

Transboundary Groundwaters

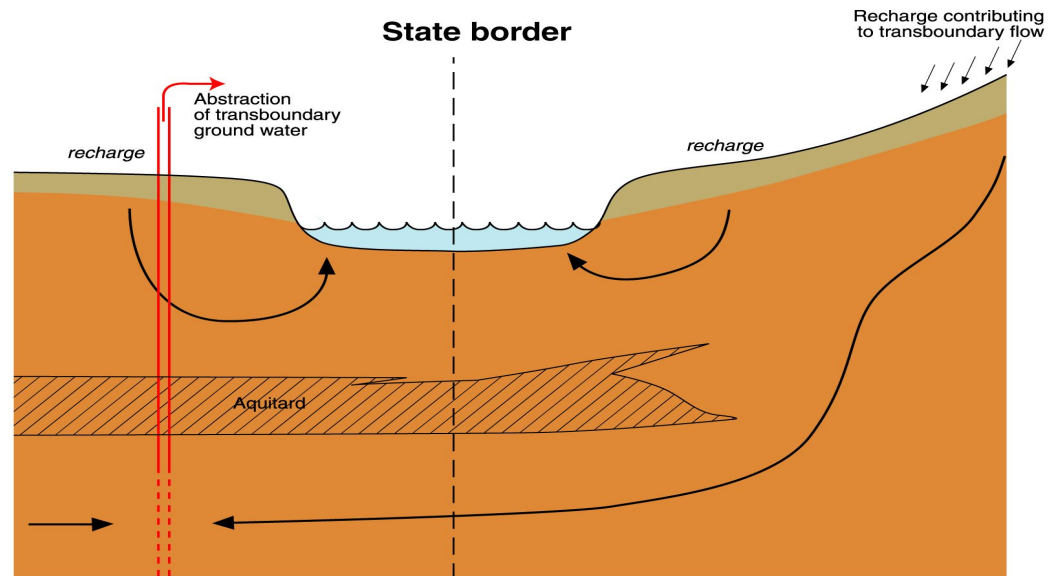
(20 years of assessing; achievements and challenges)

Dr Neno Kukurić

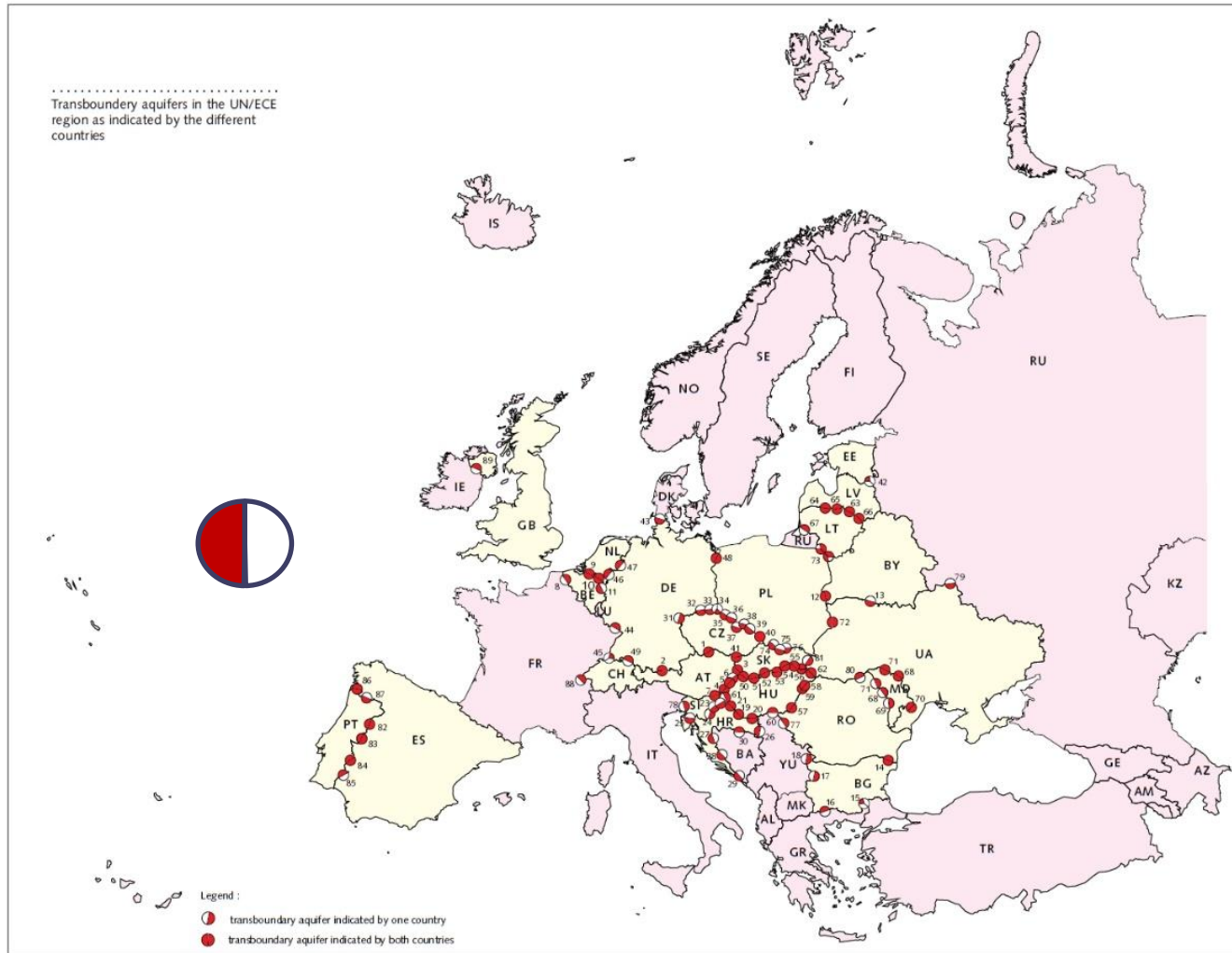


Assessment of Transboundary Aquifers

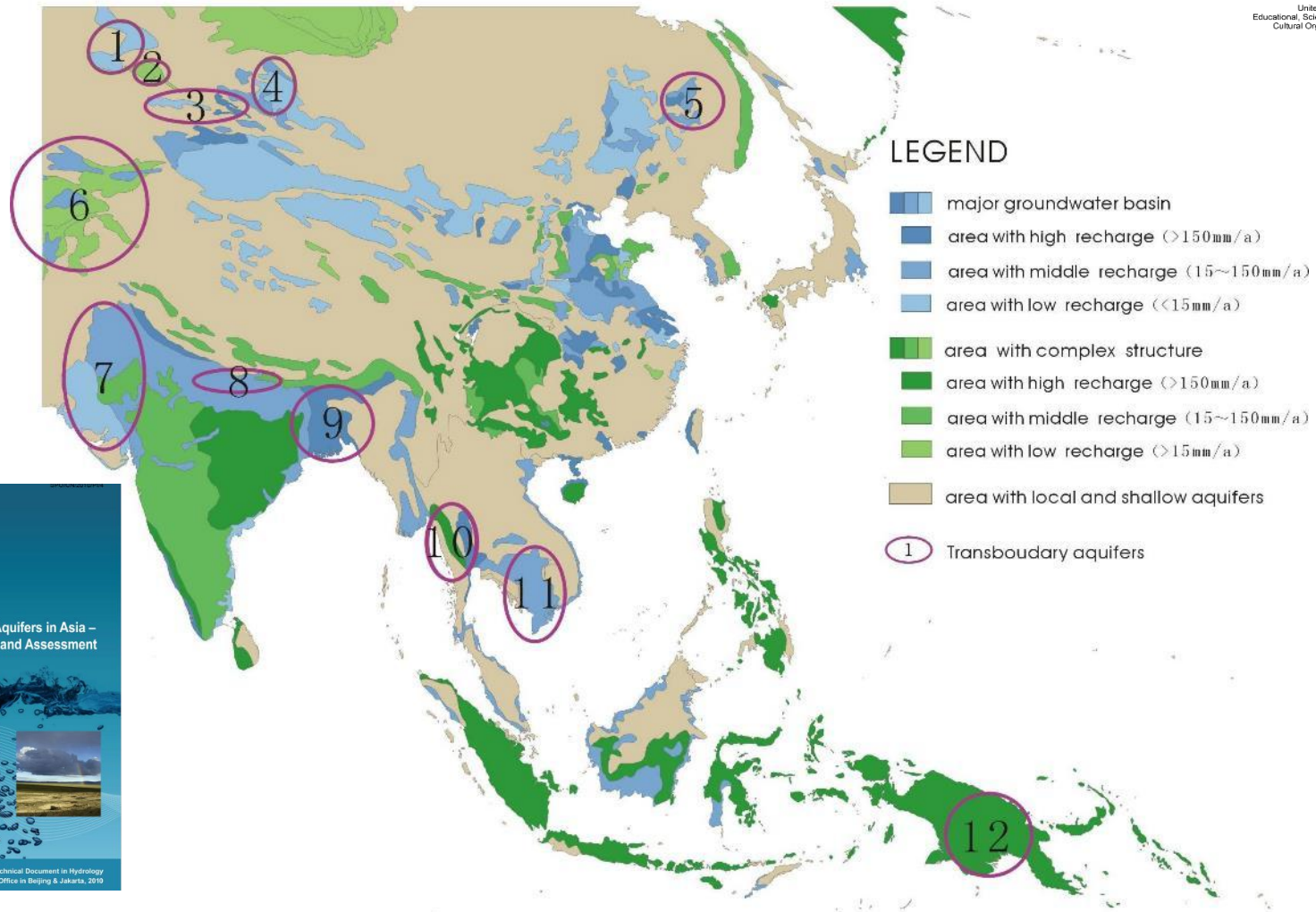
- Most of the **countries share aquifers**
- Changes of groundwater quality and quantity can lead to **international problems** but sharing a resource is also **a platform for cooperation**
- **Cooperation** is required to mitigate or **eliminate problems** and increase the overall **benefit from groundwater**
- **Harmonisation:** differences in languages, classifications and reference systems, policy, legal and institutional structure



Inventory of Transboundary Aquifers 1999



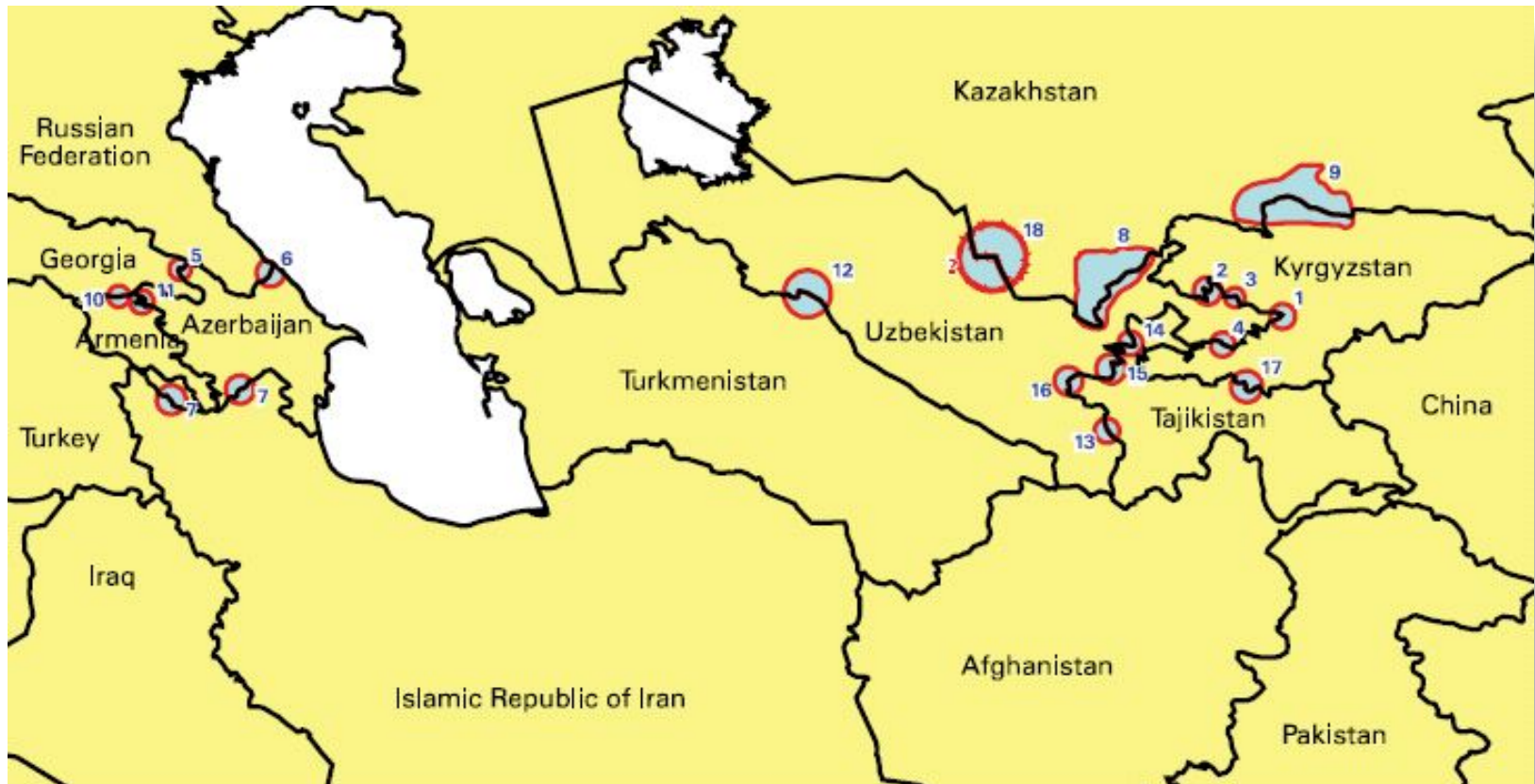
TBA Assessments in South-East Asia 2006



Transboundary Aquifers in Asia –
A Preliminary Inventory and Assessment

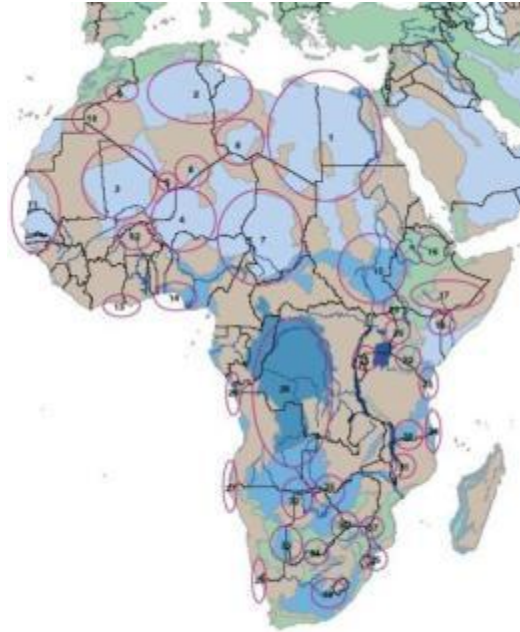
IHP VII Technical Document in Hydrology
UNESCO Office in Beijing & Jakarta, 2010

TBA Assessments in Central Asia 2007

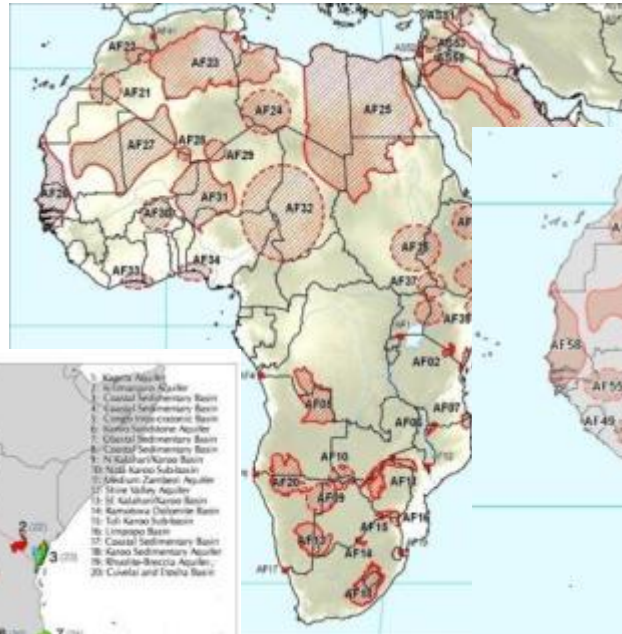


Assessment of Transboundary Aquifers

2002



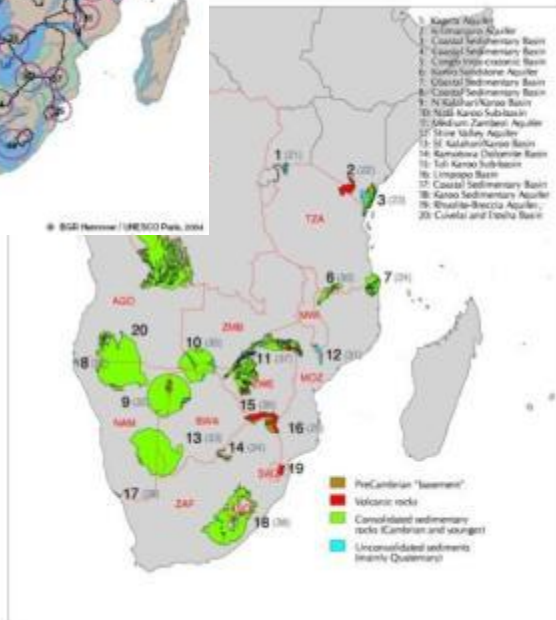
2009



2012



2005



Transboundary Aquifers of the World

Special Edition for the 7th World Water Forum 2015



Legend

Occurrence and extent

- aquifer
- groundwater body
- overlapping area
- small aquifer
- small groundwater body

TBAs type of delineation

- confirmed boundary
- approximate boundary
- aquifer/groundwater body label

Geographic elements

- country boundary
- detailed maps provided on back
- rivers
- lakes

Prepared by IGRAC

Base maps
Country borders: ESRI World Country Generalized layer (April, 2014)
Rivers and lakes: ESRI (2009)

Map projection
Robinson projection, geographic coordinates, spherical WGS84 longitude of water meridian (°)

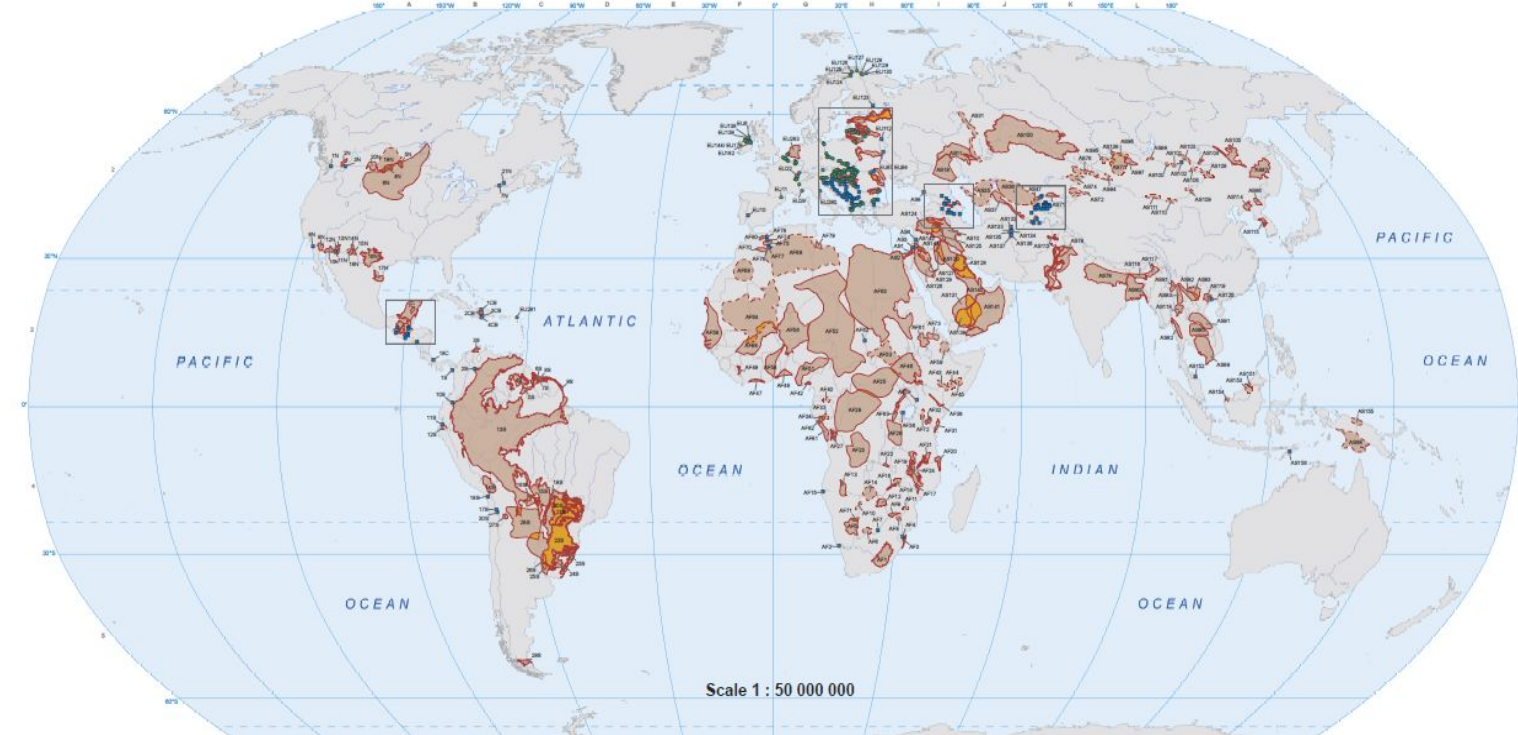
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ABOUT THIS MAP
This map is about transboundary aquifers of the world. It shows the state of information presently available on the occurrence and extent of TBAs worldwide. The map provides a global overview of these important transboundary water resources and intends to encourage further research and assessment thereof. The map is based on the most recent inventory results of many active working groups around the world, details on the procedures for preparing this map are available in the section 'Map compilation and labelling'. Inventories and assessments of transboundary aquifers across the world and information exchange between states overlying them are requisite for informed transboundary aquifer governance. This map aims to contribute to raising awareness on the importance of the governance of transboundary aquifers and to building a much needed global knowledge base.

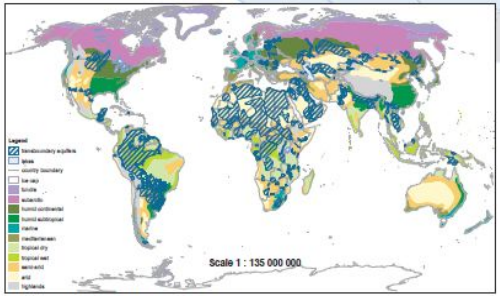
Since its establishment in 2003, IGRAC has been involved in the identification and assessment of transboundary aquifers within the framework of the UNESCO Transboundary waters assessment, GEF International Waters (IW) Focal Area and the International Shared Aquifer Resources Management (ISARM) initiative led by UNESCO-HP and IAH.

DISCLAIMER
Any designation employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of IGRAC, UNESCO, WMO or the Government of the Netherlands concerning the legal status of any country, territory, city or area, nor of its authorities and sovereignty on its territory and natural resources, and delimitation of its borders or boundaries. Furthermore, the location and boundaries of several transboundary aquifers have not yet been confirmed by representatives of all countries involved. In such cases, IGRAC has opted to indicate on the map the corresponding provisional status.

COLLOPHON
The mission of the International Groundwater Resources Assessment Centre (IGRAC) is to facilitate and promote global sharing of information and knowledge required for sustainable groundwater resources development and management. As an independent and non-profit centre, IGRAC operates under auspices of United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organisation (WMO). IGRAC is an in-house partner of UNESCO-IHRC in Delft, the Netherlands, and receives financial support from the Government of the Netherlands.

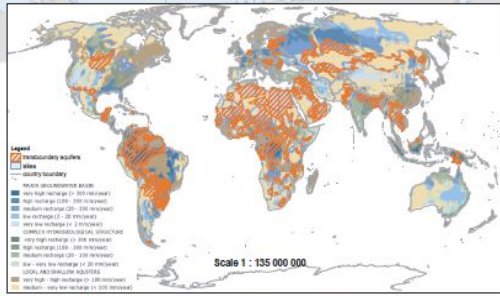


Scale 1 : 50 000 000



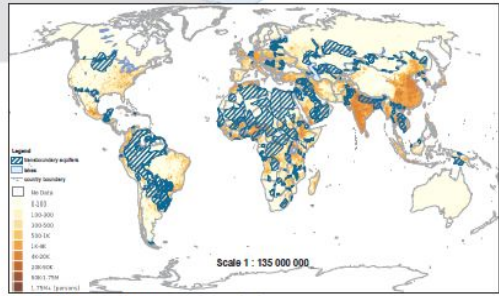
Scale 1 : 135 000 000

Transboundary Aquifers of the World and Climate Zones
(Source: ACOG/IGRAC, center: MapInfo/World, credits: National Geographic)



Scale 1 : 135 000 000

Transboundary Aquifers of the World and Groundwater Resources and Recharge
(Source: WYMAP - IGRAC & UNESCO)



Scale 1 : 135 000 000

Transboundary Aquifers of the World and Population Estimate
(Source: Socioeconomic Data and Applications Center, layer name: Population Count Future Estimate 2015)

Assessment of Transboundary Aquifers



There is a **global baseline** available prepared by >330 experts from >130 countries!

- Interdisciplinary **methodology** developed
- **Legal framework** (UN Watercourse Convention, Helsinki Convention, Draft articles of the 'Law of Transboundary Aquifers') to build regional and bilateral agreements, such as the Guarani Aquifer System
- First structured and publicly accessible **information system** on transboundary aquifers



TBA Information Management System

The screenshot shows the TWAP GIS viewer interface. A search query 'WC1.2 Renewable groundwater resources per capita' is entered in the search bar. The map displays North America with various data layers overlaid. A red circle highlights the search bar, and a blue circle highlights the 'Active layers' panel on the left. A red arrow points from the search bar to the 'View Aquifer information sheet (pdf)' button in the popup window.

https://ggis.un-igrac.org/ggis-viewer/twap/public/default 8_20_27746

Transboundary Aquifer Information Sheet
AF52 - Lake Chad Basin

Geography
 Total area TBA (km²): 1 983 814
 No. countries sharing: 7
 Countries sharing: Algeria, Cameroon, Central Africa Republic, Chad, Libya, Niger, Nigeria
 Population: 40 123 241
 Climate Zone: Arid
 Rainfall (mm/yr): 314

Hydrogeology
 Aquifer type: Multiple-layered hydraulically connected system
 Degree of confinement: Confined with some parts semi-confined and unconfined.
 Main Lithology: crystalline rocks – granite, sedimentary rocks - limestone

AF52 Lake Chad Basin

Legend
 Transboundary aquifer
 Confined aquifer boundaries
 Other aquifers
 Others symbols
 Rivers
 Lakes
 National borders
 TBA Location
 Regional location of aquifer

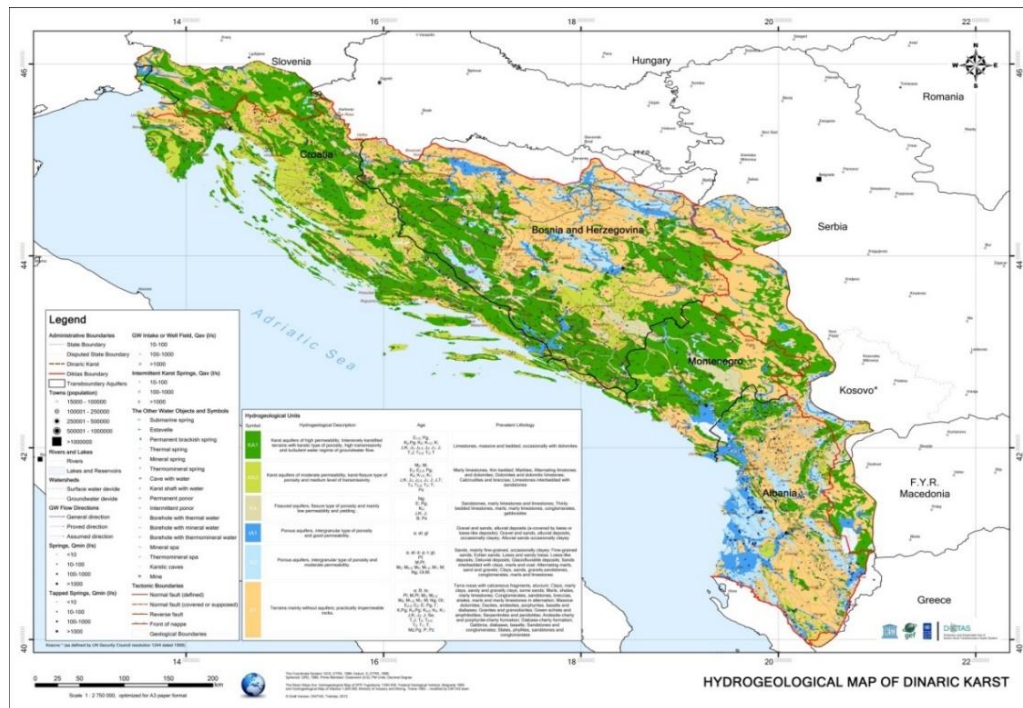
Cross section along Maiduguri to the SW and Faya Largeau to the NE of the Lake Chad Basin (after Schneider & Wolff, 1952 modified)
 Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate

Page-Footer:
 UNEP, gef, IGRAC logos
 1
 DRAFT Version 8 January 2015

TBA Assessment and Management

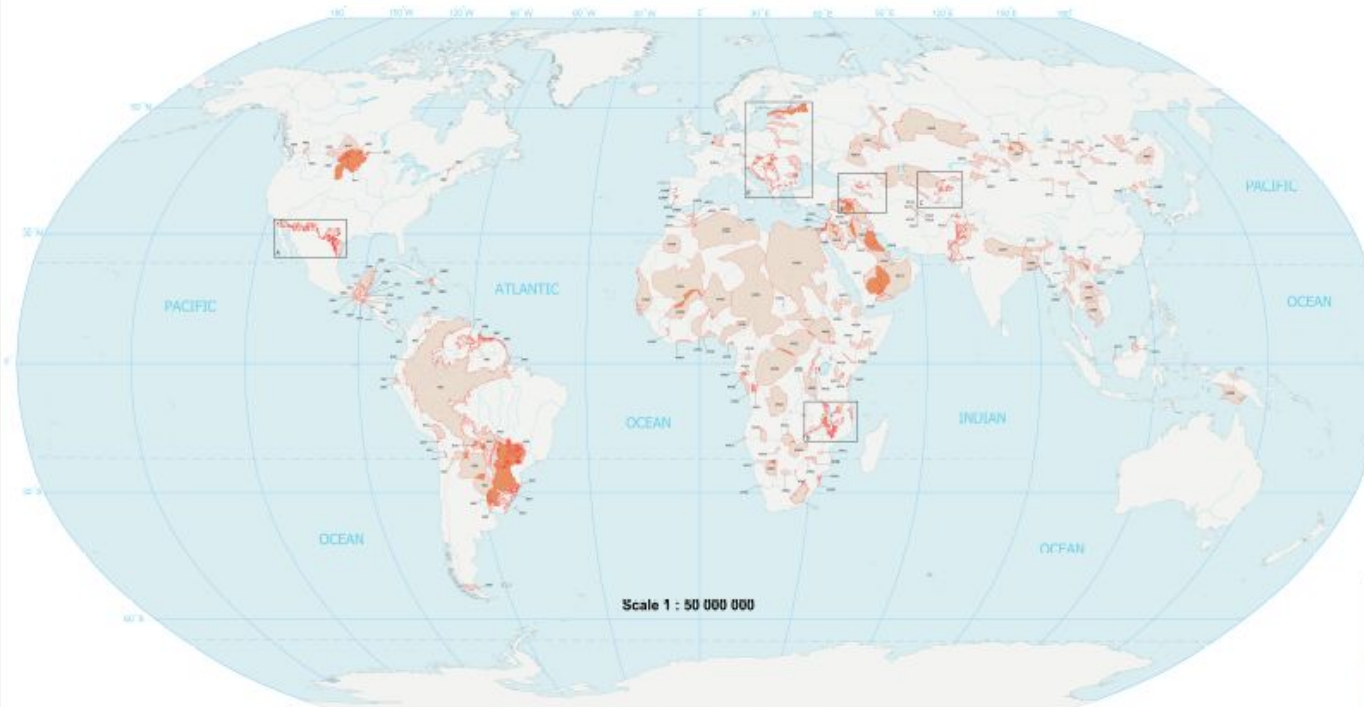


- Nubian, Guarani, Limpopo Basin, NW Sahara, Iullemdenden, DIKTAS ...
- Mostly concentrate on one aquifer (system) allowing **in-depth analysis**:
 - Improving state of knowledge (TDA)
 - Establishing/improving cooperation mechanisms
 - Facilitating harmonisation & priority reforms (SAP)



Transboundary Aquifers of the World

- Update 2021 -



Legend

Occurance and extent

- aquifer
- overlapping area

Type of TBA delineation

- confirmed boundary
- - - unconfirmed boundary

Geographic elements

- rivers
- lakes
- detailed maps

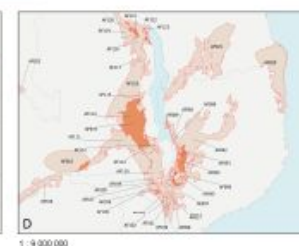
Prepared by IGRAC

Base maps
Country borders: The United Nations Clear Map (2018)
Rivers and lakes: ESR (2018)

Map projection
Robinson projection, geographic coordinates, spheroid WGS84, longitude of central meridian 0°

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Disclaimer
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. A full disclaimer is available on the back of this map.



1 : 8 500 000

1 : 5 000 000

1 : 8 000 000

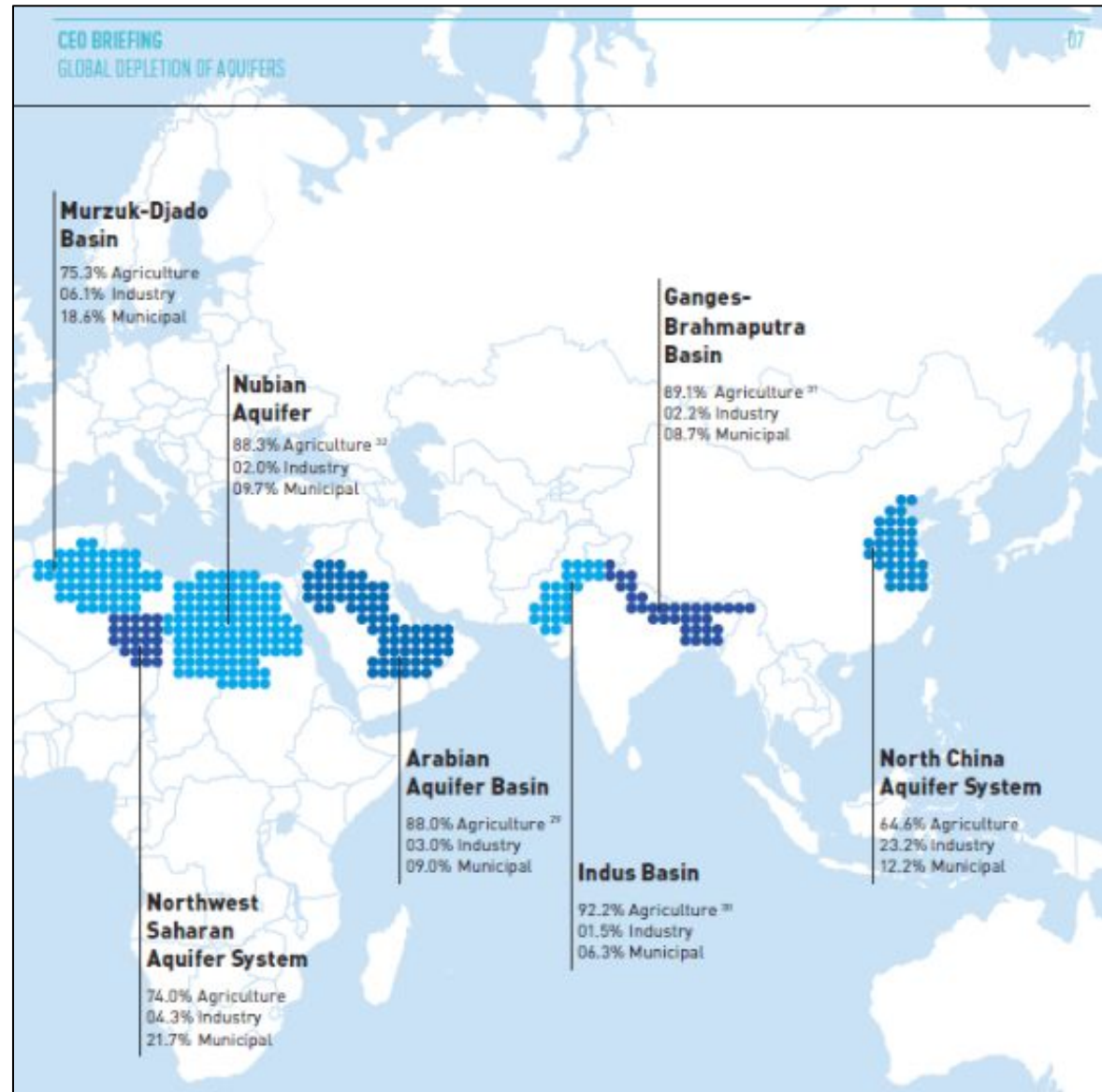
1 : 9 000 000

1 : 10 000 000

TBAs and Global Water Security



Most of the large aquifers under stress are transboundary





AQUIFER

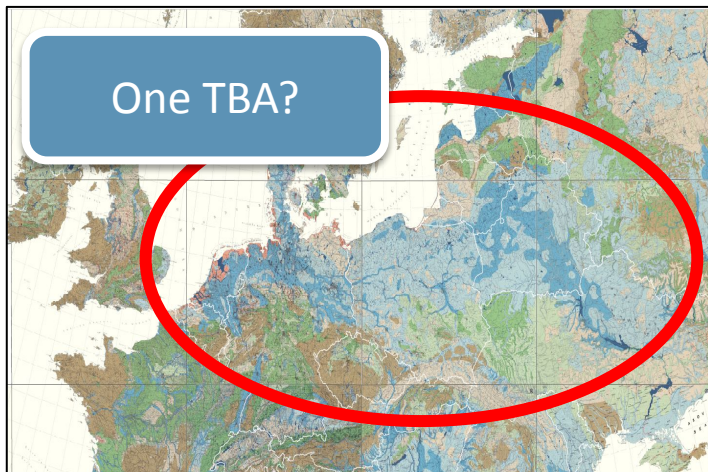
BORDER

SPRING

Need for Transboundary Cooperation

Main TBA challenges

- Data & information **harmonisation** across borders
- Lack of **monitoring data**, quantity and especially quality
- Selecting **priority areas** and/or issues within a TBA
- The establishment of **cooperation** mechanisms and trust building



TRANSBOUNDARY AQUIFERS

A GLOBAL OUTLINE

2021

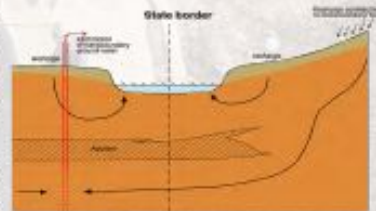
Transboundary aquifers (TBAs) are aquifers which cross national borders¹. Perhaps we should call boundaries "trans-aquifer": After all, aquifers were there first. Nevertheless, aquifers are a vital natural resource and they should have a voice.

The vast majority of countries (excluding island states) are so-called "aquifer states", sharing a precious natural resource: groundwater. Aquifer states need to have a good knowledge of these shared resources because changes in groundwater quality and quantity can have an effect across the border which can lead to international problems.

In the first instance, aquifer states need to acknowledge that they share an aquifer. For rivers and lakes this is a simple step, whereas the presence and extent of a shared aquifer is not always obvious or not easy to prove. Accordingly, cooperation over TBAs is more challenging than transboundary surface water in terms of awareness raising, assessment, monitoring and enforcement. No wonder then that trust is extremely important while collaborating over invisible shared resources.

In the last two decades substantial progress has been made in delineation of TBAs globally, including their presence, extent and basic description. Some of the world's largest aquifers are assessed in more detail. On the other hand, there are just a handful of international agreements dedicated solely to groundwater and, likewise, only a few examples of fully operational international cooperation over TBAs. Most of the world's largest aquifers that are already under stress are transboundary. As the pressure on groundwater resources grows due to human activities and climate change, the role of TBAs needs more attention in order to ensure global water security.

¹ "Transboundary aquifer" or "transboundary aquifer system" means, respectively, an aquifer or aquifer system, parts of which are situated in different States; "aquifer" means a permeable water bearing geological formation underlain by a less permeable layer and the water contained in the saturated zone of the formation; "aquifer system" means a series of two or more aquifers that are hydraulically connected.



AQUIFERS

Transboundary aquifers was coordinated by UN-FAO. The first inventory had a pioneering character, addressing the challenges of transboundary aquifer management and was covered by the UNESCO, 2006). It was based on a map with an approximation of the delineation of TBAs, a joint effort and the Organisation



Rivers, Lakes and Wetlands (UNEP, 2007) and TBAs. However, it is not only the status of aquifers (management measures), but also the quality of the water. This assessment, Caucasus and Central Asia (2011) extended the inventory. At that time, the European Union's Water Framework Directive, which requires the mapping of TBAs, was also in force.



Another important step in the delineation of TBAs was the presentation of the first global inventory of TBAs by UN-FAO in 2006. The inventory was based on the United Nations World Water Assessment Programme (UNWAP) and the International Groundwater Assessment Review (IGAR) data.



The same through the TWAP, 2011-2015. TWAP was coordinated by UN-FAO and the International Groundwater Assessment Review (IGAR) partners (UNEP, UNEP, etc.). The methodology was used at the global scale. The inventory is publicly accessible and is still being updated. The participatory approach for data from the TWAP has incorporated the output of that time, such as the Sahara (Africa), the Danube (Europe) aquifer

igrac

The progress in the delineation of TBAs is partially down to a network of specialists and their respective organisations that was established through the Internationally Shared Aquifer Resources Management (ISARM) programme.

Concluding Remarks

- Keep fostering international cooperation: **climate change** and **human impact** on groundwater resources do not stop at administrative borders.
- Place transboundary aquifers in a context of relevant **broader societal/ environmental issues**
- Use **multidisciplinary approach** that includes **fact finding**, strengthening **collaboration** mechanism and **joint action program/prioritization**
- Step up **groundwater monitoring**: assessment is not complete- and no predictions can be made without an **analysis of historical data**.
- Use the **international protocols** as a framework and (in)formal, **local agreements** as a building block.



building trust asks for understanding and patience

Thank you for your attention