

# Cartographie sur les eaux souterraines en Afrique : les aquifères transfrontaliers et le potentiel d'irrigation des eaux souterraines renouvelables



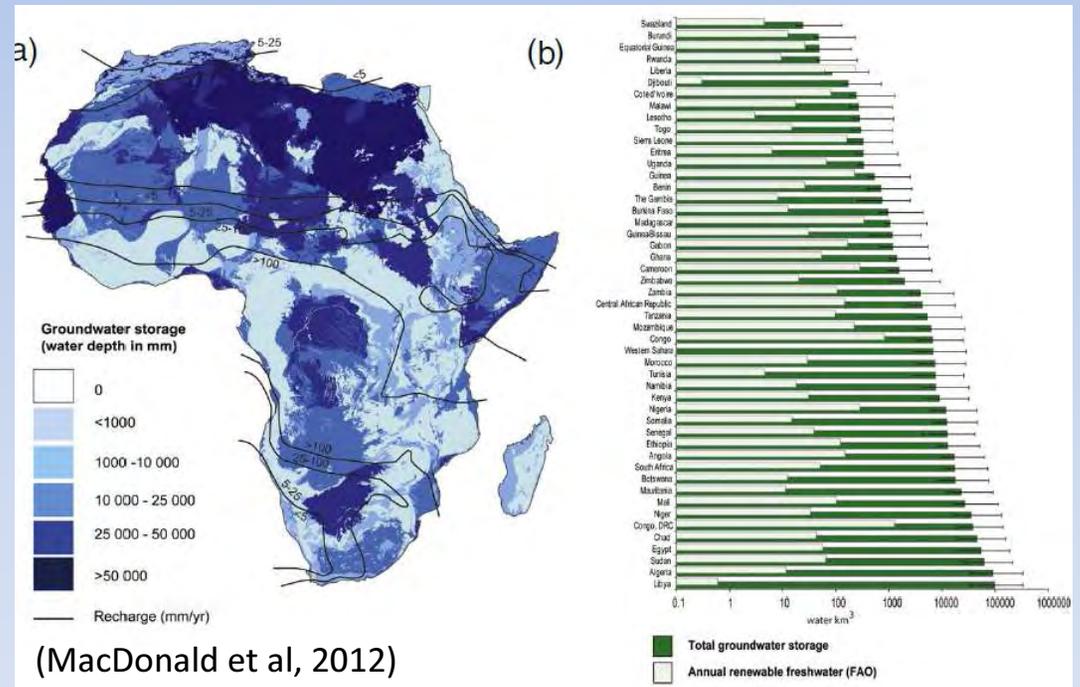
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*Vendredi-Découverte*  
*IRSTEA, Montpellier, 22 Avril 2014*

Photo: David Brazier/IWMI

## Groundwater resource in Africa

- 75 % of the African population dependant on groundwater for basic water supply (UNECA et al., 2000)
- Groundwater demands are set to increase in the future with:
  - Population increase
  - Climate change
  - Need to combat growing food insecurity
- Total groundwater storage in Africa to be 0.66 million km<sup>3</sup> (0.36–1.75 million km<sup>3</sup>)
- Not all is available for abstraction
- The estimated volume is more than 100 times estimates of annual renewable freshwater



## Why focus on groundwater management in a transboundary sense?

- Impacts of Groundwater (GW) development and use in one state may affect another
- Water and land use development in one state may affect GW resources in another
- GW impacts across borders may not be obvious without joint monitoring
- Equitable, informed, and mutually agreed development of GW and land use can prevent tension
- Costs, results, and benefits of monitoring can be shared
- Many transboundary terrestrial and aquatic ecosystems are GW-dependent and cannot be properly managed without knowledge on the GW resources
- Surface Water (SW) issues involve, or even have root in, GW related activities and impacts
- General collaboration and goodwill can be enhanced
- Equitable and informed GW development and management has a lot to do with achieving MDGs, poverty alleviation, food security, climate change adaptation, and drought mitigation



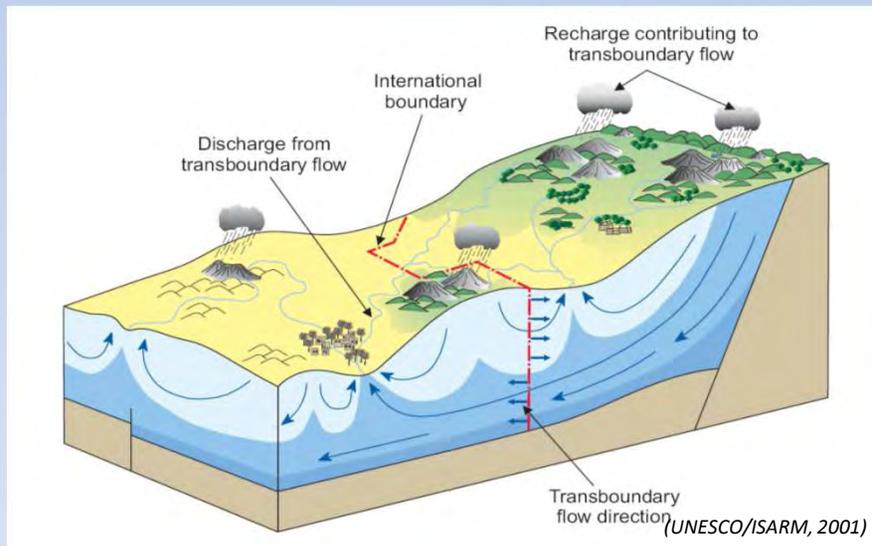
# What is a Transboundary Aquifer (TBA)?

## DEFINITION

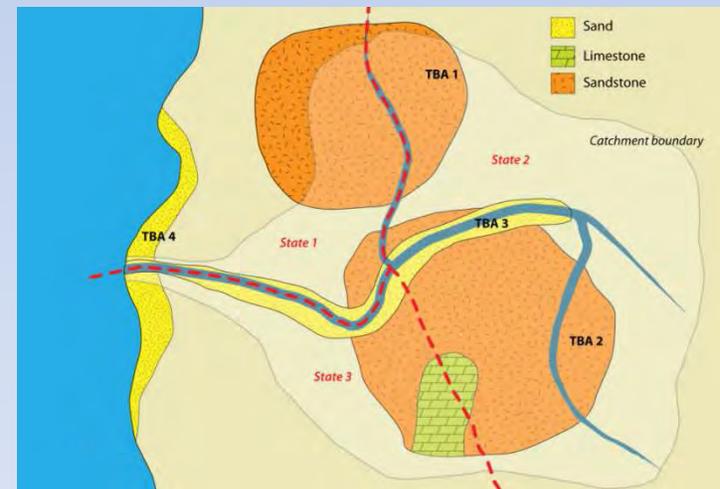
transboundary aquifer or a transboundary aquifer system (TBA) is defined as “an aquifer or aquifer system, parts of which are situated in different States” (UN International Law Commission - UNILC)

## BUT

in practical identification and verification of a TBA, the spatial delimitation, hydrogeological similarity, recharge and discharge mechanisms and zones, and significant hydraulic connectivity between the national compartments of the TBA are important and should be established and agreed upon between aquifer-sharing states.



## Where find a TBA?



# Evolution of the number of TBAs in Africa



AFRICAN REGION <sup>a</sup>	UNESCO 2004	WHYMAP 2006	IGRAC 2009	IGRAC 2012	This paper 2012
North Africa	6	6	7	9	15
Western and Central Africa (except countries in SADC <sup>b</sup> )	9	9	9	22	22
Eastern Africa (except countries in SADC)	5	5	5	6	8
Southern Africa (SADC countries)	18	20	20	34	35
<b>TOTAL</b>	<b>38</b>	<b>40</b>	<b>41</b>	<b>71</b>	<b>80</b>

<sup>a</sup> according to United Nations sub-region definition  
<sup>b</sup> SADC: Southern African Development Community



Water for a food-secure world

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## A new nomenclature proposed based on 3 zones

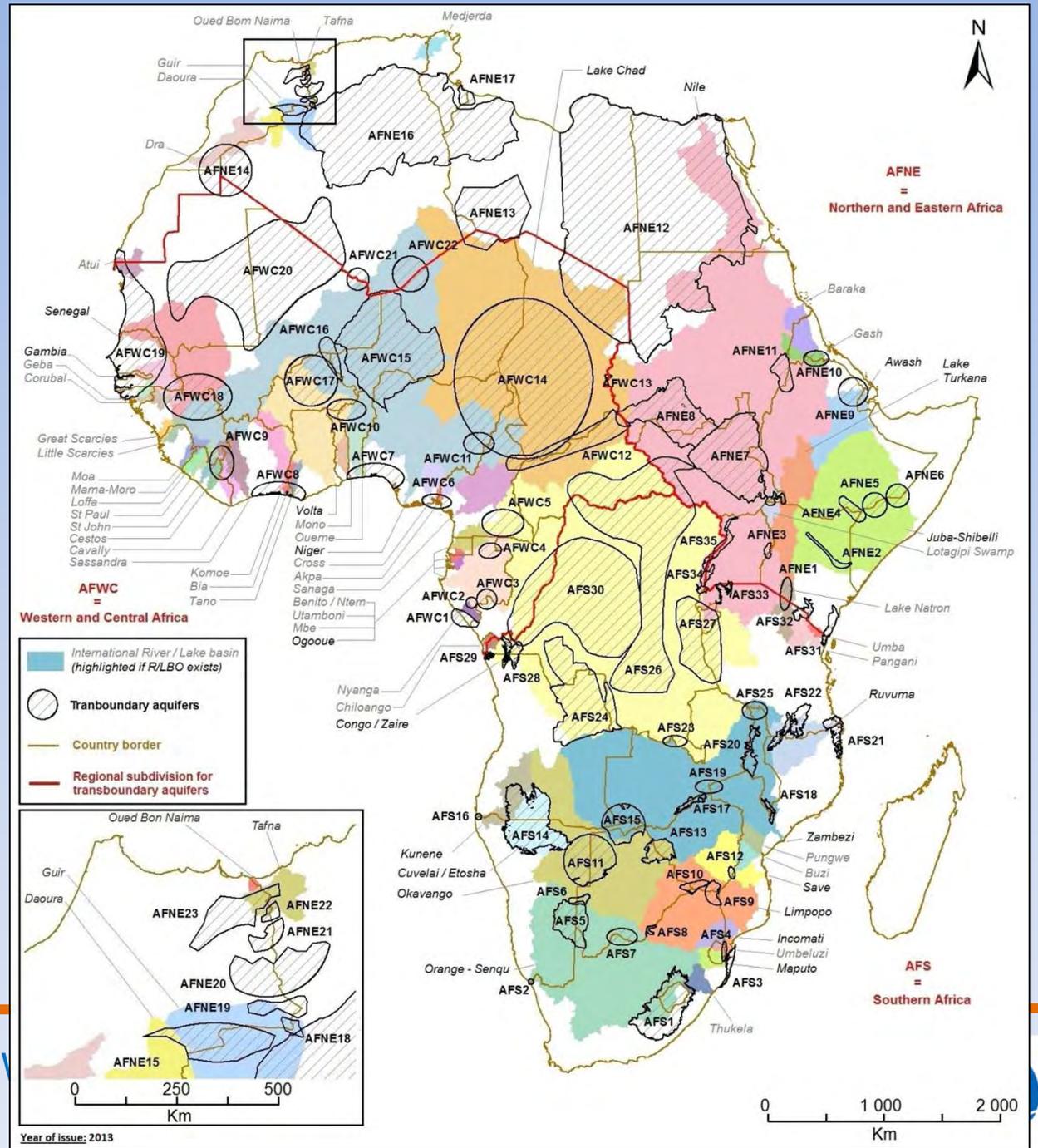
Sub-division zone name (code name)	African continental countries	Regional economic communities (RECs) concerned
Northern and Eastern Africa (AFNE)	Algeria, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Morocco, Somalia, South Sudan, Sudan, Tunisia, Uganda and Western Sahara	IGAD (a) *** COMESA(b) ** CEN-SAD(c) ** EAC(d) ** AMU(e) *
Central and Western Africa (AFWC)	Republic of Benin, Burkina Faso, Cameroon, Central African Republic (CAR), Chad, Republic of the Congo, Republic of Côte d'Ivoire, Equatorial Guinea, Gabon, Republic of Gambia, Republic of Ghana, The Republic of Guinea, The Republic of Guinea Bissau, The Republic of Liberia, Republic of Mali, Mauritania, Republic of Niger, Federal Republic of Nigeria, Republic of Senegal, Republic of Sierra Leone and Togolese Republic	ECOWAS(f) *** ECCAS(g) ** CEN-SAD** AMU*
Southern Africa (AFS)	Angola, Botswana, Burundi, Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe	SADC(h) *** COMESA** EAC**

(\*\*\* active, \*\* poorly active, \* non-active in transboundary water resources management, according to NEPAD et al. 2011)



# The TBAs map

- ✓ 80 transboundary aquifers
- ✓ 42 % of area of Africa
- ✓ 30 % of African population
- ✓ 63 international river/lake basins
- ✓ 21 international water basin organisations



## TBAs Information table

Proposed ID	Reference number				Main Name (other names found)	Countries sharing	Major river basin (sub-river basin name)	Geographical type (Figure 2)	Population <sup>a</sup>	Area (km <sup>2</sup> ) <sup>b</sup>	Aquifer type	Average rainfall (mm/a) <sup>c</sup>	Annual recharge (WHYMAP) <sup>d</sup>	Sources other than IGRAC or INWEB or UNESCO <sup>e</sup>
	WHYMAP 2006	IGRAC		INWEB										
		2009	2012											
AFNE1	417	37	NA	NA <sup>f</sup>	Rift Aquifer	Kenya Tanzania Uganda	Rift Valley (Lake Natron, Lake Navalsha/Turkana) Nile (Nyando, Simiyu)	6	279 000	21 150	Volcanic	450 – 1100	Very low to medium	Betch et al. 2006
AFNE2	420	40	NA	NA	Merti Aquifer (Wabishhebele and Genale Aquifer)	Kenya Somalia	Shebelli & Juba (Lak Dera)	4	129 000	13 500	Semi-consolidated sedimentary (clays, sands, sandstones, limestones)	350 – 750	Low to medium	Mumma et al. 2011, Mwango et al. 2002, Krhoda 1989
AFS10	436	15	9	NA	Tuli Karoo Sub-Basin (Gaborone To Shashe River; encompasses Motloutse Sand River Aquifer)	Botswana South Africa Zimbabwe	Limpopo Basin (Limpopo, Sashe, Motloutse)	4	70 600	14 330	Volcanic and basement rocks (plus alluvial along river)	300 – 450	Very low to low	Wellfield and BGS 2011
AFS18	433	12	17	NA	Shire Valley Aquifer	Malawi Mozambique	Zambezi Basin (Shire)	4	527 000	6 200	Tertiary/Quaternary	780 – 900	Medium to very high	Wellfield and BGS 2011
AFWC3	NA	NA	34	NA	No name referenced	Congo Gabon	Central West Coast (Ogooue, Nyanga)	2	41 000	23 500		1750 – 1950	High to very high	
AFWC15	411	31	56	6	Irhazer-Iullemeden	Algeria Mali Niger Nigeria	Lake Chad (Dilia, Komaras) Niger River (Tilemsi, Niger, Dallol Bosso, Dallol Maouri, Tarka, Sotoko, N'Kaba, Bunsuru, Zamfara, Gulbinka)	5	12 888 600	545400	Group of sedimentary deposits containing two main aquifers: Intercalary Continental (IC) and Terminal Continental (TC)	80 – 900	Very low to very high	OSS 2008a



## TBAs management

- Transboundary water resources management has been totally dominated by a surface water focus, practically ignoring the interconnections with surface water
- Data on TBAs reside in national institutions, transboundary River/Lake Basin Organisations (R/LBOs) and other international organisations i.e. IGRAC
- 2 options to adopt groundwater into international agreement:
  - The 1997 United Nations WaterCourses Convention (UNWCC) which defines GW as a physical extension of surface water body within the watercourse spatial domain  
**BUT** groundwater boundaries don't necessary match with river basin boundary
  - The 19 drafts articles on the Law of Transboundary Aquifers presented in 2008  
**BUT** still not adopted by the UN General Assembly which promote bilateral or regional agreement between the countries in the interim i.e. Guarani Aquifer
- African Ministers' Council on Water (AMCOW) promote TBAs management by R/LBOs



## TBAs management by R/LBOs ?

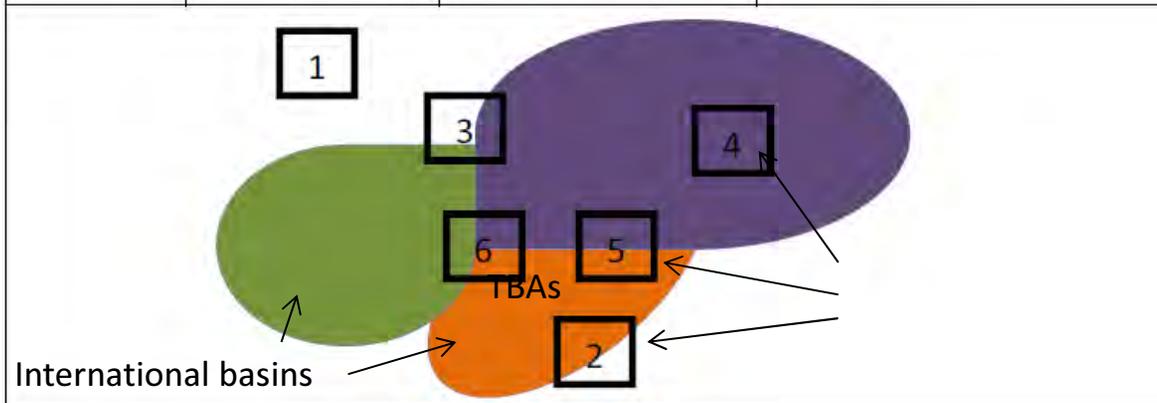
- Argument for:

Their present integral role as custodians for shared river and lake basin resources

- Counterargument:

- Poor human capacity, financing and authority
- The geographical location of the TBAs doesn't necessary match with the spatial mandate of the R/LBOs

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 <sup>a</sup>



<sup>a</sup> TBA has no name according to IGRAC (2012)

## TBAs management in Africa

- 3 groundwater explicit agreements:
  - Nubian Sandstone aquifer system (AFNE12) from 2000
  - North Western Sahara aquifer system (AFNE16) from 2002
  - Irhazer – Iullemeden (AFWC15) from 2009
- 2 R/LBOs with high focus on groundwater
  - Orange-Senqu River Basin
  - Lake Victoria Basin
- SADC is taking a frontrunner position in TBAs management:
  - Protocol on Shared Watercourses revised in 2000 and hinged on the UNWCC
  - Regional Strategic Action Plan for integrated water resources management explicitly addressing TBAs management
  - Work in process on identifying “troublesome” TBAs to prioritised support and piloting solutions



## TBAs - Conclusions

- TBAs identification and delineation is still a on-going process
- TBAs management is expected to raise the profile of neglected local/national GW resources management, especially in low development countries
- TBAs management can reduce future conflicts linked with groundwater abstraction development
- **BUT** there is a need to:
  - understand flow processes and interactions with surface water
  - develop collaboration and knowledge sharing between the riparian countries
  - reformulate and adapt the legal basis of R/LBOs to include explicit mentioning of GW (not as a new and separate domain)
  - design flexible and hybrid institutional models build on the present customary approach of making the R/LBOs responsible

