





International Groundwater Resources Assessment Centre

IGRAC, the International Groundwater Resource Assessment Centre facilitates and promotes international sharing of information and knowledge required for sustainable development, management, and governance of groundwater resources worldwide. Since 2003, IGRAC has been providing independent content and process support, focusing on transboundary aquifer assessment and groundwater monitoring.

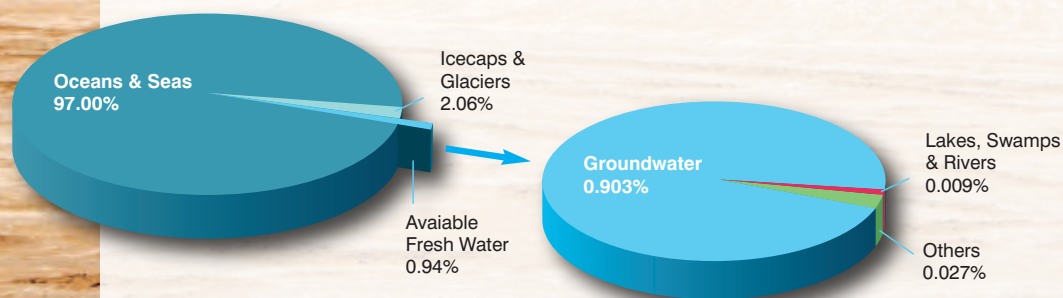


GROUNDWATER: AN IMPORTANT GLOBAL RESOURCE

Groundwater is a very important natural resource and element of the environment. About 50% of the world's population drinks groundwater every day. Groundwater is also vitally important for agriculture as it contributes to more than 50% of the world's production of irrigated crops. Groundwater sustains ecosystems, maintains baseflow of rivers and stabilises land in areas with soils that are easily compressed.

To ensure maximum benefit from groundwater and to control groundwater problems that develop under increased pressures from climate change and human activities, groundwater resources need to be assessed and managed properly. Groundwater management can only be effective if it is based on area-specific information and is tailor-made for the area of concern. In order to identify and analyse the issues to be addressed worldwide and to define priorities for the global water agenda, this area-specific information needs to be aggregated at the national, regional and global levels. Therefore, IGRAC collects, processes and disseminates groundwater related information to the global groundwater community.

Distribution of the water on earth



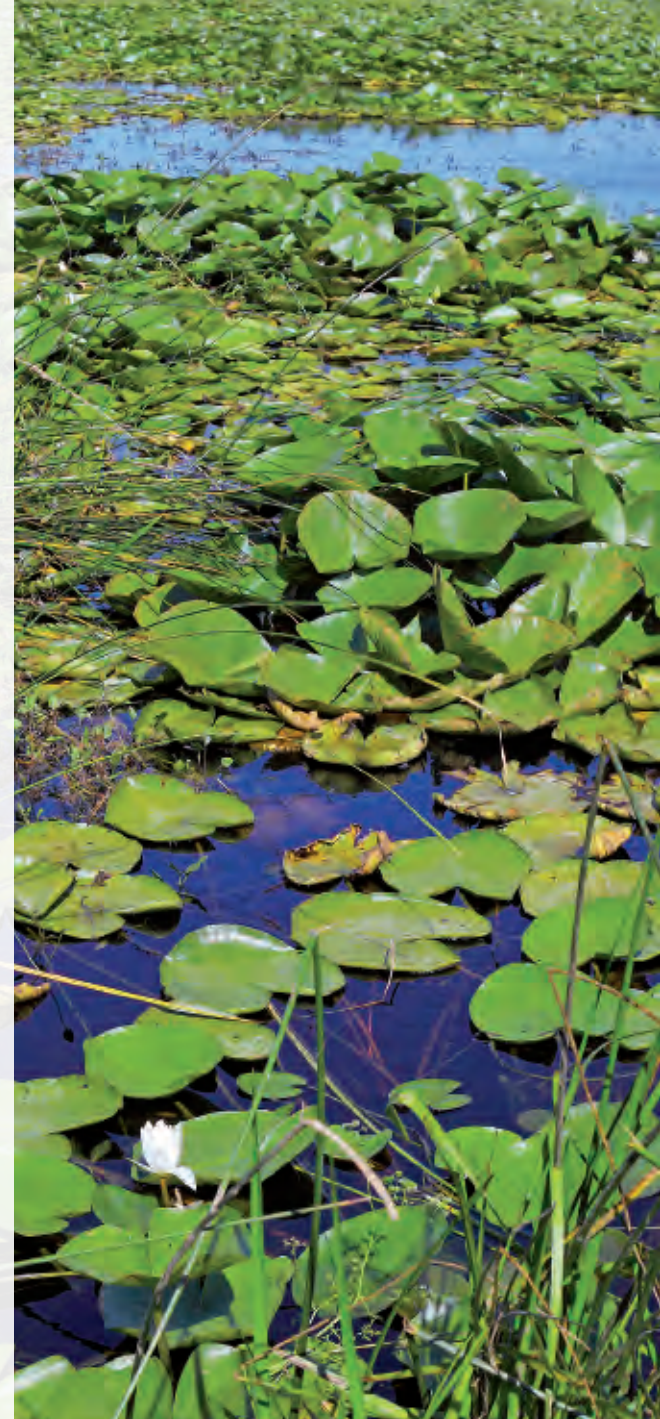


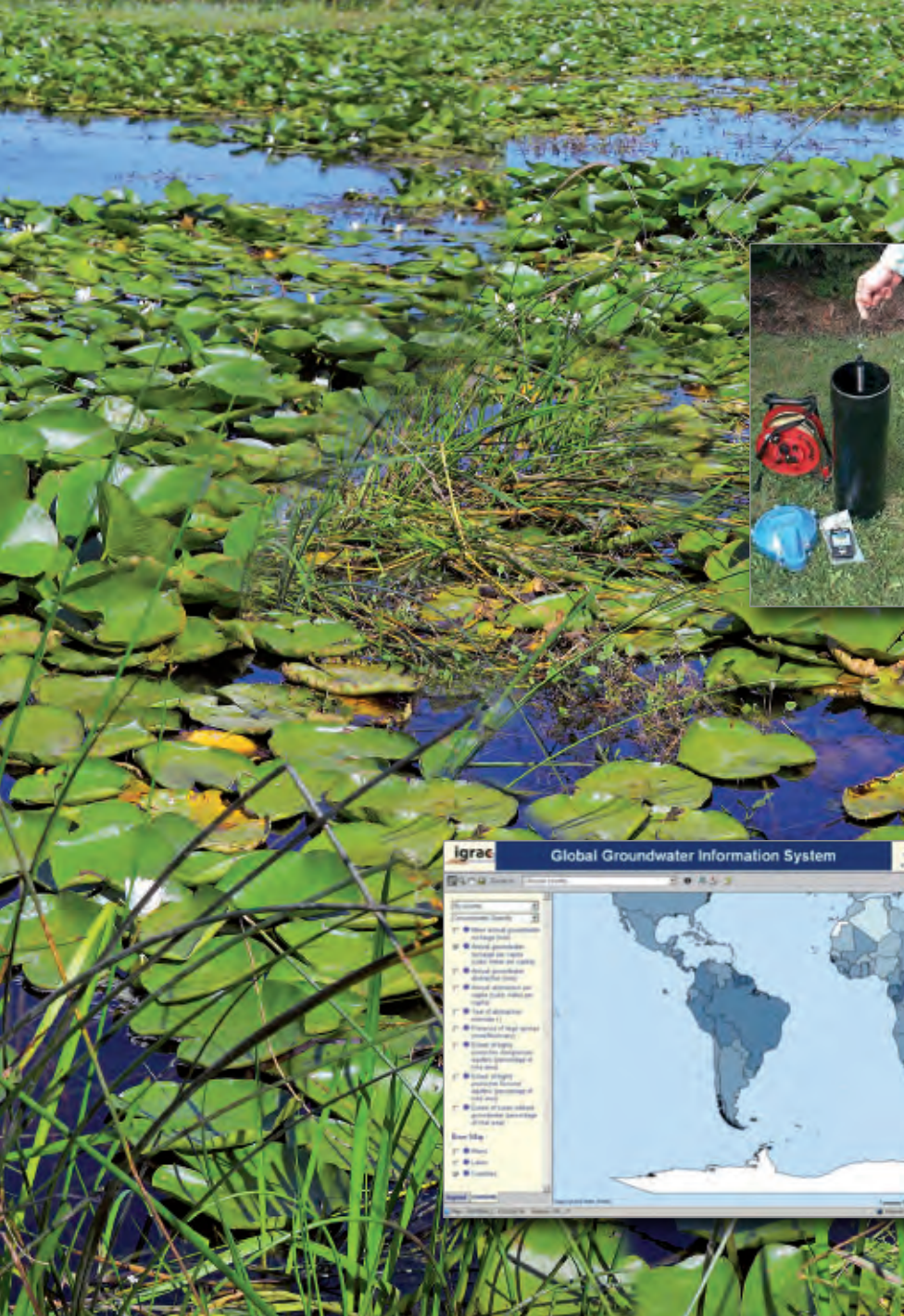
ESTABLISHMENT OF IGRAC

In 1999, UNESCO and the World Meteorological Organization took the initiative to establish IGRAC - the International Groundwater Resource Assessment Centre. In 2000, the Government of the Netherlands expressed interest in hosting IGRAC and *the centre was launched in March 2003*, during the third World Water Forum in Kyoto. Initially, IGRAC was hosted by Netherlands Organization for Applied Scientific Research (TNO) and financed by the Government of the Netherlands through the *Partners for Water Programme*.

In January 2011, the Government of the Netherlands reaffirmed its commitment to IGRAC and in June 2011 IGRAC was registered as a legally independent foundation. Becoming an independent organisation facilitated IGRAC's recognition as a UNESCO centre. *The agreement between UNESCO and the Kingdom of the Netherlands* regarding IGRAC was signed in November 2011. Not much later, in October 2012, the *World Meteorological Organization* and IGRAC signed a Memorandum of Understanding to work under its auspices.

Now, IGRAC is the UNESCO Global Groundwater Centre, working under the auspices of the World Meteorological Organization and cooperating closely with the International Association of Hydrogeologists. IGRAC continues to be financially supported by the Government of the Netherlands. Being the in-house partner of the UNESCO-IHE - UNESCO's Institute for Water Education - IGRAC's offices are located in Delft, the Netherlands.



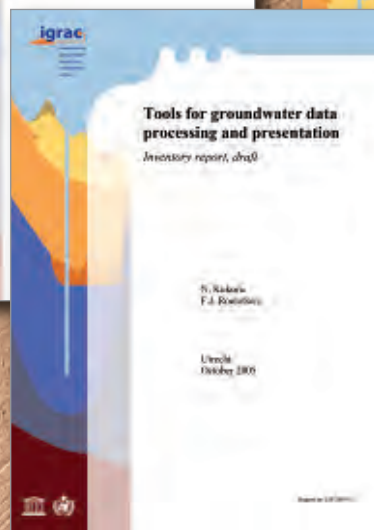


IGRAC'S FIRST INITIATIVES

IGRAC was born from the need to *better understand groundwater at the regional and global scales*. Since groundwater assessments cannot be done without sufficient information and knowledge, from the beginning IGRAC's main task has been one of *knowledge management and knowledge sharing*. Ten years ago IGRAC began gathering, processing and disseminating groundwater data and information, with ambitions of facilitating and promoting broader information and knowledge sharing within the global groundwater community.

In 2003 IGRAC started with two main activities: the collection, development and promotion of Guidelines and Protocols related to groundwater data acquisition and groundwater monitoring and the development of a Global Groundwater Information System (GGIS). Now, the *Guidelines and Protocols* initiative has concluded and has paved the way for the creation of a global groundwater monitoring network programme. The second activity, the *Global Groundwater Information System* has been developed into an easily accessible on-line platform. Year by year, it keeps on expanding as an increasingly robust source of information.

From the very beginning, IGRAC was also enthusiastic about *participating in regional and global projects and programmes*. This took some time, but now international cooperation is present in most of IGRAC's activities. IGRAC is participating in numerous projects and programmes together with agencies such as the UNESCO International Hydrologic Programme and the Global Environment Facility (GEF).



igrac

Guidelines and protocols

Online database

Search result
47 publications found
[Show publications](#)

Detailed search (within publications found)

Text search (case sensitive)

Target group/intended user

Type

Nature

[Detailed search](#)

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Guidelines & Protocols

To IGRAC site



GROUNDWATER MONITORING GUIDELINES AND PROTOCOLS

In 2003, IGRAC conducted an *inventory of existing guidelines and protocols for groundwater assessment and monitoring*. It was aimed at improving the international community's access to monitoring guidelines and protocols that might be useful to them. Following the same objective, IGRAC developed an on-line database containing structured information of about 400 guidelines and protocols.

A year later, a *worldwide inventory on groundwater monitoring practices* followed. It further identified the need for guidelines and protocols in the field of groundwater monitoring. At the time available guidelines did not adequately address challenges in the early stages of creating a groundwater monitoring system. These challenges include poor hydrogeological information, limited financial resources and/or limited institutional capacity.

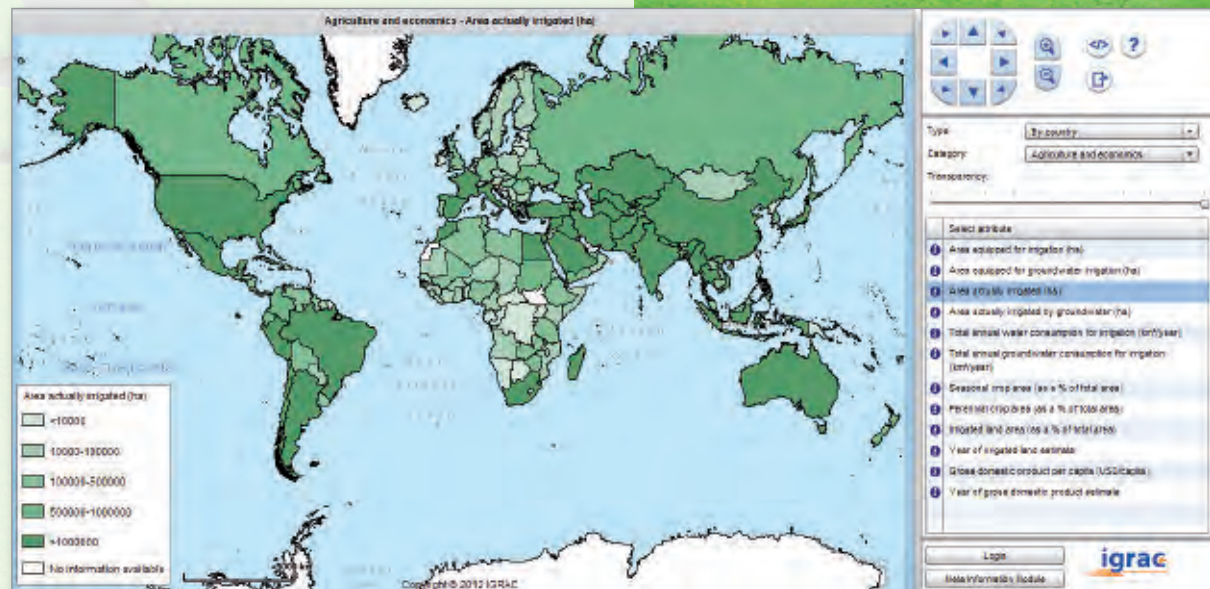
To confront these challenges, IGRAC assembled a working group of specialists from 12 countries to develop a *guideline on groundwater monitoring for general reference purposes*. The guideline was completed in 2006 and translated into Spanish a year later. With these initial efforts, IGRAC's activities on Guidelines and Protocols have been completed. Currently, the Guideline and Protocols on-line database is incorporated into the Global Groundwater Information System.



GLOBAL GROUNDWATER INFORMATION SYSTEM

In 2004, IGRAC launched the first version of the GGIS - *Global Groundwater Information System*. GGIS is an interactive, web-based portal to groundwater-related information and knowledge. GGIS is simple to use and publicly accessible. It leads the user from aggregated, global information in *Global Overview* via related information sources in the *Meta-Information Module* towards a direct information exchange in a collaborative environment. The Global Overview contains information on the assessment of global groundwater resources. The online application currently contains a *Country View* with about 70 world maps showing aggregated groundwater-related attributes for each of the countries. The Meta Information Module is an online repository, containing information on groundwater experts, organisations and groundwater related documents. Groundwater specialists and groundwater-related organisations can upload their profiles, links and documents that they wish to share with the wider groundwater community. The *Global Groundwater Monitoring Network* is the youngest GGIS module developed to facilitate monitoring of a global change of groundwater resources.

After eight years of on-line operation, in 2012, IGRAC undertook a major update of the Global Overview and Meta Information Module in order to apply state of the art technology and make the system more interactive and user friendly. Currently, the Global Overview is undergoing a major content update, including the development of Transboundary Aquifer View, which will enable users to view attributes of specific transboundary aquifers.

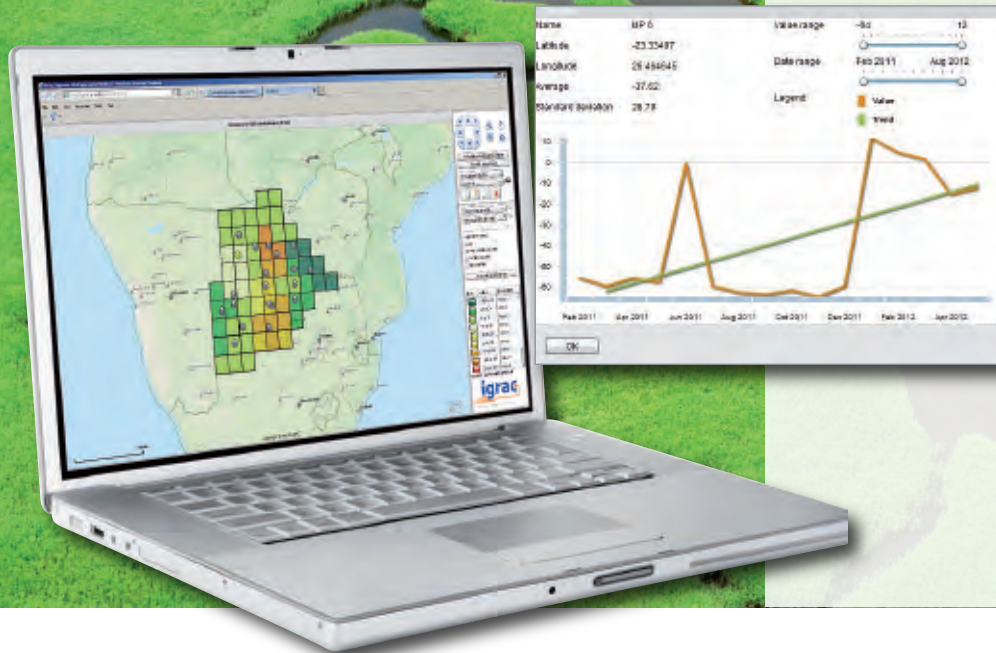


GLOBAL GROUNDWATER MONITORING NETWORK

Lack of data from systematic groundwater monitoring is one of the crucial obstacles for sustainable management of groundwater resources. Based on the principles of participatory monitoring, IGRAC has developed the Global Groundwater Monitoring Network (GGMN). The GGMN is a programme in which groundwater data from a global network of groundwater professionals is gathered, processed and made accessible to a range of stakeholders. The programme aims to close the groundwater data gap, enabling periodic assessment of groundwater resources at the transboundary, regional and global scale.

The GGMN has two major components: GGMN Portal, which is an online GIS-based application, and a GGMN People Network. The *GGMN Portal* assists the members of the *People Network* in the analysis of monitoring data and provides insights into changes occurring in groundwater resources worldwide.

IGRAC is continually engaging more countries and regional specialists in the programme. Regional workshops are organised to strengthen and expand the GGMN People Network in data sparse areas. At the same time, IGRAC is establishing automated data transfer from national databases that are already available on-line. The long-term ambition of the GGMN is to provide an on-line overview of global groundwater changes on a monthly basis.



COLLABORATIVE TRANSBOUNDARY AQUIFER ASSESSMENT

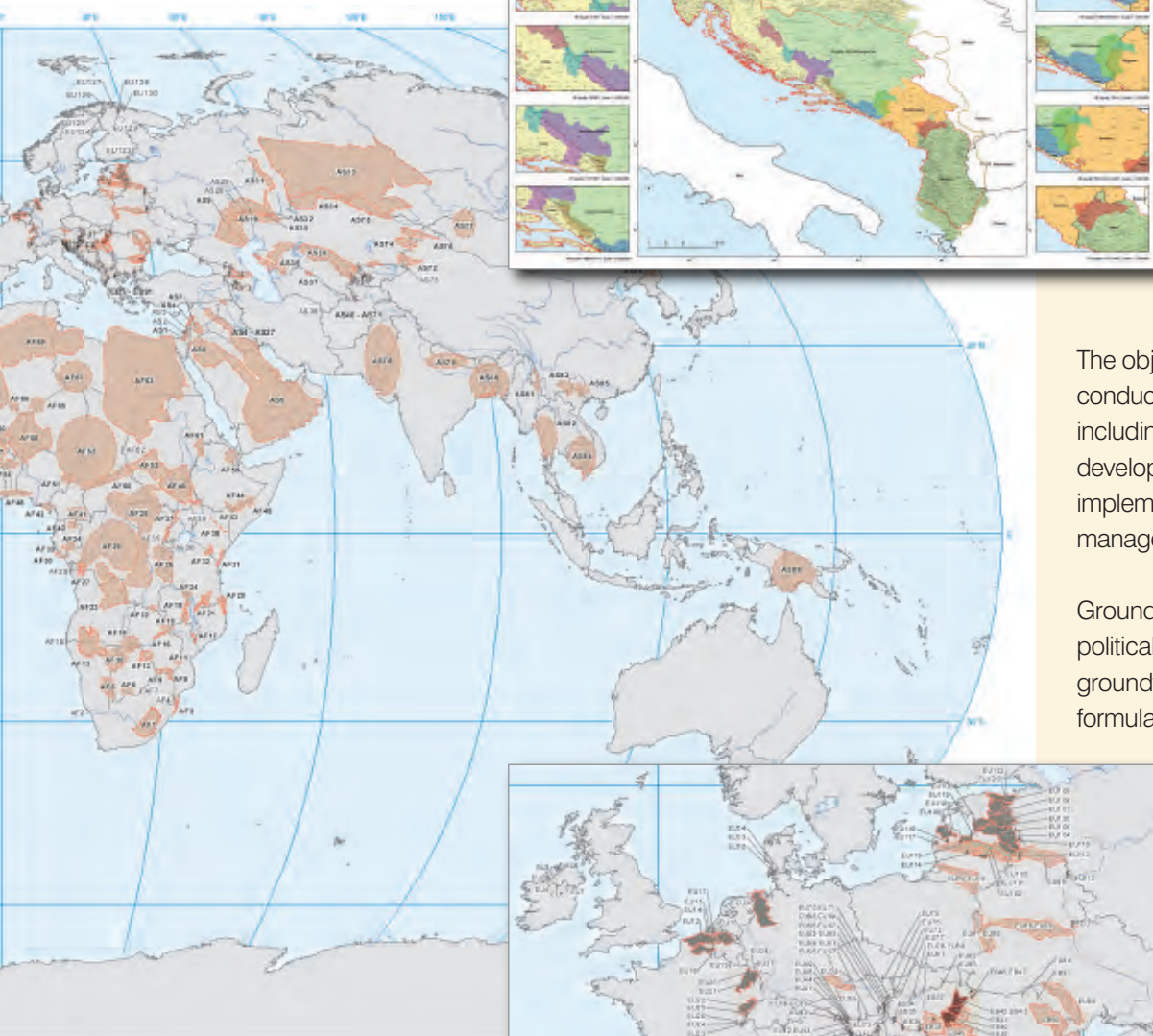
The vast majority of countries share aquifers with their neighbours. Political, institutional, socio-economic, cultural and other differences among countries make the assessment and management of internationally shared aquifers challenging - especially in comparison to aquifers encompassed within national borders. Insufficient knowledge of transboundary aquifers and a lack of mutually coordinated management can lead to undesirable changes in groundwater flow, quality and quantity. Accordingly, appropriate assessment and management of *Transboundary Aquifers* (TBAs) is necessary to prevent or mitigate groundwater problems and to improve the overall benefits from groundwater.

In the last several years, assessment of transboundary aquifers has become one of IGRAC's main activities. The major transboundary aquifer assessment activities at IGRAC are carried out within the framework of ISARM - *the Internationally Shared Aquifer Resource Management* programme (www.isarm.org), the UNECE assessments and the GEF - *Global Environment Facility* projects. In collaboration with these three programmes maps of transboundary aquifers from across the world have been mapped. The results of the mapping are compiled in the IGRAC map *Transboundary Aquifers of the World* in 2009 and updated in 2012.

In 2005, IGRAC partnered with GEF to facilitate a forum on transboundary groundwaters. Since then, IGRAC has become involved in the preparation and execution of various GEF International Waters projects such as IW Learn, IW Science, DIKTAS, and the Transboundary Waters Assessment Programme (TWAP).

For example, the *DIKTAS project* aims to improve understanding of transboundary groundwater resources of the Dinaric region of South-East Europe and to facilitate their equitable and sustainable utilisation. This





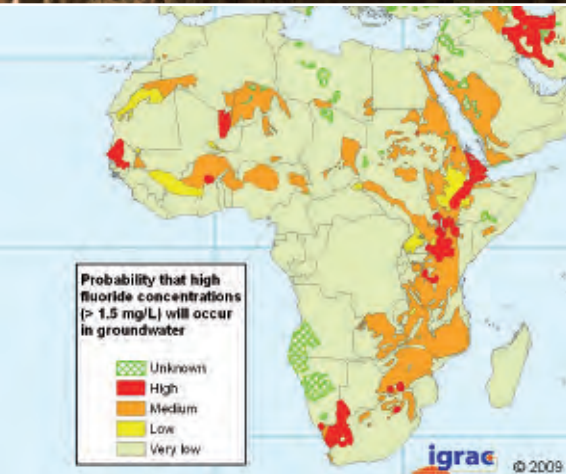
Transboundary Aquifers of the World



includes the protection of unique karst groundwater dependent ecosystems. Karst is a special type of geologic environment characterised by almost total absence of surface water, high infiltration rates and rapid underground flows of groundwater. More than 25 percent of the world's population either lives on or obtains its water from karst aquifers. DIKTAS is the first ever application of an integrated, transboundary management approach to regional karst water resources and ecosystems.

The objective of the GEF *Transboundary Water Assessment Programme* is to conduct a global baseline assessment of transboundary water systems, including groundwater. In the first project phase, IGRAC contributed to the development of the TWAP methodology. Currently, this methodology is under implementation. IGRAC is also developing an information system to store, manage and disseminate information derived from the TWAP assessment.

Groundwater governance is of particular importance with aquifers across political boundaries. Also IGRAC increasingly contributes to programmes on groundwater governance through actions such as contributing to the formulation of the International Law Commission's *Draft Articles on the Law of Transboundary Aquifers*. IGRAC also stresses the importance of using data and information as the basis for groundwater management. Access to this information is crucial to all stakeholders involved in groundwater governance. Therefore, IGRAC is actively contributing to the project *Groundwater Governance – a Global Framework for Action*. The project is designed to raise awareness on the importance of groundwater resources for many regions of the world, and to identify and promote best practices in groundwater governance as a way to achieve the sustainable management of groundwater resources.

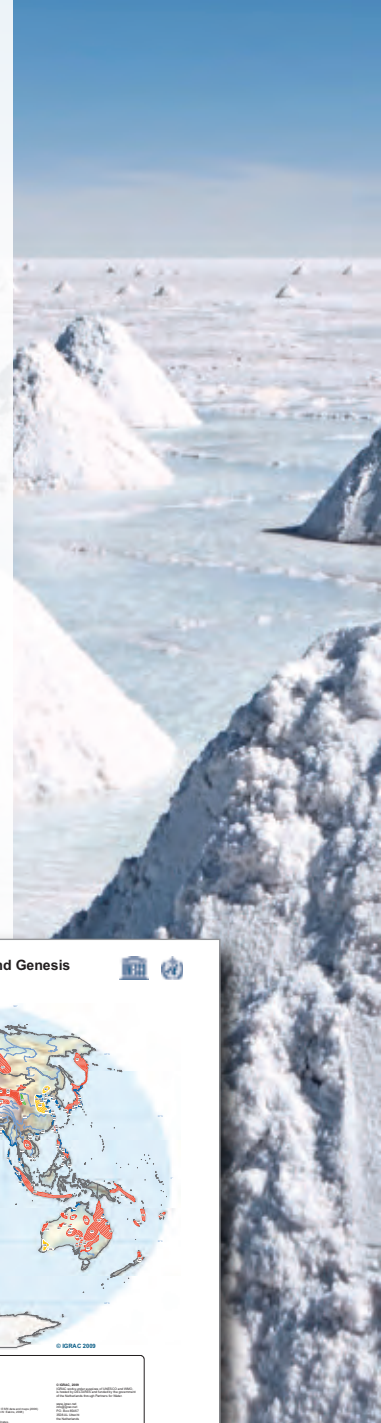
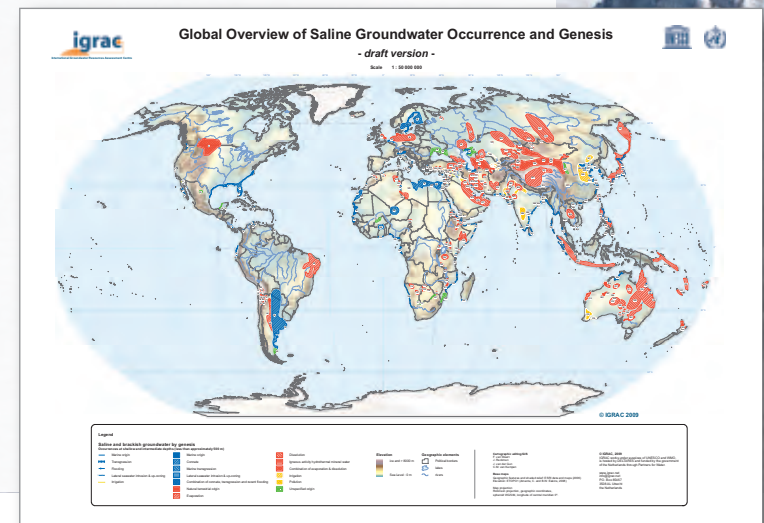


GLOBAL GROUNDWATER INVENTORIES

Over the years IGRAC has conducted global assessments to help groundwater professionals understand the state of the art of highly relevant groundwater issues. IGRAC's first global assessments were inventories of *fluoride and arsenic occurrence in groundwater* throughout the world. The assessment reports produced in 2007 are accompanied by comprehensive overviews of methods developed for removal or mitigation of fluoride and arsenic from contaminated groundwater.

Artificial recharge techniques, also called Managed Aquifer Recharge or MAR for short, use the storage capacity of aquifers to reserve groundwater in rainy seasons for use in dry periods. MAR is by far the most tangible climate change adaptation method in water resources management. In 2006, IGRAC and the Acacia Institute implemented the project *Artificial Recharge of Groundwater in the World* to improve visibility and dissemination of existing information and knowledge on MAR. A wealth of documentation on MAR, including information on about 400 case-studies, is now available to the public via IGRAC's portal.

In 2009, IGRAC carried out a major study entitled *Global Overview of Saline Groundwater Occurrence and Genesis*. The purpose of the study was to improve the understanding of brackish and saline groundwater at shallow and intermediate depths, with an emphasis on their genesis and world-wide occurrence. The study resulted in description, characterisation and geographical delineation of the global occurrence of saline groundwater as well as in documentation about how saline groundwater is observed and managed in different parts of the world.





KNOWLEDGE DISSEMINATION AND PARTNERSHIPS

IGRAC actively seeks out venues to share the knowledge we acquire. Through participation in global events for the water community as well as contributions to publications and consortiums relevant to water resources management, IGRAC plays a role in the *global dissemination of groundwater information and knowledge*. IGRAC has also developed facilities to support on-line collaboration and hence bridge the gaps between face-to-face encounters.

Since IGRAC's launch at the 3rd World Water Forum in Kyoto, we have continued to contribute to this triennial event. Various reports, maps and promotional materials were prepared for World Water Forums in Mexico, Istanbul and Marseille, in addition to contributions to sessions and organisation of side events. The annual Stockholm World Water Week and IAH (International Association of Hydrogeologists) congresses are other global venues with regular contributions from IGRAC.

Over the years, IGRAC has established cooperation with over 100 organisations that operate at the global, regional and national level. We are a partner of UN-WATER www.unwater.org and an active member of Group on Earth Observations www.earthobservations.org. We are also working on various projects with IAH, with the WHYMAP hydrogeological mapping programme, with the Karst and MAR commissions, and with many others.



IGRAC has also produced reports, scientific papers, and newsletters in the last several years. We have also contributed to books and assessments such as the World Water Development Report (WWDR), published every three years by United Nations.

THE FUTURE OF THE WORLD'S GROUNDWATER

Given that groundwater constitutes 97% of the world's unfrozen freshwater resources, it is expected to play a crucial role in water security in the future. In Africa, Latin America and Asia increasing access to groundwater resources has been a major *catalyst of growth and development*. Overall water consumption in developing countries is expected to grow 25% between the years 2010 and 2025, due to increased demand for water intensive foods in combination with technological advancements and economic development. Also, if managed properly, groundwater use has the potential to *combat impacts of climate change*. Consequently, IGRAC foresees playing a critical role in facing these future challenges.

IGRAC will continue to provide *independent content and process support* to the assessment, monitoring and management of internationally shared groundwater resources. IGRAC also aims to grow further as the *international water community's hub* for groundwater information and knowledge-sharing. To this end, we will continue to advance our Global Groundwater Information System. We will also make the Global Groundwater Monitoring Network exhaustive in order to provide data for regional and global groundwater assessments and in particular for the assessment of internationally shared aquifers.

We look forward to continue making significant contributions that will enhance the international community's efforts to understand, manage and protect the world's groundwater.







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Government of
The Netherlands



United Nations Educational,
Scientific and Cultural Organization



World Meteorological
Organization

