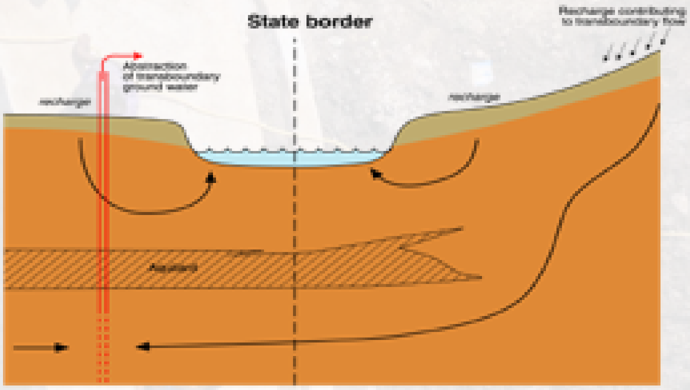
TRANSBOUNDARY AQUIFERS

A GLOBAL OUTLINE 2021

Transboundary aquifers (TBAs) are aquifers which cross national borders[1]. 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.

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[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.*

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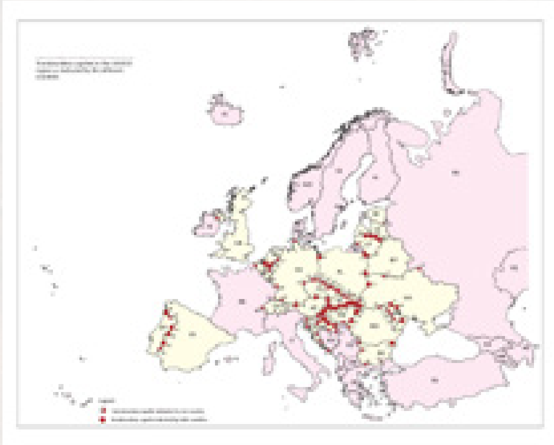
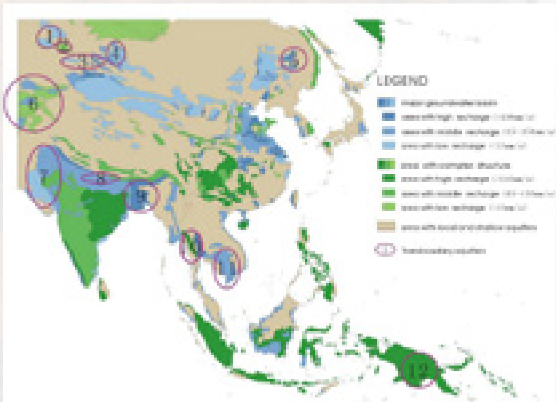
International Groundwater Resources Assessment Centre

ASSESSING TRANSBOUNDARY AQUIFERS

The first regional inventory of transboundary aquifers was prepared in 1999 for Europe under the coordination of UN-ECE, cautiously distinguishing between TBAs "indicated by one or by both" aquifer states. The inventory had a pioneering role in addressing TBAs, revealing the challenges of a TBA assessment in terms of data harmonisation and cooperation. The next significant inventory covered the major TBAs in East and South-East Asia (UNESCO, 2006). In both inventories aquifers were presented on a map with circles or ovals, providing the first, rough approximation of TBA presence and extent. The first distinct delineation of TBAs took place in 2006 in Americas as a joint effort and excellent cooperation of UNESCO-IHP and the Organisation of American States (OAS).



The First Assessment of Transboundary Rivers, Lakes and Groundwaters for Europe and Central Asia (UNECE, 2007) used the very same simple representation of TBAs. However, it also provided a regional overview of current groundwater status (including transboundary impact and management measures), the pressures and future trends and prospects. This assessment was limited to TBAs of South-East Europe, Caucasus and Central Asia. The second UNECE assessment (2011) extended TBA analysis from Europe to the whole continent. At that time, the European Union, through the Water Framework Directive, introduced Groundwater Bodies (GWBs) as administrative units, which caused a harmonisation issue while mapping TBAs at the borders of the EU. The fact that a GWB (as a 'distinct volume of groundwater within an aquifer or aquifers') can align to national borders but still not be administratively considered as transboundary made the mapping even more challenging. Therefore, the UNECE map from 2011 contains both TBAs and 'transboundary' GWBs, as the most objective presentation of a state of the assessment at that moment. Another important regional TBA assessment was carried in Western Asia by UN-ESCWA and BGR (2013) as the first effort led by the United Nations to catalogue and characterize transboundary surface and groundwater resources in the Middle East.



A major step forward in TBA assessment came through the Transboundary Water Assessment Programme (TWAP, 2011-2015) which provided the first global TBA baseline. TWAP was co-funded by the Global Environment Facility (GEF) and the groundwater assessment component was coordinated by UNESCO with assistance of IGRAC and other partners (UNEP, 2016). A comparative, indicator-based methodology was used to assess almost 200 aquifers at the regional and global scale. TWAP also provided the first structured & publicly accessible information system on transboundary aquifers which is still accessible at IGRAC via http://geftwap.org. The participatory approach used in TWAP unlocked groundwater data from the national level and triggered the cooperation of more than 300 experts from 131 countries. TWAP also incorporated the outcomes of all bilateral assessments available at that time, such as of the Nubian, Iullemenden and North-West Sahara (Africa), Guarani (South America) and Dinaric Karst (Europe) aquifer systems.

The clear success of the TWAP global baseline is partially down to a network of specialists and their respective organisations that was established through the Internationally Shared Aquifer Resources Management (ISARM) programme.

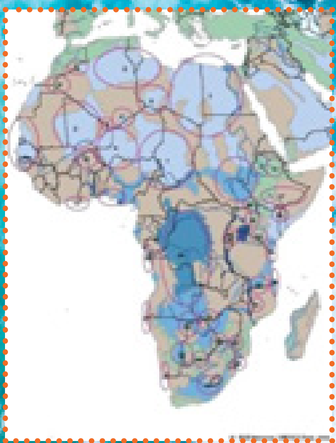
ISARM: A GLOBAL TBA PROGRAMME

The ISARM programme (UNESCO, 2001) was initiated to improve knowledge on TBAs globally and to raise awareness of TBAs societal and environmental importance. In the last twenty years, ISARM activities (www.isarm.org) have been carried out in close cooperation between UNESCO-IHP, the IAH TBA Commission, IGRAC and many other partners around the world.

The TBA Map of the World (2002-2021) is compiled under the umbrella of ISARM and is an inventory of regional and global TBA assessment outcomes. Over two decades, the map had developed from circles and ovals representing TBAs in 2002, to complete delineated TBA shapes by TBA 2015.

ISARM was very instrumental in the preparation of the Draft Articles UN Draft articles on the Law of Transboundary aquifers (UN ILC, 2008) and in unlocking financing for TBA assessment. Regionally, ISARM has been the most active in Americas (https://isarm-americas.org). In 2010, ISARM organised the first TBA conference in Paris; the second one is planned for December 2021.

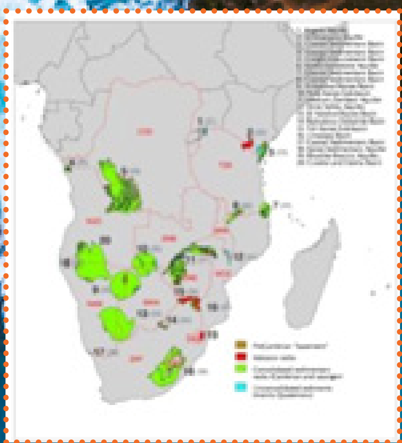
While TWAP provided the first global TBA baseline, ISARM is ensuring the continuation of a global TBA network. Furthermore, ISARM encourages an interdisciplinary approach to TBA assessment through a powerful combination of science and diplomacy.



2002

2009

2005

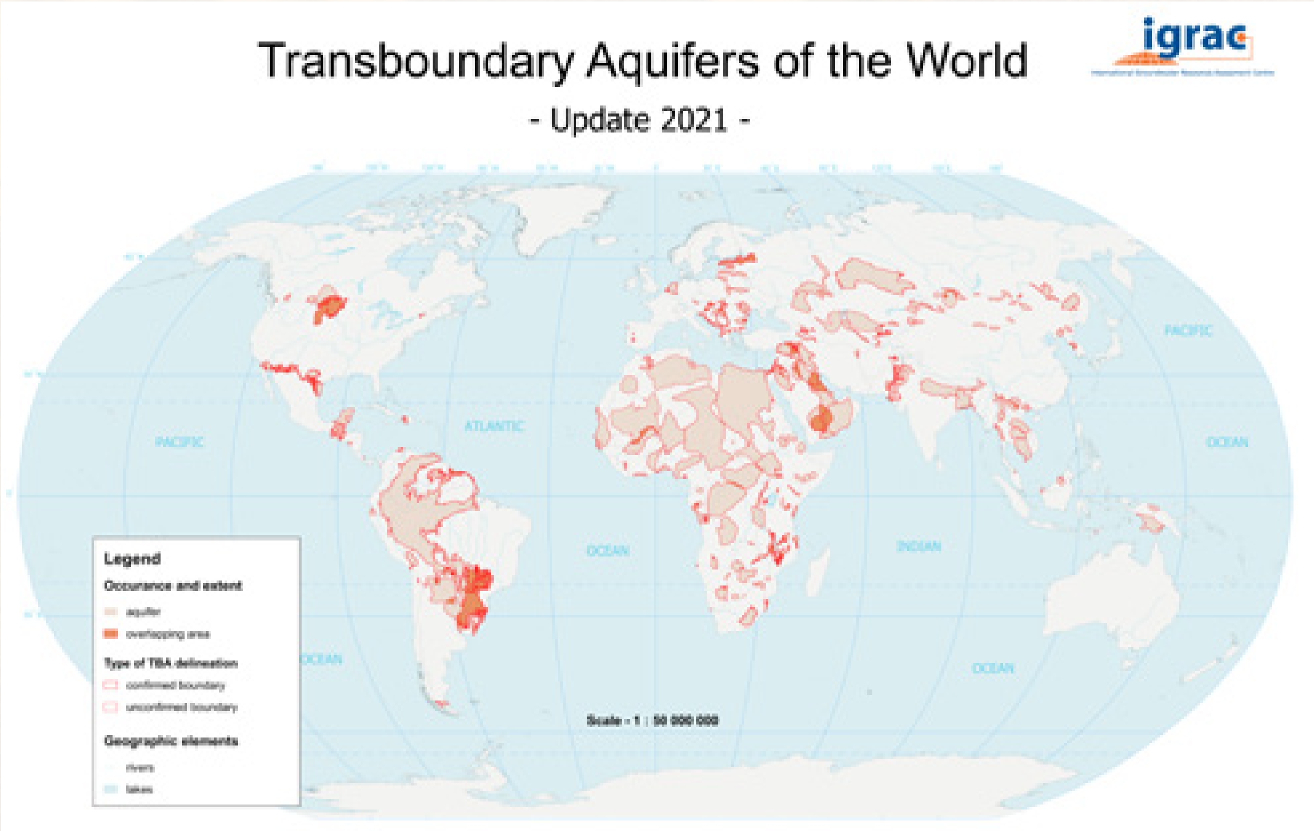


2012

THE CURRENT KNOWLEDGE OF TBAS

The majority of large aquifers globally are transboundary. Almost every nation state shares a TBA. In particular, TBAs cover around 40% of the continental area of Africa and South America. About 30% of the African population and 20% of South America live in these areas. At the global scale, we know the location and extent of TBAs fairly well. However, TBA delineation represented on maps are still only a vertical projection of the aquifer extent at the surface.

The most significant update of the TBA Map of the World was in 2015, when almost all major TBA were delineated and provided with a basic description (so called ‘aquifer briefs’). The 2015 TBA Map shown 366 aquifers/aquifer systems and 226 transboundary groundwater bodies. Following map updates brought some refinements but - as expected –no major changes delineation of TBAs at the global scale. The 2021 TBA Map (depicted below) contains 468 aquifers/aquifer systems (see: ggis.un-igrac.org).



Significant advancement in TBA assessment, however, has continued at the aquifer scale in many parts of the world. In Southern Africa, for example, the Ramotswa Aquifer System was thoroughly studied and research into TBAs shared by Malawi (and neighbours Tanzania, Mozambique and Zambia) relieved the importance of local aquifers. Knowledge of both the aquifer properties and a governance of TBAs shared by Mexico and USA has significantly improved. Furthermore, a GGRETA project (UNESCO, 2013-2022) was implemented in three pilot aquifer systems, in three regions of the World:

- Stampriet (Southern Africa)
- Pretashkent (Central Asia)
- Ocotepeque-Citala (Central America)

“Joint assessment and management of transboundary groundwaters is vital for water security and political stability in many parts of the world.”

While productive and useful for international cooperation, GGRETA and other major TBAs projects reconfirmed a lack of data. Although the main properties of transboundary aquifers are usually sufficiently understood at a regional scale, a general lack of monitoring data limits the assessment and prediction of aquifer regimes. In general, more is known about the quantitative than about qualitative state of TBAs.

The GGRETA project also provided the opportunity to draft the Guidelines for Multidisciplinary Assessment of TBAs (IGRAC and UNESCO, 2015). These guidelines are based on an ISARM framework that includes hydrogeological, environmental, socio-economical, legal and institutional aspects of internationally shared groundwaters. A similar approach is followed in the Transboundary Diagnostic Analysis (TDA) method, used in GEF funded TBA projects.

Alongside a methodological assessment guideline, TBAs need a legal framework for international cooperation. The Convention on the Law of the Non-Navigational Uses of International Watercourses (UN, 2014) included groundwater in its scope but only when hydraulically connected to surface water. Therefore, the UN Draft Articles on the Law of Transboundary Aquifers were published in 2008 (UN, 2008). The articles promote equitable and reasonable use and regular exchange of data, alongside cooperative system monitoring. However, they are currently annexed to a UN General Assembly Resolution and can only provide guidance to countries in the development of a transboundary aquifer agreement. The UNECE 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention) was originally negotiated as a regional framework for the Pan-European region. In 2016 it was opened up for accession to all UN Member states. In 2014, the Model Provisions on Transboundary Groundwaters were designed to build upon and work alongside the Draft Articles (UNECE, 2014).

"Keep fostering international cooperation: climate change and human impact on groundwater resources do not stop at administrative borders."

Two decades after systematic work on TBAs started, there is a global TBA baseline, a TBA information system, a TBA assessment methodology and a legal framework for international TBA cooperation.

CHALLENGES IN TBA ASSESSMENT AND GOVERNANCE

The main challenge while assessing TBAs in comparison with aquifers within national borders is harmonisation. Countries use different languages, classifications, reference systems, policy, legal and institutional structure, etc. and those need to be properly understood, compared and analysed. In the GEF 'Transboundary Diagnostic Assessment' terminology, this process of data collection, processing and interpretation is usually denoted as strengthening a scientific knowledge base.

A lack of monitoring data (quantity and especially quality) is another challenge. A TBA assessment is not complete -and no future predictions can be made- without the analysis of historical data. Groundwater monitoring requires a larger initial investment but is necessary for sustainable aquifer utilisation and protection. In addition, groundwater monitoring is essential when deciding where to concentrate transboundary assessment and management efforts.

After providing an aquifer-wide context, a TBA assessment should then focus on **priority areas and/or issues** within the aquifer. When large TBAs are being examined, a thorough assessment of the whole aquifer is not always an option. Accordingly, management measures are usually required only where issues or hot-spots are, not over the entire aquifer (or at least not thoroughly, e.g. in a case of diffuse pollution).

Selecting the areas/issues for more detailed assessment and management interventions is not always a straightforward exercise. Hotspot mapping, aquifer zoning, the identification of effective transboundary aquifer areas and establishing buffer or protection zones along borders are tools developed to assist with this task. Science should inform these decisions, however a lack of crucial data and information (e.g. on groundwater dependent ecosystem or groundwater quality/pollution) makes this process challenging. Additionally, socio-economic and environmental factors are often not adequately assessed in current TBA assessments. In some cases, prioritisation of data collection and/or actions within the TBA based on expert judgement can assist in the selection of management interventions.

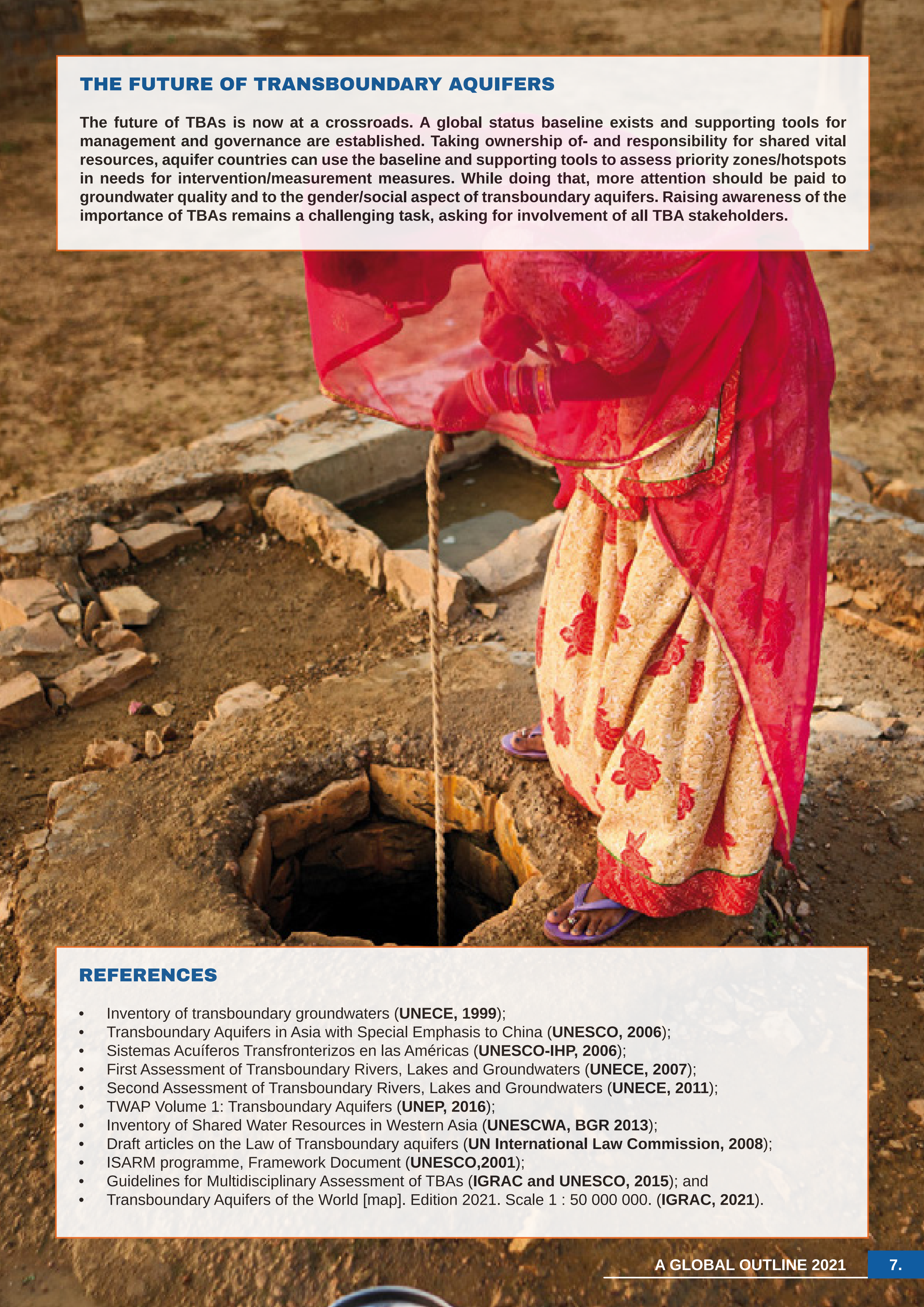
Additionally, as aquifer states begin to agree on common management measures and governance agendas, they may be influenced by national politics representing interests much broader than of the local aquifer-related population and environment. The establishment of **cooperation mechanisms** from the beginning of a TBA assessment is therefore crucial for building the trust and a common interest between aquifer states. This includes a joint assessment with multidisciplinary (groundwater specialists, environmentalists, lawyers, etc) working groups, broad stakeholder engagement, inter-departmental committees and regional (aquifer-wide) consultation bodies.

"While the pressure on shared groundwater resources increases, international cooperation and knowledge sharing are crucial for tackling serious groundwater pollution and depletion problems worldwide."

The state of the aquifer and its current and projected use will define the level of necessary cooperation between aquifer countries. Hence, assessment, monitoring and management of TBAs are interconnected. Data and information must inform water diplomacy. Likewise, the scientific understanding alone of a TBA is not sufficient to ensure proper management and governance. Working together across disciplines, scales and boundaries is the only way to ensure the sustainability of internationally shared groundwaters.

THE FUTURE OF TRANSBOUNDARY AQUIFERS

The future of TBAs is now at a crossroads. A global status baseline exists and supporting tools for management and governance are established. Taking ownership of- and responsibility for shared vital resources, aquifer countries can use the baseline and supporting tools to assess priority zones/hotspots in needs for intervention/measurement measures. While doing that, more attention should be paid to groundwater quality and to the gender/social aspect of transboundary aquifers. Raising awareness of the importance of TBAs remains a challenging task, asking for involvement of all TBA stakeholders.



REFERENCES

- Inventory of transboundary groundwaters (**UNECE, 1999**);
- Transboundary Aquifers in Asia with Special Emphasis to China (**UNESCO, 2006**);
- Sistemas Acuíferos Transfronterizos en las Américas (**UNESCO-IHP, 2006**);
- First Assessment of Transboundary Rivers, Lakes and Groundwaters (**UNECE, 2007**);
- Second Assessment of Transboundary Rivers, Lakes and Groundwaters (**UNECE, 2011**);
- TWAP Volume 1: Transboundary Aquifers (**UNEP, 2016**);
- Inventory of Shared Water Resources in Western Asia (**UNESCWA, BGR 2013**);
- Draft articles on the Law of Transboundary aquifers (**UN International Law Commission, 2008**);
- ISARM programme, Framework Document (**UNESCO,2001**);
- Guidelines for Multidisciplinary Assessment of TBAs (**IGRAC and UNESCO, 2015**); and
- Transboundary Aquifers of the World [map]. Edition 2021. Scale 1 : 50 000 000. (**IGRAC, 2021**).

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