Groundwater data collection and sharing

- Opportunities for Lake and River Basin Organisations in Africa -

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Why L/RBOs need to know about groundwater?

• There are interactions between groundwater and surface water.
  
  ![Diagram of gaining, losing, disconnected, and throughflow streams](image)

• Surface water resources must be managed in conjunction with groundwater resources (IWRM), in particular in a context of climate change.
  
  Examples: construction of dams, planning of irrigation, protection of ecosystems

• L/RBOs can be instrumental in developing cooperation mechanisms between member states over transboundary aquifers (TBAs).
  
  Example: the Stampriet Transboundary Aquifer System and ORASECOM
What L/RBOs need to know?

A. Physiography and climate
   A.1. Temperature*
   A.2. Precipitation*
   A.3. Evapotranspiration
   A.4. Land use*
      A.4.1. Groundwater-fed agricultural land
      A.4.2. Groundwater-irrigated land
      A.4.3. Groundwater-supported wetlands and ecosystems
      A.4.4. Areas with land subsidence
   A.5. Topography: elevation data*
   A.6. Surface water network (rivers, lakes, swamps, reservoirs, canals, etc.)

B. Aquifer geometry
   B.1. Hydrogeological map
   B.2. Geo-referenced boundary of the Transboundary Aquifer
   B.3. Depth of water table/piezometric surface
   B.4. Depth to top of aquifer formation
   B.5. Vertical thickness of the aquifer
   B.6. Degree of confinement
   B.7. Aquifer's cross section

C. Hydrogeological characteristics
   C.1. Aquifer recharge
      C.1.1. Natural recharge
      C.1.2. Return flows from irrigation
      C.1.3. Managed aquifer recharge
      C.1.4. Induced recharge
      C.1.5. Extent of recharge zones
      C.1.6. Sources of recharge
   C.2. Aquifer lithology
   C.3. Soil types
   C.4. Porosity
   C.5. Transmissivity and vertical connectivity
   C.6. Total groundwater volume
   C.7. Groundwater depletion
   C.8. Natural discharge mechanism
   C.9. Discharge by springs

D. Environmental aspects
   D.1. Groundwater quality (suitability for human consumption)
   D.2. Groundwater pollution
   D.3. Solid waste and wastewater control
      D.3.1. Wastewater being collected in sewerage systems
      D.3.2. Wastewater treated
      D.3.3. Solid waste being stored in controlled fields
   D.4. Shallow groundwater table and groundwater-dependent ecosystems

E. Socio-economic aspects
   E.1. Population (total and density)*
   E.2. Groundwater use
      E.2.1. Total volume groundwater abstraction
      E.2.2. Groundwater abstraction for domestic use
      E.2.3. Groundwater abstraction for use in agriculture and livestock
      E.2.4. Groundwater abstraction for commercial and industrial use
   E.3. Surface water use*
      E.3.1. Total volume of surface water use
      E.3.2. Surface water for domestic use
   E.3.3. Surface water use for agriculture / livestock
   E.3.4. Surface water for commercial and industrial use
   E.4. Dependence of industry and agriculture on groundwater
   E.5. Percentage of population covered by public water supply
   E.6. Percentage of population covered by public sanitation

F. Legal and institutional aspects**
   F.1. Transboundary legal and institutional framework
   F.2. Domestic legal and institutional framework
      F.2.1. Ownership of groundwater
      F.2.2. Water resource planning
      F.2.3. Groundwater resource abstraction and use
      F.2.4. Abatement and control of groundwater pollution
      F.2.5. Other water resource protection measures
      F.2.6. Government and non-government water institutions
      F.2.7. Implementation, administration and enforcement of the legislation

* National or local data can be used; estimates are also available from global datasets.
** The legal and institutional aspects are assessed by questionnaires.
Two main sources of groundwater data

1) **Groundwater monitoring**

   Regular or continuous measurement of
   - Groundwater level
   - Groundwater quality
   - Groundwater abstraction

Examples of groundwater quality parameters:
- temperature
- EC / total dissolved solids (TDS)
- \( pH \)
- major ions
- microbiological quality
Two main sources of groundwater data

2) Borehole siting, drilling and testing
Recording relevant data from activities related to the construction of new boreholes, such as stratigraphic log, water strike, borehole design, aquifer properties, etc.
Collecting groundwater data is far more challenging than surface water data, because
- **Groundwater is an invisible resource.** Drilling or indirect investigation methods like geophysics is expensive.
- **The subsurface is a 3D, heterogeneous environment.** The significance of groundwater data is spatially limited. Many data points are necessary to get a reliable picture of groundwater resources.

*Example: What is the aquifer thickness between two distant observation wells?*

- **These data are in most cases collected by the member states,** e.g. national (ground)water departments. Some countries have limited capacity to collect and store groundwater data and/or are not willing to share data.

→ How do L/RBOs get hold on relevant information and data?
Data vs. Information

- Groundwater data are translated into information by hydrogeologists

Examples of groundwater information:
- Piezometric map
- Graph showing groundwater level trends
- Report on the state of groundwater
- Warning on groundwater pollution

⇒ L/RBOs must have access to groundwater information
Data vs. Information

- Data are **independent of the context**. Unlike information, they are unbiased.
- **Data can be reinterpreted** for multiple purposes.

*Example: How would you merge different groundwater maps into one that covers the entire basin?*

⇒ **L/RBOs must also have access to groundwater data**
Organising groundwater data sharing
Organising groundwater data sharing

What can L/RBOs do to promote groundwater data sharing? What are the prerequisites?

1. Staff with education or work experience in groundwater, like hydrogeologists.

2. Mechanisms for web-based data sharing. Most frequent options are:
   - Emails – on request only
   - Organisation websites
   - FTP solutions
   - Cloud-based solutions
   - Dedicated platforms for geospatial data exchange

https://gip.sadc-gmi.org  
http://gis.orasecom.org  
https://ramotswa.un-igrac.org
Organising groundwater data sharing

- The exchange of data is independent of the application
- Data providers decide who has access to the data and to what level
- Data users have access to up-to-date data
- Data users don’t have to store the data

In any case, the solution must be adapted to the capacity and need of the L/RBOs.

Organising groundwater data sharing

3. **Mandates** certainly help but are not essential for data sharing. **Willingness and dialog** are more important.

4. **Lead by example**: share your data as well.

5. Additional **budget** might be needed for hiring staff and hardware/software development, especially for L/RBOs with limited capacity. Regional cooperation on TBAs is receiving a significant support from donors and international organisations.
TBA assessment and management

- The assessment and management of TBAs can be an opportunity for L/RBOs to get into groundwater.

**Example of Stampriet Transboundary Aquifer System (STAS):**
- 2013-2015: 1st assessment + data sharing platform
- 2016-2018: Creation of Multi Country Cooperation Mechanism nested at ORASECOM. ORASECOM already had a groundwater committee.

**Example of Ramotswa aquifer:**
- 2015-2019: 1st assessment + data sharing platform
- 2019: Creation of cooperation mechanism for groundwater management at LIMCOM. Focus on Ramotswa Aquifer, Tuli Karoo Aquifer and Limpopo Aquifer Basin.

- The participation of representatives from national (ground)water departments in TBA cooperation mechanisms greatly helps the sharing of groundwater data.
TBA assessment and management

- Not all TBAs fall within a L/RBO, but L/RBOs can be instrumental nonetheless.

Example of **Senegalo-Mauritanian Aquifer Basin:**
If Mauritania and Senegal exchange data via OMVS and the Gambia and Guinea-Bissau via OMVG, half the job is done.

- All TBAs fall within a REC.

Example of **SADC Groundwater Management Institute:**
Since 2016, it promotes sustainable groundwater management in SADC, e.g. supporting the collection and the sharing of groundwater data.
The way forward

- Groundwater governance requires the **participation of all stakeholders**.

- **Open data** will considerably reduce the efforts. The value of data increases when shared.
In conclusion...

- L/RBOs need data and information about groundwater.
- Groundwater data and information are collected by the Member States but L/RBOs can be instrumental in developing groundwater data sharing.
- L/RBOs can be instrumental in developing cooperation mechanisms over TBAs.
Thank you for your attention