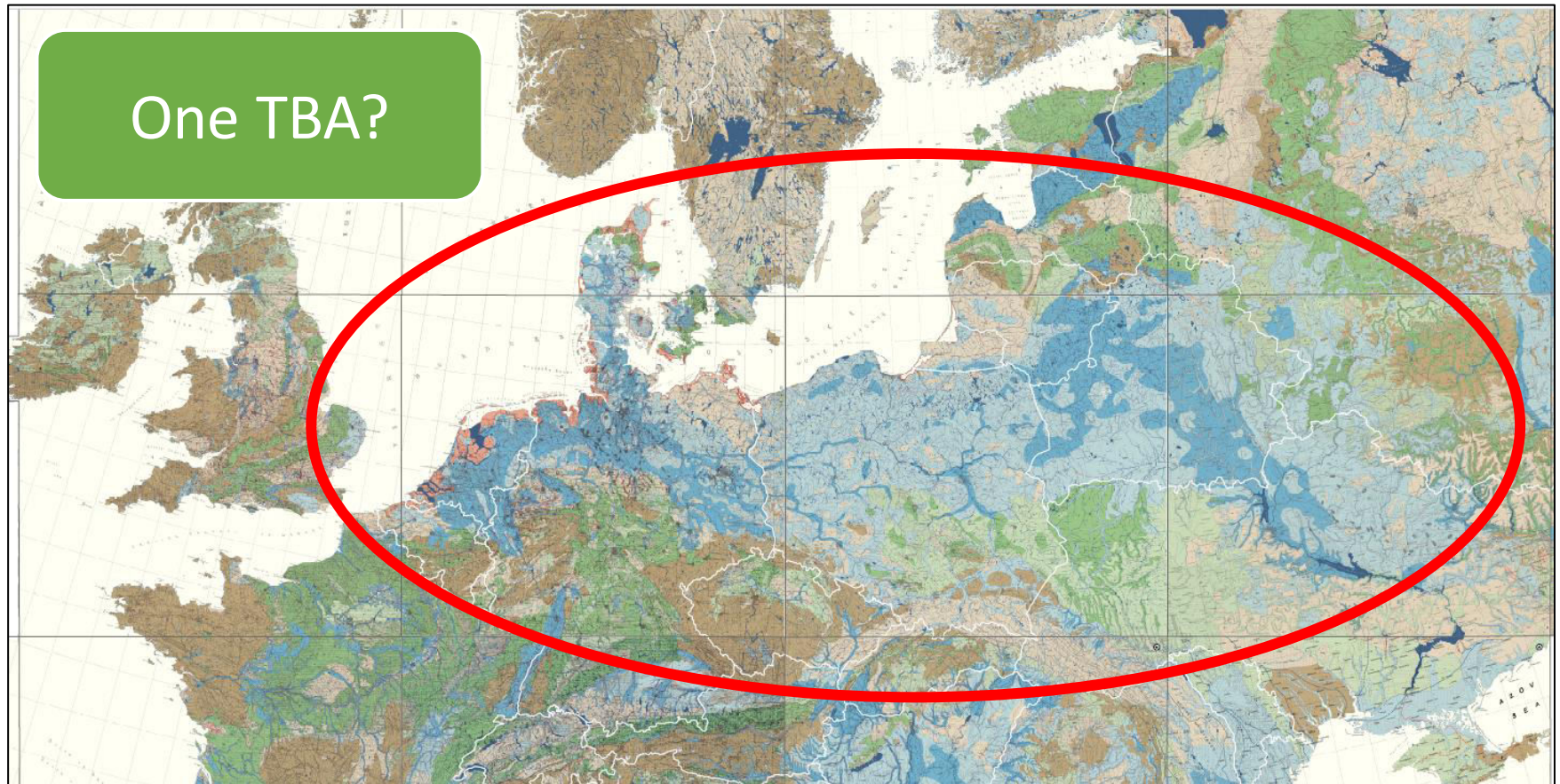


UN Water, 2020

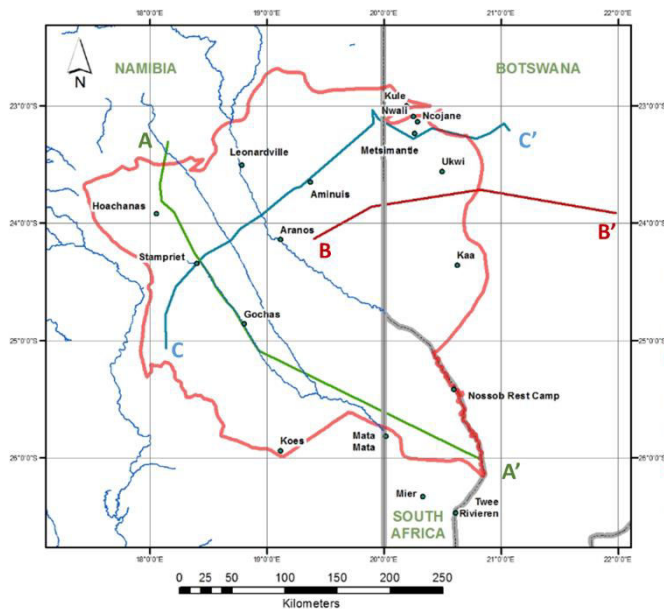
Legal Mechanisms

	Focusing on groundwater or surface water?	Regional scope	Comment
UN Convention on the Law of the Non-Navigational Uses of International Watercourses	Surface water and groundwater hydraulically connected to surface water	Global	Fossil aquifers do not fall under its scope
Convention on the Protection and Use of Transboundary Watercourses and Lakes	Both	Originally Europe, now global	Supported by Model provisions for TBAs
UN Draft Articles on Transboundary Aquifers	Groundwater	Global	Annexed to a UN General Assembly Resolution 63/124
SADC Revised Protocol on Shared Watercourses	Surface water and groundwater hydraulically connected to surface water	SADC	Good example of regional protocol

An issue of scale...



How to define transboundary impact zones?



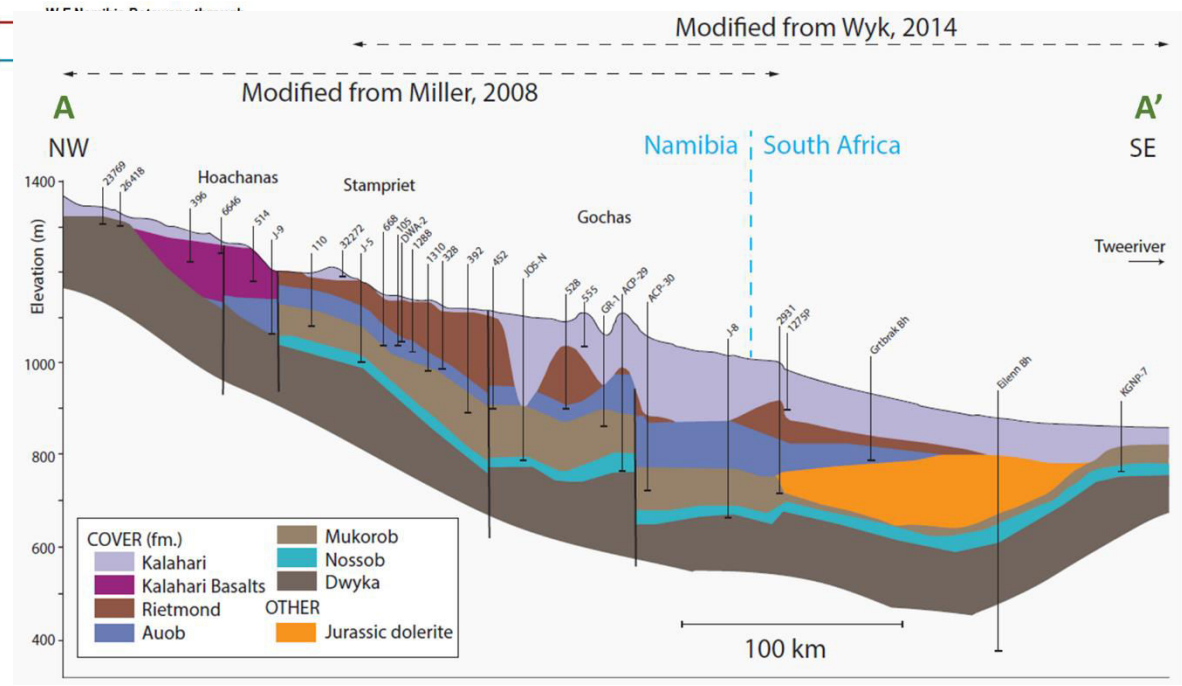
Stampriet Transboundary Aquifer System
Location of the cross-sections

- Legend**
- Villages and settlements
 - Rivers
 - STAS Boundary
 - National Boundaries
- Cross-sections:**
- NW-SE Namibia-South Africa
 - NW-SE Namibia-South Africa
 - NW-SE Namibia-South Africa

How to define transboundary management zones?

Regional aquifers (Auob and NOssob) are shown in blue colours, discontinuous Kalahari aquifer in purple.

Source: JICA, 2002; Van Wyk, 1987 in GGRETA Stampriet Report Vierien 2017.



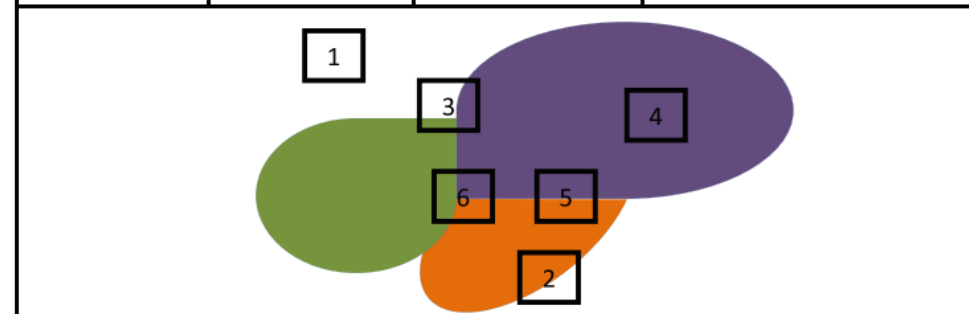
Management within L/RBOs

Transboundary aquifers are a vital component of lake and river basins across Africa

However, L/RBOs are limited by:

- Poor human capacity
- A lack of financing and authority
- Spatial distribution of TBAs vs L/RBOs

Geographical type	Intersection of TBA with R/LB	Number of cases in Africa (number of cases with intersection with R/LBO)	Example of TBA with no R/LBO
1	None	3	Ain Beni Mathar (AFNE 20)
2	TBA partly inside a single R/LB	20 (13)	Coastal Sedimentary Basin 1 (AFS 31)
3	TBA partly inside two or more R/LBs	12 (7)	Tano Basin (AFWC 8)
4	TBA fully inside a single R/LB	23 (22)	Figuig (AFNE18)
5	TBA fully inside two R/LBs	18 (17)	Errachidia Basin (AFNE 15)
6	TBA fully inside three or more R/LBs	4 (3)	AFWC9 ^a



What about TBAs that don't fit the criteria?

e.g., Fossil transboundary aquifers, not connected to surface waters?

e.g., TBAs that sit outside L/RBO boundaries?

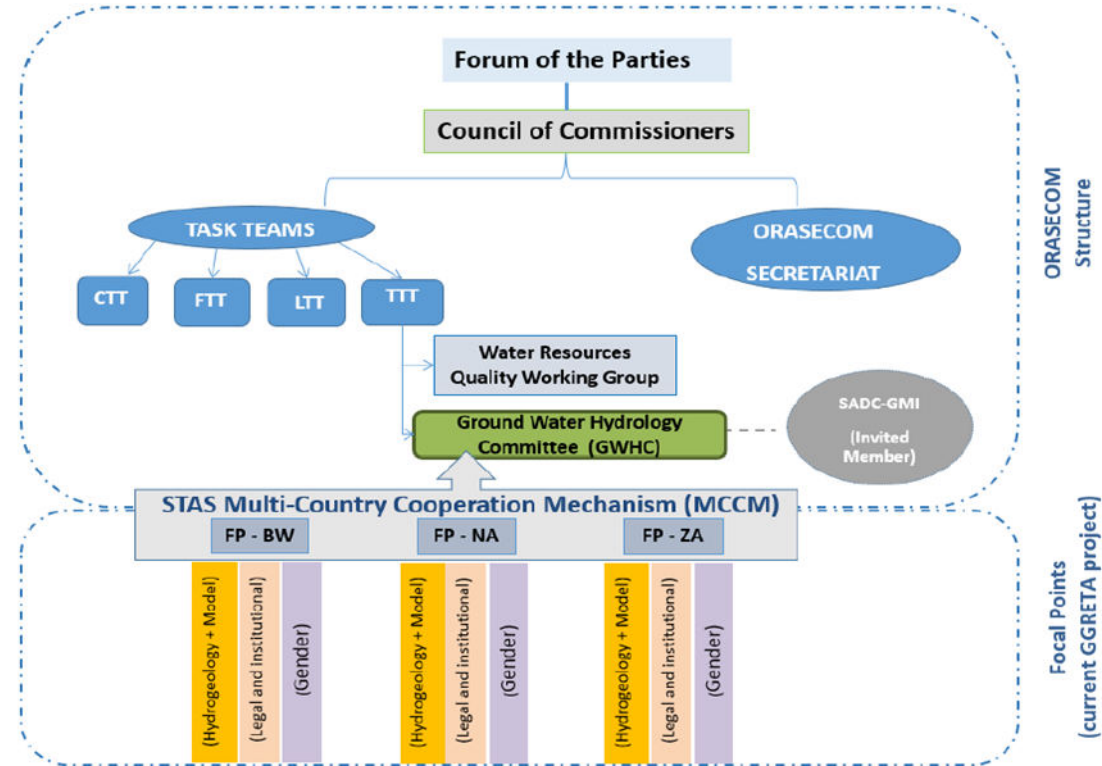
Example of TBA management nested within L/RBOs

The Stampriet Transboundary Aquifer System (STAS) lies entirely within the Orange-Senqu River Basin, in an area shared by Botswana, South Africa and Namibia

The countries sharing the STAS agreed to establish a Multi-Country Cooperation Mechanism (MCCM) for the joint governance and management of the aquifer, nested in the structure of ORASECOM

The MCCM currently supports groundwater data collection and exchange between the countries sharing the STAS

Long term goal – to achieve permanent institutionalized cooperation the region



Some considerations to reflect on...

- ◁ We still don't know everything about transboundary aquifers!
- ◁ Transboundary aquifer assessment is essential for progress. This then needs to be supported by monitoring and data sharing
- ◁ L/RBOs could take the lead in transboundary aquifer assessment and management across Africa – in some circumstances!
- ◁ Already good examples of TBA cooperation through L/RBOs
- ◁ Take advantage of the current momentum around transboundary aquifer cooperation from SDG 6.5.2 – TBA management is raising the profile of neglected local/national groundwater management

Useful Resources

- Altchenko, Y. & Villholth, K.G., 2013. Transboundary aquifer mapping and management in Africa: a harmonised approach. *Hydrogeology Journal*, 21(7), pp.1497–1517
- Burchi, S. 2018. Legal frameworks for the governance of international transboundary aquifers: Pre- and post-ISARM experience. *Journal of Hydrology: Regional Studies* 20. 15-20.
- Davies, J., Robins, N., Farr, J., Sorensen, J., Beetlestone, P., Cobbing, J. 2013. Identifying transboundary aquifers in need of international resource management in the Southern African Development Community region. *Hydrogeology Journal*. Vol 21(2), pp.321-330. DOI 10.1007/s10040-012-0903-x
- Eckstein, G and Eckstein, Y. 2005. Transboundary Aquifers: Conceptual Models for Development of International Law. *Ground Water* 43(5):679-90. DOI: 10.1111/j.1745-6584.2005.00098.x
- Fraser, C.M., Kalin, R.M., Rivett, M.O., Nkhata, M., Kanjaye, M. 2018. A national approach to systematic transboundary aquifer assessment and conceptualisation at relevant scales: A Malawi case study. *Journal of Hydrology: Regional Studies*. Special Issue on International Shared Aquifer Resources Assessment and Management. Vol 20. Pages 35-48.
- IGRAC and UNESCO-IHP. 2015a. Guidelines for Multi-Disciplinary Assessment of Transboundary Aquifers - Draft version. IGRAC Publications, Delft, Netherlands
- IGRAC and UNESCO-IHP. 2015b. Transboundary Aquifers of the World [map]. Edition 2015. Scale 1: 50 000 000. IGRAC Publications, Delft, Netherlands
- IWMI. 2015. Thinking inside the basin: scale in transboundary water management. Colombo, Sri Lanka: International Water Management Institute. 8p. Water Policy Brief 39. doi: 10.5337/2015.222
- Nijsten, G-J., Christelic, G., Villholth, K.G., Braune, E., Becaye Gaye, C. 2018. Transboundary aquifers of Africa: Review of the current state of knowledge and progress towards sustainable development and management. *Journal of Hydrology: Regional Studies*. Volume 20, December 2018, Pages 21-34. <https://doi.org/10.1016/j.ejrh.2018.03.004>
- Puri, S. and El Naser, H. 2003. Intensive Use of Groundwater in Transboundary Aquifers. Chapter 20, in *Intensive Use of Groundwater*, ed. R. Llamas and E. Custodio, 415–438. Lisse, The Netherlands: Balkema Publishers Available at SSRN: <https://ssrn.com/abstract=2780917> or <http://dx.doi.org/10.2139/ssrn.2780917>
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Thank you for your attention



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Delft, The Netherlands



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