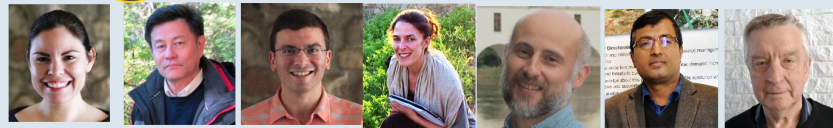


International Association of Hydrogeologists
IAH TRANSBOUNDARY AQUIFERS COMMISSION



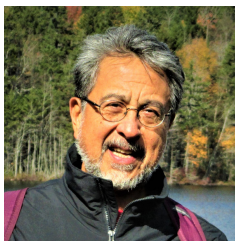
NEWSLETTER

JULY.20TH, 2021

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EDITOR'S MESSAGE

Alfonso Rivera
 Chair, TBA Commission



This is the first edition of the IAH-TBA Commission Newsletter in 2021, and the third since the Commission was restructured in early 2020. It has been eight months since our 2nd edition, a long winter and a long and winding road to deconfinement and liberation.

So many things have happened in spite of the imposed confinement; transboundary-aquifers related activities continued developing on our front. The good news is that we are healthy and continue having jobs.

Thus, we have many news to share with you in the transboundary aquifers' domain, and in groundwater in general.

Our main story in this issue is the ISARM-2021 International conference to be held in Paris, France, December 6-9, 2021. Other news includes the Progress on Transboundary Water Cooperation, second report on SDG indicator 6.5.2; webinars on transboundary issues, involvement of our TBA commission members in various events and many other groundwater science talks.

We have our usual sections on ISARM Networks as well, People in the News, Cooperation and Collaboration, Knowledge Capsules in TBA, upcoming meetings, webinars, conferences, and recent publications.

Good reading!

WHAT'S INSIDE THIS ISSUE:

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Recent Publications

ISARM-2021 INTERNATIONAL CONFERENCE ON TRANSBOUNDARY AQUIFERS

The Internationally Shared Aquifers Resources Management (ISARM) is a major multi-agency initiative launched more than 20 years ago. There have been many regional or local meetings on ISARM, but only one global conference held in Paris in December 2010. So, after more than a decade the time has come to hold the second International UNESCO Conference on transboundary aquifers: *ISARM2021 Challenges and way forward*. [ISARM2021](#) aims to be an opportunity for showcasing diverse efforts made by UNESCO and many partners across the world, including the IAH, FAO, GEF, and the regional ISARM networks from the Americas, Europe, Asia, and Africa.

Over the last 12 months, the IAH-TBA Commission, one of the main partners of this global conference, has been heavily involved in its organization with technical and scientific contributions. Six members of the TBA commission are participating either in the [Technical Program Committee](#), or in the [Scientific Committee](#). The TBA Commission contributed with 16 abstracts to the conference, two moderators and 2 panelists in the conference panels, and one keynote speaker.

Overall, the call for abstracts attracted close to 300 contributions from four continents, of which 110 were accepted for oral or poster presentations. In addition to individual presentations, ISARM2021 planned 7 panels and one side event. The panels are designed as forums for discussion, where moderators and panelists provide additional, deeper sense, of the TBA issues as compared to the oral or poster presentations. The moderators and panelists were carefully selected considering gender, regions equity, and expertise in TBA. The moderators will be encouraged to provoke the panelists to get them out of their comfort zone to express their real opinions.

The results of this conference will be captured in two books. A book of abstracts, which will be available to all as a PDF at the beginning of the conference; and a book with full papers extended from a selection of abstracts received. The second book will be published by UNESCO three to six months following the conference.

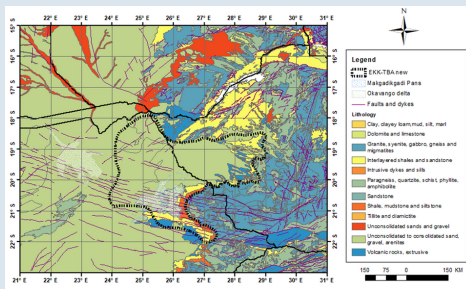
This will be an online conference with no registration fees required to participate, so don't miss it, it will be an exciting conference indeed!



ISARM 2021

6-9 DEC 2021
UNESCO HQ, PARIS, FRANCE

Challenges and the way forward



TDA ANALYSIS, HYDROGEOLOGY REPORT AND STRATEGIC ACTION PLAN (SAP)

THE EKK-TBA SHARED BETWEEN BOTSWANA AND ZIMBABWE IS A KEY SOURCE OF GROUNDWATER. KNOWN TO SUPPORT KEY ECONOMIC ACTIVITIES SUCH AS MINING, TOURISM AND FARMING, THE EKK-TBA IS SIGNIFICANT IN ANCHORING GDP GROWTH AND DEVELOPMENT IN BOTH BOTSWANA AND ZIMBABWE.

AS PART OF THE PROJECT “SUSTAINABLE GROUNDWATER MANAGEMENT IN SADC MEMBER STATES”, WHICH WAS FUNDED BY GEF AND THE MULTI DONOR TRUST FUND CIWA THROUGH THE WORLD BANK, THE SADC GROUNDWATER MANAGEMENT INSTITUTE (SADC-GMI) COMMISSIONED RESEARCH ON THE MANAGEMENT OF WATER RESOURCES IN THE EKK-TBA.

THE APPROACH TO ADVANCING JOINT MANAGEMENT OF THE RESOURCE ACROSS THE TWO COUNTRIES WAS PURSUED THROUGH (I) UNDERTAKING A TDA TO GATHER STATE OF KNOWLEDGE IN THE SHARED BASIN AND IDENTIFY PRIORITY ISSUES; (II) A SAP, FOLLOWING A RANGE OF STAKEHOLDER ENGAGEMENTS ACROSS RELEVANT SECTORS AND ACTORS; AND (III) KNOWLEDGE MANAGEMENT AND RESEARCH RESULTS. THE WORK ALSO RESULTED IN A DETAILED HYDROGEOLOGICAL ANALYSIS OF THE EKK-TBA.



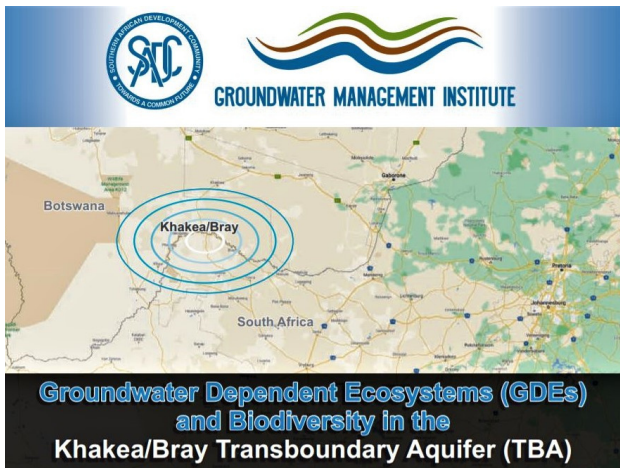
ISARM Africa TBA News

Stampriet Transboundary Strategic Action Plan (SAP)

UNESCO has commissioned the development of the Joint Stampriet Transboundary Aquifer System (STAS) Strategic Action Plan (SAP). The STAS extends from Central Namibia into Botswana and South Africa and falls within the Orange-Senqu River Basin. The purpose of the SAP is to provide a framework for joint management of the STAS between the three governments, as they address key challenges and leverage opportunities for sustainable development and use of the aquifer system. The SAP was developed through an engagement process of stakeholders to make sure that it reflects the priorities of the basin states. The Strategic Action Programme for the Orange-Senqu River Basin is guided by the overall objective: “Orange–Senqu basin states collectively reduce water pollution, control catchment degradation and mitigate the effects of environmental degradation”.

At a workshop attended by representatives of the Member States of the STAS, the following subsidiarity sustainability goal was formulated: “Improved groundwater governance in the STAS for a safe water and water secure future”.

The following strategic objectives were identified through the consultative process: (i) limit the decline in groundwater levels and reduction in storage to provide for equitable use of groundwater resources; (ii) maintain current groundwater quality by limiting anthropogenic and geogenic concentrations; (iii) strengthen source water protection and resilience of water supplies; and (iv) develop and strengthen appropriate groundwater governance institutions resulting in capacitated local participative groundwater resource management. The STAS SAP has been submitted for formal approval through the Orange-Senqu River Basin Commission decision-making structures.



Groundwater Dependent Ecosystems (GDEs) and Biodiversity in the Khakea/Bray Transboundary Aquifer

The Khakea/Bray Transboundary Aquifer shared between Botswana and South Africa is experiencing rapid increase in water abstraction for agriculture and domestic use, which threatens the sustainability of its GDEs. This project will integrate GIS and remote sensing, hydrogeology, and ecology to generate data on the biodiversity of the Khakea/Bray TBA and develop a database linking groundwater information to ecological health.

This project aims to define the relationships between groundwater quality, groundwater levels, and the biodiversity in the TBA and ultimately encourage joint management of the Khakea/Bray TBA and other transboundary systems in the SADC region. Information about the project is available from <https://sadc-gmi.org/wp-content/uploads/2020/10/Khakea-Bray-Transboundary-Aquifer-GDEs.pdf>.

Big Data Analytics and Modelling: Localising transboundary data sets in Southern Africa: A case study approach

A transboundary aquifer analytics framework was designed to provide a methodical approach to the application of Big Data analytics to support groundwater management. The main components of the framework include case study areas selection, establishment and selection of groundwater management scenarios and a set of sustainability indicators. Relevant data and modelling of sustainability indicators using Big Data analytics, will better inform local groundwater management scenarios.

Two case study areas were chosen to explore the applications of Big Data analytics to groundwater management: The Zeerust/Lobatse/Ramotswa Dolomite aquifers of Botswana and South Africa, and the Shire Valley Alluvial Transboundary aquifer in Malawi and Mozambique. Through a process of model training, validation, and testing, a Gradient Boosting Decision Tree machine learning model was developed for the Ramotswa aquifer that predicted 30-day groundwater level changes.

Concerns regarding model performance in terms of predicting extreme values are still present, as well issues regarding effective model training. This is a consequence of aquifer processes such as abstraction and episodic events that could not be accounted for. Nonetheless the results suggest that additional data and the inclusion of features such as abstraction may improve model performance.



New project brings five African countries together to jointly manage region's groundwater

The five Partner States of the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA) have joined forces with the International Water Management Institute (IWMI) to manage groundwater resources spanning an area larger than Austria and Germany. The KAZA TFCA counts on at least five transboundary aquifers (TBAs). Further information is available at <https://www.iwmi.cgiar.org/2021/04/new-project-brings-five-african-countries-together-to-jointly-manage-regions-groundwater/>.

ISARM AMERICAS TBA NEWS



The ISARM Americas network is coordinated by CeReGAS since 2018; since then, new representatives from countries across the American hemisphere have been appointed. This new network replaces the very successful network that existed between 2005 and 2015 composed of 24 countries.

Training is one of the various CeReGAS activities going on since 2018. In 2021, and for the second consecutive year, the course "Governance of Transboundary Aquifers" was held under the coordination of UNESCO, CODIA and CeReGAS. The virtual course was held from June 14 to 18 2021, with an average of 120 attendees per day. The contents of the course focused on legislation and hydrological planning in Latin America and the Caribbean (LAC), the governance of groundwaters and transboundary aquifers and the case of the Guaraní Aquifer System Agreement.

Also noteworthy in the region is the upcoming start of the Project "Implementation of the Strategic Action Program of the Guaraní Aquifer System: facilitating regional actions" which is financed by the GEF and is the result of the coordination effort between Argentina, Brazil, Paraguay and Uruguay. CAF will be responsible for the implementation of the project, while UNESCO will be in charge of the execution according to the design made and assumed by the countries and approved by GEF. The technical execution of the project will be coordinated with the support of CeReGAS who will host the "*Technical committees of monitoring and models and of gender, participation and dissemination*", in close contact with the National Coordinators.

In other areas of the region, within the framework of the ISARM Americas Program, actions are being initiated on transboundary aquifer systems: Yucatan-Candelaria-Hondo Peninsula shared by Guatemala, Mexico and Belize and Artibonito-Masacre shared by Haiti and the Dominican Republic.

Finally, the LAC region has promoted the participation and presentation of work to the Second International Conference on Transboundary Aquifers-ISARM 2021 to be held in Paris in December 2021.



The Permanent Forum of Binational Waters is celebrating its 1st Anniversary this month. The Forum currently integrates over 150 members and 64 binational institutions. Has developed 4 permanent science-based communication programs including Coffee Breaks, Science Talks, Facts and Mythbusters and Open Mic series.

It has also developed 3 initiatives: Women in Science, the Binational Groundwater Task Force, and binational publications. Over a year or work, the Forum has built an archive of data, models and over 500 scientific publications related to transboundary waters between the two countries. The Forum has been institutionalized as a non-profit organization with autonomy to become a formal entity in the U.S.-Mexico border region, but also as a potentially global institution that could support water collaboration in other regions of the world.

The Forum has organized a fundraising Campaign: A Call for Art, to Call for Water. To see the gallery of art and guidelines to participate in this event, [click here](#). And if you are interested in supporting the Forum, please [donate here](#).

GGRETA WORKSHOP

On the 29th June-1st July, IGRAC, in collaboration with UNESCO-IHP under the GGRETA 3 project, hosted a 3-day online training course for African Lake and River Basin Organizations on groundwater management. The course provided theoretical background and practical guidance on how to implement transboundary groundwater resource management in Lake and River Basin Organizations.

Online course on groundwater quality in TBAs

In the same GGRETA framework, a short online course on groundwater quality in TBAs was implemented in Africa. As a precursor to the course, a webinar was held attracting over 1,500 participants worldwide. The complete course was developed to be delivered in modules from 12th April to 11th May, 2021. Kevin Pietersen, member of the TBA Commission, was one of the instructors for this training course.

The four modules were: 1) TBAs in Southern Africa; 2) groundwater quality monitoring; 3) climate change and groundwater quality implications in TBAs; and 4) the role of stakeholders' participation and communities in groundwater quality management.



UNESCO/UNECE SDGs: role of ISARM within indicator SDG 6.5.2

In 2015, the 2030 Agenda for Sustainable Development was adopted by all United Nations Member states. Superseding and building upon the Millennium Development Goals era, the Sustainable Development agenda is built around 17 global goals that are designed to reflect currently global challenges within the 3 pillars of sustainable development: the economic, society and environmental. ISARM principles have contributed to the SDG targets.

The first report on Transboundary Water Cooperation was published in 2017. In the first reporting cycle held in 2017-2018, 107 out of 153 countries sharing transboundary waters responded to the invitation to report on SDG indicator 6.5.2 by UNECE and UNESCO. 38 out of 40 Parties responded to the request to report under the Water Convention.

The second report on SDG indicator 6.5.2 includes analysis of accelerating progress on transboundary water cooperation to achieve Target 6.5. It is expected that a much larger number of countries will report back; the second report is due in 2021. At the time of completing this new issue of our Newsletter, the SDG 6.5.2 progress report had not been published yet.

More news....

SDG 6 Capacity Development Initiative Concept Note

Ever since the Sustainable Developments Goals (SDGs) were launched, many countries have struggled with SDG 6 implementation and achieving SDG 6, in particular, 'due to a lack of institutional, human, financial and technological capacity'. UN-Water is launching an initiative to help address the gaps in implementing water and sanitation related goals and targets of the 2030 Agenda for Sustainable Development. A concept note was recently circulated to around 150 representatives of various organizations worldwide and was discussed at a meeting on 14 June by UN Water and invited speakers.

IAH (represented by IAH President, Dave Kreamer) was one of the organizations that confirmed its interest in being involved in the initiative. Dave Kreamer and Ian Davey will act as the two focal points for this initiative, our TBA Commission will be involved contributing in the specific aspects of one transboundary water cooperation indicator SDG 6.5.2.

Contribute to the Transboundary Aquifers of the World Map Update 2021

This year, IGRAC are updating the Global Transboundary Aquifer Map. The map is designed to show the information presently available on the occurrence and extent of transboundary aquifers globally. Members of the TBA Commission are participating in the new IGRAC global map.

As part of this update, they are looking for contributions from the TBA Community. Therefore, we kindly ask that if you or your organization has been part of a project where the assessment and understanding of a TBA has been improved, or a new TBA has been identified, please get in touch.

More information can be found [here](#).

EVENTS

IAH EVENTS 2021

Because of the Covid-19 pandemic, the 2020 AIH Congress in Sao Paulo could not be held. It was thus decided to hold two congresses in 2021, in Sao Paulo and in Brussels. Brazil and Belgium are coordinating efforts to organize the two events. Therefore, hydrogeologists will be able to attend the 47th IAH CONGRESS in Brazil on August 22nd – 26th, and the 48th IAH CONGRESS in Belgium, on September 6th – 10th.

The 47th IAH Congress in Sao Paulo, will be organized by the International Association of Hydrogeologists (IAH), the Latin American Groundwater Association (ALHSUD) and the Brazilian Groundwater Association (ABAS). It is named "GROUNDWATER 4.0: CONNECTED, VISIBLE AND ETHICAL". Transboundary aquifers are not identified as a main session theme but never far from the topics of the congress. It will be associated with other events: XV Latin American Congress of Hydrogeology, XXI Brazilian Congress of Groundwater, XXII National Meeting of Well Drillers and National Water Fair. It will be a hybrid event (online and on-site) and will definitely engage a very large groundwater community. Registration is here:

<https://iah2021brazil.org/en/registration-2/>



The 48th IAH Congress in Brussel is named "Inspiring Groundwater", to evoke the fact that "water and groundwater have constantly inspired mankind to develop techniques for the production of drinking water, to transport water to people, to the control of water courses, to the search for new sources, to combat scarcity". It is organized by IAH and the Belgian Committee of Hydrogeologists (CBH-BCH). It will be a live event (on-site) presenting about 300 speakers. There will be a specific session on "Regional groundwater systems and transboundary aquifers" co-organized by the IAH Regional Groundwater Flow Commission (Session chairs: OkkeBatelaan, Xiaowei Jiang, Hanneke Verweij and FadouaHamzaoui)

Registration is here:

<https://iah2021belgium.org/registration/>

In our previous newsletter (October 20, 2020), we launched an initiative to compile a working list of all transboundary aquifer agreements and arrangements. The TBA Commission began compiling a list in collaboration with IGRAC and UNESCO IHP; we reached out to all members to assist us in identifying and describing agreements and arrangements over transboundary aquifers, may these be formal or informal. The survey has not been completed and we have not had many entries.

We ask for your assistance again by adding any agreements or arrangements that you know of help populate the table in the link below. All contributions can be added to the working google document here:

<https://docs.google.com/document/d/1Q09-OzIDhuqREoy979teG04n8A4uv14yWPIPunT4KCK/edit>

People in the news

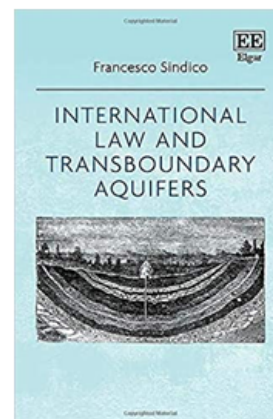


Alfonso Rivera, Chairman of the IAH-Transboundary Aquifers Commission, received a recognition by the IAH Canadian Chapter for an outstanding contribution to the groundwater community in Canada over 21 years. They granted him the prestigious award: "Recognition of Lifetime Achievement in Hydrogeology". This award recognizes scientists who have provided significant local, national or international contributions to the profession of hydrogeology over their careers.

Book International Law and Transboundary Aquifers by Francesco Sindico

In his book *International Law and Transboundary Aquifers*, Francesco Sindico offers a comprehensive study of the emerging body of international law applicable to transboundary aquifers.

Adopting a scenario-based approach, this much-needed book analyses a diverse set of transboundary aquifer agreements and arrangements. With just a handful of such agreements and arrangements around the world, it demonstrates how identifying a normative roadmap for countries that want to begin jointly managing a transboundary aquifer is of paramount importance. Offering an in-depth exploration into the ILC Draft Articles on the Law of Transboundary Aquifers, it provides insight into how this body of law is evolving, and discusses its relation to customary international law.



Academics and researchers interested in international water law, environmental law and public international law more widely will find this a unique and compelling work, whilst the book's practical approach will also make it a useful tool for transboundary aquifer professionals and wider stakeholders working in governments and public bodies dealing with water management around the world.

To launch the book, a webinar was held in March 28, 2021 with prominent guest speakers discussing the future of international water governance through the journey that has led to this book.

The full webinar can be watched here: <https://www.youtube.com/watch?v=tvI0huxbzT8&t=1607s>

OTHER SHORT NEWS

- The TBA Commission participates as partners and contributors to the webinar: *Transboundary Aquifers – Science and International Water Law*.
- Members of the TBA Commission participate in the drafting of chapter dedicated to *Transboundary Aquifers* in the upcoming *World Water Development Report WWDR-2022*.
- Members of the TBA Commission are involved with the *Permanent Forum of Binational Water – USA/Mexico* in its BGTF group; a *Binational Groundwater Task Force*. This group includes members from the USA and Mexico. The BGTF was tasked to set the basis for the way forward of the *Binational Forum* and to identify the main common transboundary groundwater issues along the Mexico/USA /US) border.

KNOWLEDGE CAPSULES ON TBA

In the previous edition of our Newsletter, we discussed the terms: aquifer, transboundary aquifer, fossil water, and groundwater age; we also suggested a means to initiate the discussion on how to design groundwater management units and why it was important to have long-term data on water levels.

In this issue, we add an open question on transboundary aquifers and transboundary groundwater, and we launch a discussion in an effort to define the meaning of sustainable use of groundwater under TBA contexts.

Transboundary Aquifer -vs- Transboundary Groundwater

A hotly debated subject has emerged under the context of transboundary aquifers (TBA). When planning any type of arrangement to manage an aquifer spanning two or more jurisdictions, MoU, Minutes, legally binding agreements, etc., what should be managed—the aquifer or the groundwater flowing through the aquifer? Is there a trend of misunderstanding between the two terms? In the realm of hydrogeology, there is no dispute on the existence of clarity about the differences between groundwater and aquifers. However, this does not seem to be the case for the law and policy literature, which are strong components of any type of agreement to share a TBA (Rivera, 2021).

A new vocabulary, new concepts, and more accuracy in terminology have emerged over the last 20 years under ISARM (Internationally Shared Aquifer Resources Management). However, there are disagreements because cultural, political, economic, and social factors differ around the world. In addition to its natural boundaries, *jurisdictional boundaries* need to be added to the TBA.

As of today, there is no single solid response to this debate. Rivera (2021) suggested that “*Management of groundwater at the scale closer to the jurisdictional boundaries, should be chosen rather than the full aquifer*” but this is still open to discussion.

Transboundary zoning: to zone or not to zone

When dealing with a shared aquifer with groundwater crossing from one jurisdiction to the other, we should keep in mind the artificial (jurisdictional) boundary. For example, if we need to build a numerical model of the aquifer for management purposes, we would need to add an additional boundary condition to it: a jurisdictional boundary. This type of boundary condition does not exist in numerical models.

In that case, we are faced with the issue of selecting the best optimal area for shared management. So, should we zone in in the area for managing closer to the jurisdictional boundary only? Or should we consider the full extent of the complete aquifer? If we concentrate in the most urgent and most important areas, e.g., closer to the artificial boundary, we could make use of a specific units for management purposes: a groundwater flow system, the radius of influence, a capture area, a pressure compartment, groundwater age, etc. To do that correctly, however, the dynamics of groundwater within the aquifer (time and space scales) must be well understood closer to the jurisdictional boundary. Further, to complement the knowledge of groundwater dynamics, new elements and/or variables need to be added, e.g., social, economic, and political needs.

Unfortunately, there are currently no available guidelines that detail how to prioritize and estimate these zones within TBAs to inform and guide groundwater policy and decision makers.

During the ISARM2021 World Conference, one of the [panel discussions](#) will debate on this issue, it will summarize the advances in this specific domain.

Sustainable use of groundwater within a transboundary aquifer context

It is not easy to define the sustainable yield of an aquifer system; there is neither universal consensus, nor a single definition. In many cases, programs for groundwater management pay attention to the integration of groundwater and surface water in the planning process. Those plans usually discuss issues of demand and yield, but never directly address a fundamental issue behind the plans—how to define sustainable yield of an aquifer system.

If we add the fact that the aquifer system is shared by two jurisdictions with very different approaches for water management, then defining and adopting a sustainable yield and use of that aquifer becomes mind boggling.

One approach for designing a sustainable groundwater development within a transboundary aquifer context is to build a conceptual model, or framework, with a comprehensive balance of the aquifer system. Such a development would be appraised by the balance between the transboundary aquifer **storage** (the groundwater resource) and the social, environmental and economic **benefits** for the countries sharing the TBA system.

To assess storage, on the one hand, detailed estimates of natural indirect, and artificial recharge, and groundwater in storage, should be assessed. The **benefits**, on the other hand, groundwater supply (drinking water), groundwater discharge (rivers, springs, wetlands, ecosystems), and groundwater abstractions (agriculture and industry) should be measured or estimated.

Theoretically, this is feasible, but it requires a great deal of collaboration in working together to create something new in support of a **shared vision**. Such a comprehensive approach, unfortunately, has yet to be tested. We will report back on this important TBA issue as new study cases are completed and publicly available.

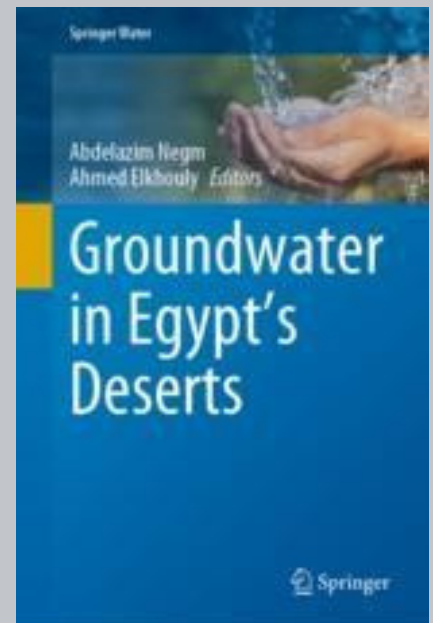
Groundwater in Egypt's Deserts

A new book on Groundwater in Egypt's Deserts (eds Negm and Elkhoully, 2021) brings together contributions from groundwater researchers and scientists on underground water resources in Egypt's deserts. The aquifers' quantity and quality are evaluated in many regions of the Egyptian deserts using established methods that can be effectively employed to investigate the potential for sustainable development in Egypt and similarly arid countries.

The book includes a chapter on transboundary issues co-authored by Caroline King, member of the IAH TBA-Commission (chapter 11: Transboundary groundwater management issues in the Nubian Sandstone Aquifer System by C. King and A. Abdelkhalek).

This chapter emphasizes that to monitor, manage and sustain the hydrological, ecological and socio-economic aspects of the transboundary system requires the engagement of local institutions to conduct or facilitate the monitoring and to implement the management practices.

The main recommendation is to build and share knowledge about local capacities to manage ecosystem service production and recharge patterns in the surface layers, as well as to monitor and jointly manage the reserves stored in the deeper layers.



RECENT PUBLICATIONS

AVAILABLE ONLINE COURSES WITH FOCUS ON TRANSBOUNDARY WATERS AND TRANSBOUNDARY AQUIFERS

- MOOC “Governance for Transboundary Freshwater Security”, Global Water Partnership in collaboration with GEF IW:LEARN, edX
<https://www.edx.org/course/governance-for-transboundary-freshwater-security?index=product&queryID=77ce16dec9d99faf8bf61c9cdebb9602&position=1>
- Water Resources Management and Policy - University of Geneva and Geneva Water Hub-Coursera French version: www.coursera.org/learn/gestion-eau English version: <https://www.coursera.org/learn/water-management>
- Introduction to Groundwater Governance GGRETA01, UNESCO https://openlearning.unesco.org/courses/course-v1:GGRETA+GGRETA01+2020_01/about

BOOK on Global Groundwater 1st Edition: Source, Scarcity, Sustainability, Security, and Solutions. Editors: Abhijit Mukherjee Bridget Scanlon Alice Aureli Simon Langan Huaming Guo Andrew McKenzie, 2021. Paperback ISBN: 9780128181720 eBook ISBN: 9780128181737.

BOOK on Groundwater in Egypt's Deserts, 2021. Editors: Negm, Abdelazim, Elkhoully, Ahmed A. eBook ISBN 978-3-030-77622-0 DOI 10.1007/978-3-030-77622-0 Hardcover ISBN 978-3-030-77621-3.

Puri, S., and K.G. Villholth, 2021. I say 'aquifer' and she says 'groundwater' ... Let's call the whole thing off... (with apologies to Ella Fitzgerald & Satchmo). A blog in Water Alternatives [Forum](#)

Rivera, A., 2021. What should we manage, aquifers or groundwater? [Guest Editorial](#), Groundwater Journal. National Groundwater Association. DOI: 10.1111/gwat.13115;

Sindico, F., 2020. International Law and Transboundary Aquifers. ISBN: 978 1 78811 762 3 Extent: 208 pp

Shamir, Eylon, Elia M. Tapia-Villaseñor, Mary-Belle Cruz-Ayala, and Sharon B. Megdal. “A Review of Climate Change Impacts on the USA-Mexico Transboundary Santa Cruz River Basin.” Water 13, no. 10 (May 16, 2021): 1390. <https://doi.org/10.3390/w13101390>.

Tapia-Villaseñor, Elia M., and Sharon Megdal. “The U.S.-Mexico Transboundary Aquifer Assessment Program as a Model for Transborder Groundwater Collaboration.” Water 13, no. 4 (February 18, 2021): 530. <https://doi.org/10.3390/w13040530>.