



International Groundwater Resources Assessment Centre

# ANNUAL REPORT

# 2016



United Nations  
Educational, Scientific and  
Cultural Organization



International  
Hydrological  
Programme





# IGRAC Report 2016

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Delft, February 2017



IGRAC (International Groundwater Resources Assessment Centre) facilitates and promotes international sharing of information and knowledge required for sustainable groundwater resources development and management worldwide. Since 2003, IGRAC provides independent content and process support, focusing particularly on transboundary aquifer assessment and groundwater monitoring.

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## LIST OF ACRONYMS

BGS	British Geological Survey
CCOP	Coordinating Committee for Geoscience Programmes in East and Southeast Asia
DIKTAS	Protection and Sustainable Use of the Dinaric Karst Aquifer System project
Eol	Expression of Interest
FMS	Fiji Meteorological Service
FREEWAT	Free and open source tools for water resource management
GEF	Global Environment Facility
GEMI	Global Environmental Monitoring Initiative
GGIS	Global Groundwater Information System
GGRETA	Groundwater Resources Governance in Transboundary Aquifers project
GGMN	Global Groundwater Monitoring Network
GRIPP	Groundwater Solutions Initiative for Policy and Practice
GroFutures	Groundwater Futures in Sub-Saharan Africa
IAH	International Association of Hydrogeologists
IGAD	Intergovernmental Authority on Development
IHP	International Hydrological Programme
IMS	Information Management System
ISARM	Internationally Shared Aquifer Resources Management
IWA	International Water Ambition (new cooperation mechanism among three ministries in the Netherlands)
IWA	International Water Association
IWMI	International Water Management Institute
MAR	Managed Aquifer Recharge
MIM	Meta-Information Module (a GGIS component)
MRC	Mekong River Commission
NAWAPI	National Center for Water Resources Planning and Investigation
RESILIM	Resilience in the Limpopo Basin Program
RIMS	Ramotswa Information Management System
RSAP-IWRM	Regional Strategic Action Plan on Integrated Water Resources Development and Management
RWSN	Rural Water Supply Network
SADC	Southern African Development Community
SAP	Strategic Action Plan
SDC	Swiss Agency for Development and Cooperation, in the past also used to indicate the SDC funded GGRETA project
SDGs	Sustainable Development Goals
SEO	Search Engine Optimisation
SIDS	Small Island Developing States
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
STAC	Strategic and Technical Advisory Committee
TAC	Technical Advisory Committee
TBA	Transboundary Aquifer
TBA-IMS	Transboundary Aquifers Information Management System
TWAP	Transboundary Waters Assessment Programme
UCL	University College London
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VACI	Vietnam wAter Cooperation Initiative
WMO	World Meteorological Organization

## 1. SUMMARY

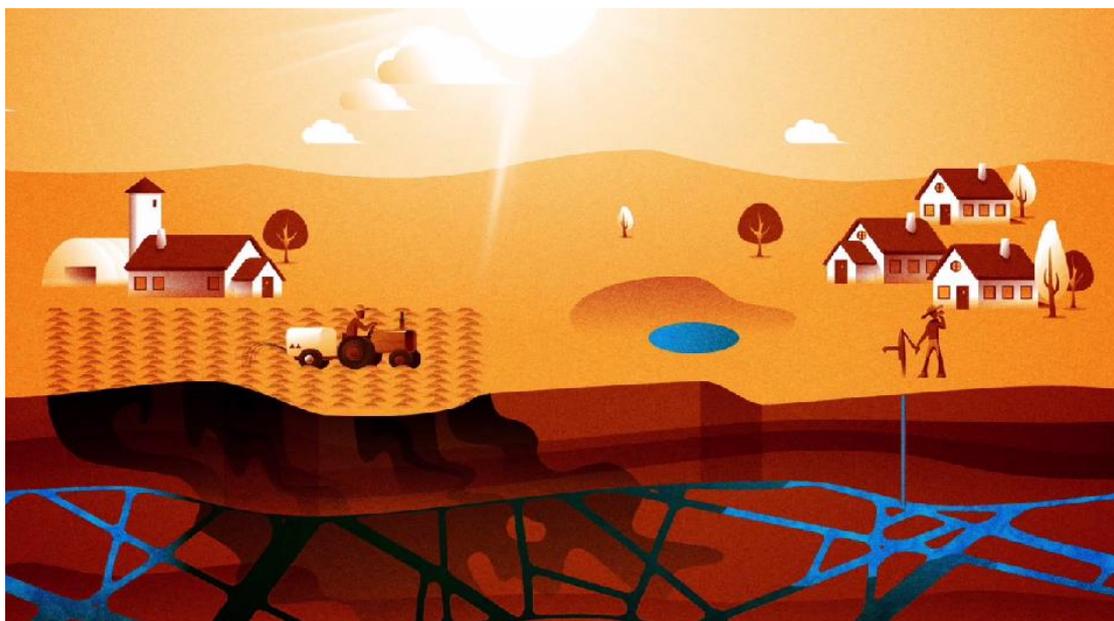
This is a report of IGRAC's activities in 2016, which were conducted in line with 'Work Plan 2016' and 'Strategic Document 2012-2017.'

The past year, 2016, was a transitional year for IGRAC, especially regarding the relation with UNESCO and the financing of the centre. The Agreement between the Government of The Netherlands and UNESCO on IGRAC from 2011 was renewed in December 2016; the renewal followed up the positive outcome of the UNESCO evaluation of IGRAC and the decision of the Government of The Netherlands to continue its support to IGRAC for the coming six years (2016-2021).

Termination of long-term projects commissioned by UNESCO-IHP and reduction of core financing led however to a substantial decrease of IGRAC turnover in 2016. IGRAC's efforts to compensate these setbacks through acquisition of new projects have not produced desired results yet. That holds for both the IGRAC possible contributions to Dutch international water related projects and the projects tendered by international financial institutions and funds. Therefore, the IGRAC Governing Board took initiative (in December 2016) to review and revise the IGRAC modalities in order to provide a stronger leverage for extra-budgetary financing.

In 2015 IGRAC had the largest turnover in 12 year of its existence; in 2016 it showed its endurance and determination in challenging times. The latter is obvious when it comes to extent and quality of the content work performed in 2016. The Global Groundwater Information System (GGIS) is further updated and extended with a number of portals developed on request from the user community. Groundwater assessment was carried out at various scales and the levels of detail. For the first time since 2011, assessment of transboundary aquifers was not the main single activity at IGRAC (due to completion of the long-term projects) but it certainly remained one of the core activities (also with respect to project acquisition activities). 2016 was a year of intensive groundwater monitoring activities: a new version of the Global Groundwater Monitoring Network (GGMN) portal was completed and implemented in trainings throughout South East Asia and Pacific. Finally, the IGRAC activities focusing on knowledge sharing and governance contributed among others to development of a methodology for Sustainable Development Goals (SDGs) and to further understanding of groundwater governance at various scales.

In short, 2016 was transitional and therefore challenging year where IGRAC used its financial reserves to maintain the level and quality of work. In coming year(s) this will be possible only by upscaling extra-budgetary activities again.



## 2. ORGANISATIONAL/INSITUTIONAL ACTIVITIES

### 2.1 INSTITUTIONAL POSITIONING

2016 was a transitional year for IGRAC, particularly in terms of relation with UNESCO and the financing of the centre. This new situation brought new insights and initiated new activities at IGRAC.

The Agreement between the Government of the Netherlands and UNESCO on IGRAC - as signed in November 2011 – was officially to expire in August 2016, while preparations of the renewal of agreement took more than expected. The 2011 agreement was therefore extended for a one year and in the meantime negotiations about the renewal were completed, resulting in the signing of the renewed agreement for the period 2017-2021 in December 2016.

The renewal of the Agreement followed up the decision of the Government of The Netherlands to continue its support of IGRAC for the coming six years with a grant of 0.4M€ per year. The core-funding of centre for the period 2011-2015 was terminated in 2015 and it took the Government of the Netherlands quite some effort/time to secure/arrange the core-funding for the transitional year. Since the first part of the funding was transfer to IGRAC only in September 2016, IGRAC has used (and exhausted) its financial reserves to maintain its existence.

The third important characteristic for this period was termination of three long-term projects commissioned by UNESCO-IHP Secretariat in 2015 and of the common acquisition. In 2016, UNESCO-IHP has not involved IGRAC in any new project, including those where IGRAC participated in the previous project phases (GGRETA and IW-LEARN). That also meant a substantial decrease of turnover for about 40%.

In July 2016, the IGRAC Governing Board held an extraordinary meeting to present and discussed the IGRAC Evaluation for the period 2011-2015. The main outcome of the evaluation was that IGRAC's status as a UNESCO Category 2 Centre should be renewed for following 6 years. The evaluation also stressed that the current "IGRAC core funding is not sufficient to sustain the 'critical mass' of skilled professional staff needed for an international reference centre on groundwater resources". The Governing Board meeting was also used to further discuss possibilities for cooperation between IGRAC and UNESCO-IHP Secretariat.

Until 2016, UNESCO-IHP Secretariat was the main IGRAC partner, through the execution of commissioned projects as well as many other (budgetary neutral) common activities. This close cooperation is logical since IGRAC was originally initiated as a centre to assist UNESCO in implementation of the International Hydrological Programme. IGRAC and UNESCO-IHP Secretariat invested a considerable effort to develop the most optimal working relationship. From the IGRAC perspective, the main obstacle remains a rather ambiguous position of UNESCO second category centres, especially when it comes to close, project-based cooperation with the Secretariat. This leads to differences in interpretations of agreements, different expectations and consequently reduced effectivity of common activities. Consequently, as 2016 showed, the UNESCO-IHP Secretariat levelled the (exceptionally intensive) cooperation with IGRAC to one having with other (at this moment) 26 UNESCO water centra. This means that IGRAC needs to look for new opportunities and new partnerships in order to maintain a critical mass of staff and activities.

In accordance with initiatives and agreed actions from the Governing Board meeting in 2015, the World Meteorological Organization (WMO) and IGRAC increased have contacts and cooperation during 2016. A training "Advancing Groundwater Monitoring in Pacific Small Island Developing States" was jointly organised and successfully conducted in August-September 2016 in Suva, Fiji. IGRAC also contributed to the congress of the WMO Commission of Hydrology in Rome in December. In 2016, IGRAC organised groundwater monitoring trainings also in Thailand and Vietnam, responding to the increased interest for groundwater in this part of the world. Partnership with regional organisations such as the Coordinating Committee for Geoscience Programmes in

East and Southeast Asia (CCOP), the Mekong River Commission (MRC) and UNESCO and WMO regional representatives is seen as very important for the future development of the GGMN programme.

In 2016, IGRAC stepped up its effort to engage in World Bank activities, particularly in Asia and Africa; IGRAC contributed to the World Bank regional events in India, South Africa and Kazakhstan. Although these contributions are highly appreciated, the Bank and IGRAC are still exploring modalities to involve IGRAC in WB projects. With support of the Bank, IGRAC is preparing a proposal to assist the Groundwater Management Institute in South Africa in execution of the Sustainable Groundwater Management in Southern African Development Community (SADC). After a serious delay, this project is finally started in September 2016.

In 2016, initial cooperation has been established with the Asian Development Bank (ADB) as well, including analysis of modalities for possible engagement. Asian Water Development Outlook 2016 is paying substantially more attention to groundwater than ever before, including not only soil subsidence as result of over-abstraction but a much broader context of groundwater monitoring and assessment. IGRAC is invited to participate in the Asian Water Week in March 2017.

Responding to the request of the Government of the Netherlands to contribute to the International Water Ambition (IWA) programme, IGRAC took actions that should lead to increase of groundwater component in international water projects conducted/supported by The Netherlands. This is a challenging task since these projects are concentrated in deltas, where - in general - importance of groundwater is less obvious than in arid areas. Nevertheless, a preliminary review of the Mekong Delta (as a pilot area) and the workshops in Thailand and Vietnam clearly showed need for upscaling of groundwater-related activities. The financing of these activities will however be possible only through competitive bidding in future calls of Dutch international water programmes.

IGRAC and the International Water Management Institute (IWMI) substantially reinforced their cooperation in 2016. Besides common projects and acquisitions, IGRAC is one of the main strategic partners in GRIPP (Groundwater Solutions Initiative for Policy and Practice). GRIPP is an initiative of IWMI to strengthen, expand and connect groundwater-related projects and initiatives.

IGRAC continued cooperation with International Association of Hydrogeologists (IAH), contributing to various IAH commissions (e.g. on Managing Aquifer Recharge, Transboundary Aquifers, etc.) and presenting papers and posters at the IAH congress in Montpellier, France. IAH held the elections in September 2016 and IGRAC already had multiple contacts with the new president and the Council members, discussing possible increase of the cooperation.

IGRAC held the regular Foundation Board meeting in March 2016. In this meeting the director of IGRAC reported on the (primarily financial) management of the IGRAC foundation, which was thoroughly discussed and subsequently approved by the board. The board requested additional info on use of IGRAC portal. Responding to this request, IGRAC performed an analysis and reported in the document "Website Analysis and Action Plan" in May 2016.

Also due to the financial situation, anticipated meeting of the Technical Advisory Committee (TAC) did not take place. Additionally, there is a request from the Governing Board (July 2016 meeting) to renew the TAC, not only the membership but also the role; the committee should also provide strategic advice. Accordingly, IGRAC prepared concept notes for the Strategic Document 2017-2021 and terms of references for the new Strategic and Technical Advisory Committee (STAC).

At the end of 2015, IGRAC employed seven staff members (3 with permanent contracts and 4 with temporary contracts), including one PhD researcher. Due to the financial situation IGRAC was forced to reduce staff to 5 at the end of 2016. The core budget of 0.4M€ is sufficient to cover costs of 4 staff members, software costs and the office costs. For an additional staff additional incomes are required.

## 2.2 PROJECT ACQUISITION ACTIVITIES

In 2016 the IGRAC team intensified its project acquisition activities. IGRAC partner network and websites with tenders were consulted on a very regular basis to identify project funding opportunities. IGRAC responded to several calls for proposals. The table below gives an overview of the most relevant project acquisition activities in 2016.

### Overview of major project acquisition activities in 2016

Fund / Client	Programme / Project	Study location	Partners	Status Dec 2016
Adaptation Fund	Groundwater resources in the Greater Mekong Sub region; collaborative resource management to increase resilience	Cambodia, Lao PDR, Myanmar, Thailand, Vietnam	UNESCO, IWMI, Country agencies, CCOP	Proposal submitted (August 2016) Proposal declined (Oct 2016)
BMZ IWMI Proposal	Ensuring Groundwater Sustainability for Livelihoods, Food Security and Resilience	Myanmar Malawi	IWMI	Proposal submitted (March 2016) Proposal declined (Oct 2016)
CORRIDOR-GROW	Kontextspezifisches Korridormanagement für ein nachhaltiges Grundwasserressourcen-management weltweit	Germany, Namibia, India, Brasil	Goethe-Universität Frankfurt am Main	Pre-proposal submitted (March 2016)
Canada Fund for Local Initiatives	Cross-sectoral approaches for improved groundwater management in the Vientiane Plain, Lao PDR	Laos	MONRE, Lao PDR & Min. of Agric., Lao PDR IWMI	Proposal submitted (June 2016) Proposal declined (August 2016)
IUCN	SUSTAIN	Africa		Project idea
IUCN	Shared Resources, Joint Solution	Africa		Project idea
PADUCO II	Impacts of Water Quality on the Water Resources Management in the Western Basin - Palestine.	Palestine The Netherlands	Birzeit Univ. and Palestine Polyt.Univ. UNESCO-IHE	Proposal submitted (Sept 2016) and declined Dec 2016
Partners voor Water	Dropbox for Water	Global, emphasis on Vietnam and Kenya	Nelen & Schuurmans, GIZ	Proposal prepared
USAID	Sustainable Water Management in the Limpopo Basin - Transboundary Ramotswa Aquifer Project – Phase 2	Botswana, South Africa	IWMI	Project proposal Phase 2 submitted (Nov 2015)
WaterJPI	Safe use of reclaimed water for aquifer recharge in water scarce agricultural areas – UNDER RECLAIM	Mediterranean region	UN University and others	Proposal declined
WaterJPI	Global Water Fingerprints: Resilience of Supply and Vulnerability to Pollution - FINGERPRINTS	Global	University of Calgary and Göttingen	Proposal declined
World Bank / ZAMCOM	Zambezi River Basin Management Project – component: Zambezi Water Resources Information System (ZAMWIS) Enhancement 3: Hydro-Met Database and DSS	Zambezi Basin	Antea group, IMWI, UNESCO-IHE	Full proposal submitted (March) Declined without notice (June)
IGAD	Transboundary Aquifer Assessment in the Intergovernmental Authority on Development (IGAD) Region	IGAD region	IGAD, Ministry of Water Kenya	Project idea submitted 2015
World Bank / Brazil	Hydrogeological study of the North-Central region of the State of Tocantins	Brazil	Acacia, Panaoá Consult	EoI submitted 2015
SADC/GMI (World Bank)	Framework and tools for harmonisation and exchange of groundwater data and information within and between SADC Member States	SADC region	-	Concept note in preparation
INTERREG Europe 3 <sup>rd</sup> call	MAR in semi-arid basins in Mediterranean islands	Crete - Greece	TU of Crete, Acacia, TU-Delft, etc.	Concept note in preparation

Fund / Client	Programme / Project	Study location	Partners	Status Dec 2016
Partners voor Water	A Decentralised Data Collection and E-Collaboration GIS Platform for Improving Management of Kilimanjaro Aquifer	Kenya Tanzania	DU Delft, Pangani Basin Water Board, etc.	In preparation

**UNESCO Related Leads**

GEF / UNDP	GEF IW:LEARN - Strengthening IW Portfolio Delivery and Impact	Global	UNESCO	Started, IGRAC awaits engagement by UNESCO-IHP
SDC	GGRETA II - Groundwater Resources Governance in Transboundary Aquifers	Southern Africa, Central Asia, Latin America	UNESCO	Started, IGRAC awaits engagement by UNESCO-IHP
GEF / UNDP	Determining parameters of the aquifer underlying Mt. Kilimanjaro for sustainable development and management, factoring in effects of climate change	Kenya, Tanzania	UNESCO	*
GEF / UNDP / ANBO	Strengthening the institutional capacity of African Network of Basin Organization (ANBO), contributing to the improved transboundary water governance in Africa	Africa (ANBO /AMCOW)	UNESCO	*
GEF / UNEP	Improving IWRM, knowledge-based management and governance of the Niger Basin and the Iullemeden-Taoudeni/Tanezrouft Aquifer System (ITTAS)	West Africa	UNESCO	*
GEF / UNDP	DIKTAS - Enabling implementation of the Regional SAP for the Dinaric Karst Aquifer System	South East Europe	UNESCO	Await for a mission to the countries
GEF / UNDP	SYR DARYA - Enabling countries of the Transboundary Syr Darya Basin to Make Sustainable Use of their Groundwater Potential	Central Asia	UNESCO	*
GEF / UNDP	SUMTAS - Fostering multi-country cooperation and conjunctive surface and gw management in the Bug River Basins and related aquifers	Eastern Europe	UNECE	*
GEF / UNDP	NSAS - Enabling implementation of the Regional SAP for the sustainable management of the Nubian Sandstone Aquifer System	Northern Africa	UNESCO	**
GEF / UNDP	Nile Integrated Groundwater and Surface Water Project	Northern Africa	UNESCO	**
GEF / UNEP	Mediterranean Sea Program - Strategic actions for the protection of Mediterranean coastal aquifers	Mediterranean Region	UNESCO	**

\* Unknown/no change: IGRAC was involved in acquisition/preparation

\*\* Unknown: no involvement of IGRAC in acquisition so far

In 2016 IGRAC invested about 15% of its total working hours (hence excluding the absence) on project acquisition. The main leads at the end of 2015 were those with UNESCO-IHP and they retained the same status during 2016. The most of Expression of Interest (EoI) and project proposals submitted were declined. Obviously the competition for projects is high and asks for expertise to match exactly required objectives and for sound proposals. It should be noted that IGRAC was not a leading party in any of submitted proposals (IGRAC is simply too small to satisfy required criteria for a leading party). Accordingly, IGRAC needs to join (by convincingly demonstrating its added value) larger and/or accredited partners in order to – as a consortium - respond to calls provided by developing agencies or international funds. Consequently, IGRAC does not have always much influence on composition and matching expertise of a consortium.

In 2016, IGRAC invested a considerable time to secure participation in the activities of IWA, a new inter-departmental programme of the Government of the Netherlands. The main groundwater expertise required in the IWA – if general very limited - is the saltwater intrusion modelling (hence not an IGRAC core expertise). Strong advocacy for groundwater among programme managers is required to secure a broader inclusion of groundwater activities (e.g. groundwater monitoring which is the IGRAC core expertise).

### 3. CONTENT ACTIVITIES

The content activities in 2016 were conducted in accordance with 'Work Plan 2016' and IGRAC's 'Strategic Planning 2012-2017.' The most of them were continuation from previous year(s), being rounded off (e.g. TWAP project) or on contrary expanded (e.g. GGMN) in 2016. The main structure of activities remained the same as previous years:

- Global Groundwater Information System
- Global Groundwater Assessment
- Global Groundwater Monitoring Network
- Knowledge Sharing and Groundwater Governance

This chapter provides an overview of the main activities and their outcomes. Additional information is available in project documents and other IGRAC products and services, as referenced to in the overviews below.

#### 3.1 GLOBAL GROUNDWATER INFORMATION SYSTEM (GGIS)

The GGIS is IGRAC's interactive and web-portal to groundwater related information and knowledge. The main purpose of the GGIS is to assist in collection, storage and analysis of information on groundwater resources and its sharing among stakeholders such as water experts and decision makers. The system provides a global overview of aggregated information per country and per aquifer; detailed information for a selection of transboundary aquifers; and information sheets for 199 recently assessed transboundary aquifers. The map interface of the GGIS is complemented with a Meta-Information Module (MIM), where additional information and references are uploaded and linked to other data in the system. Software developed for monitoring within the GGMN application as well as IGRAC's other online databases are also considered a part of the GGIS.

##### 3.1.1 Software development

The GGIS has been developed using open and extendable state of the art technology, making it possible to connect to more varied external data sources and systems through the internet. The user interface follows specific requirements for usable data types, layout, GIS tools and web mapping services.

In 2016, there have been two releases of the GGIS. The accessibility, performance and user friendliness of the GGIS have been improved whilst also allowing more interactive participation of its users. The first release, improved the overall performance of the system, the procedure to upload data, and provided new functionalities to make viewers configurable. It also improved the IT architecture of the modular set-up of the system which now allows for easy development of dedicated Information Management Systems (IMS) for new projects. A second release provided new functionalities for display of information in the feature info window, to download data from the system and improved options to display legends. Figure 2 shows an example of improved display functionality using pie charts.

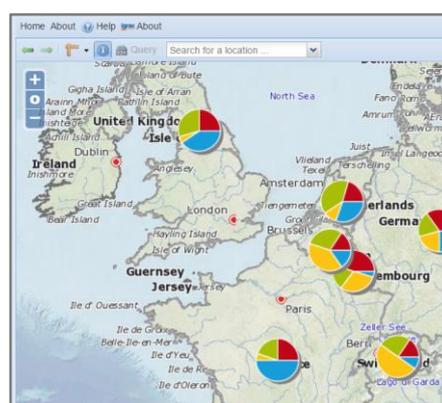


Fig2. New features in GGIS, e.g. pie

In 2016, a new portal for Small Islands Developing States (SIDS) was developed and several portals were substantially extended and/or improved like Ramotswa, Groundwater Africa and Managed Aquifer Recharge (MAR) portal (see also 3.1.2.).

### Redesign of the Global Groundwater Monitoring Network portal

In March 2016, IGRAC has launched its new GGMN Portal. The redesign of the GGMN Portal started in May 2015. The new system is built using state of the art technology and meets the requirements of international standards for data sharing. Functionalities of the system include upload, download, display and spatial and temporal analysis of groundwater data. The GGMN web-application gives insights on the availability of groundwater monitoring data across space and time. Groundwater level data and changes occurring in groundwater levels can be displayed on a regional scale. Additional data layers and information are available to understand the monitoring data in a broader water-related context. The web-based software application assists in the spatial and temporal analysis of monitoring data. Time series analysis tool is embedded into the system. The system is integrated with QGIS to process data offline. QGIS is an open source Geographic Information System that contains variety of functionalities to analyses the data and creates spatially interpolated groundwater level maps.



Fig 3. GGMN portal – selected features

The web-based software application assists in the spatial and temporal analysis of monitoring data. Time series analysis tool is embedded into the system. The system is integrated with QGIS to process data offline. QGIS is an open source Geographic Information System that contains variety of functionalities to analyses the data and creates spatially interpolated groundwater level maps.

### 3.1.2 Content update

The main content update of the GGIS in 2016 was to various portals in the system, as presented below.

### Groundwater Africa Portal

([www.groundwaterafrica.un-igrac.org](http://www.groundwaterafrica.un-igrac.org))

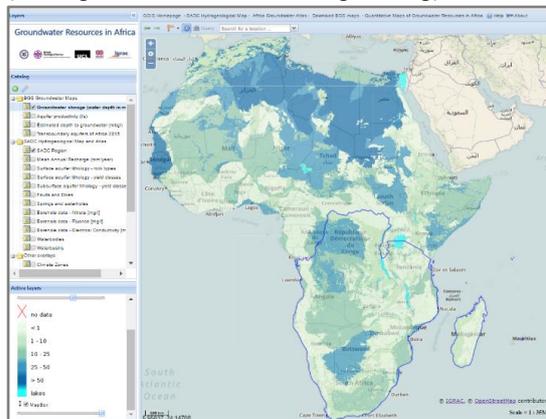


Fig4. Groundwater Africa portal in GGIS

resources vary across Africa; their resilience to climate change; and the potential for groundwater to be used in adaptation strategies to climate and other environmental changes. The SADC Hydrogeological Atlas was developed as part of the Regional Groundwater Management Programme in the Regional Strategic Action Plan on Integrated Water Resources Development and Management (RSAP-IWRM). The map is intended to provide information of hydrogeological characteristics for the SADC region, focusing on the extent and geometry of regional aquifer systems.

### Ramotswa Portal

([www.ramotswa.un-igrac.org](http://www.ramotswa.un-igrac.org))

In 2016 we set up the Ramotswa Information Management System (RIMS) under the Ramotswa Transboundary Aquifer Project. This project is funded by the United States Agency for International Development (USAID)/RESILIM and led by IWMI South Africa office. At present the RIMS contains

some 50+ thematic map layers with associated data and a database of literature on the Ramotswa aquifer area (no. of maps and documents is still growing). The viewer contains maps related to the geology, hydrogeology, surface water hydrology, demographics, socio-economics, water supply, sanitation, waste management, etc. Also results from an airborne geophysical survey to map the dolomite karst aquifer in more detail have been uploaded as thematic maps in the RIMS. Phase 1 of the project will conclude in December 2016, and there are advanced discussions on a 3 year follow up (phase 2) which would yield more data and information. With this the RIMS has the potential to develop into a showcase of how a web based and map related information management system can really contribute to informing governmental and non-governmental stakeholders involved in the management of the aquifer resources in both aquifer states.

### MAR Portal

(marportal.un-igrac.org)

1200 case studies from over 50 countries from around the whole world were collected, analysed and compiled in the first global inventory of MAR schemes. The data shown in this portal are collected by INOWAS (TU Dresden, Germany and funded by the German Federal Ministry of Education and Research) and the DEMAU project (European Union FP7 project consortium). In 2016, the MAR portal was officially launched at the ISMAR9 conference, Mexico. New data on MAR locations have been collected and uploaded to the system. Besides MAR sites, regional MAR suitability maps are collected and shared within the portal to improve accessibility to this information and provide guidance for MAR suitability.



Fig5. New content in MAR portal including MAR suitability maps

### SIDS Portal

(sids.un-igrac.org)

In 2016, a dedicated portal was developed for Small Islands Developing States. At present the portal contains mainly information derived from the Transboundary Waters Assessment Program on 43 SIDS. The data include indicators describing the hydrogeological, environmental, socio-economic and governance dimensions of the SIDS groundwater systems. The data have been derived from questionnaire surveys and an extensive desk-top study executed by the Simon Fraser University (Canada) and coordinated by UNESCO-IHP.

### Data requests

In 2016, IGRAC obtained various requests for data from the GGIS/GGMN. Most requests included data for research analysis and publications. Examples include maps of transboundary aquifers in river basins (Zambezi Nile/ Niger/ Mekong) and IGRAC's global overview of salinity maps.

## 3.2 GLOBAL GROUNDWATER ASSESSMENT

Groundwater assessment activities at IGRAC encompass country-based assessments, transboundary groundwater assessments and thematic assessments.

### 3.2.1 Global Country-based Assessment

Understanding and managing water resources can be a challenging task for decision makers and others without a professional background in water studies. Concepts like the blue water footprint aim to make water quantity related issues easier to understand by calculating a water stress index. For groundwater management similar problems exist. Existing global models use grid-based approaches to estimate (ground)water withdrawal and use. While giving a fair overview about water stress on a global-scale, the grid approach gives the impression of a homogeneous data density. Regionally and locally high-resolution statistical data are available, bearing potentials for management and policy-making as well as for refining and validation of existing global water models.

This study presents a scheme on how to process sub-national water withdrawal and use datasets, specified by source and sectoral use, for (ground)water stress calculations at various scales. The scheme was applied on a dataset for federal states and sub-watersheds in Germany and the respective groundwater stress value was calculated. The groundwater stress calculations indicate high groundwater stress for federal states exceeding 100 %, whereas sub-watersheds show moderate values up to 85 % stress. Sub-watersheds therefore appear as a more suitable spatial unit compared to federal states. The amount of used water with determinable source in a spatial unit highly depends on water import dependence of the respective spatial unit. Information on the spatial unit of origin of transferred waters will lead to a higher accuracy in the estimation of a spatial unit's groundwater stress based on groundwater use.

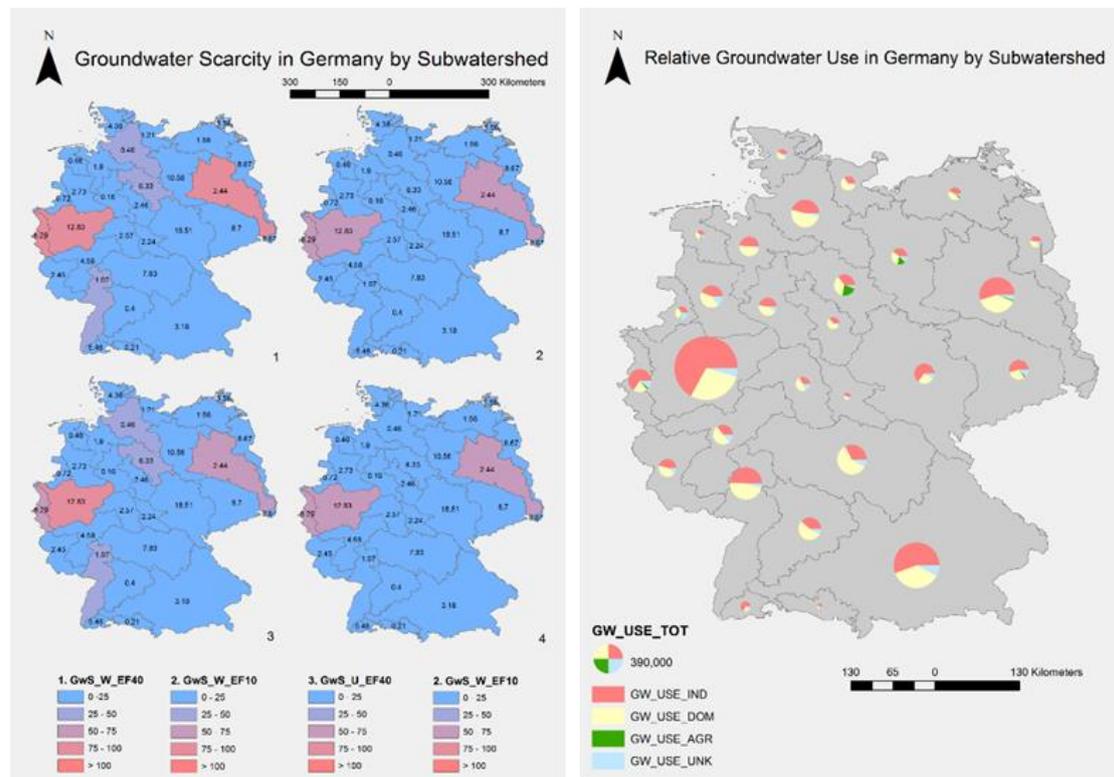


Fig. 6 Groundwater use and scarcity assessment – pilot study

### Country briefs and the Groundwater Atlas of Africa in cooperation with BGS

Country briefs are standardised presentations of a country's groundwater resources, usually composed of short narratives supplemented with some graphical information. The BGS started to produce the briefs for countries at the African continent. IGRAC and BGS agreed to publish all related maps through GGIS once they become available. The progress is slow (due to budgetary restrictions), but IGRAC succeeded to develop the Groundwater Africa Portal in 2016 (see also 3.1.) and publish all the maps available at the moment.

### 3.2.2 Transboundary Aquifer Assessment

For the first time since 2011, Transboundary Aquifer Assessment was not the main IGRAC yearly activity. The main reason for that was rounding off of the long term transboundary aquifer projects (DIKTAS, GGRETA and TWAP) without continuation or replacement by other projects. Although officially completed in 2015, these projects asked for some additional input in this year as well. The main transboundary project in 2016 was Ramotswa Transboundary Aquifer (TBA), an innovative and promising development. Further, IGRAC conducted an additional analysis to identify high-risk transboundary aquifers following Transboundary Waters Assessment Programme (TWAP). Finally, IGRAC prepared and published a comprehensive paper on approach/methodology and tools on transboundary aquifer assessments. A brief overview of main TBA assessment activities 2016 is given below.

#### Ramotswa Transboundary Aquifer Project

IGRAC is one of the partners in the project 'Resilience in the Limpopo Basin: the Potential Role of the Transboundary Ramotswa Aquifer', led by IWMI and funded by USAID. The project is a component of the Resilience in the Limpopo Basin Program (RESILIM) which supports the riparian countries of the basin (Botswana, Mozambique, South Africa, Zambia) in their efforts to improve shared management of water resources and equitably address the economic, environmental, and social needs of each country, thereby enhancing the resilience of the ecosystems and the people. The project supports equitable access to water that balances urban and rural needs with ecosystem requirements under a changing climate. It reduces climate vulnerability by promoting adaptation strategies for integrated, transboundary water resource management. By building the capacity of river basin organisations, national authorities and local communities to sustainably manage natural resources, high priority ecosystems and human communities will be resilient to climate-induced pressure.



*Fig. 7 Impressions from Ramotswa training workshops*

The Ramotswa project addresses the overall objectives by critically examining the role and options that the freshwater aquifer offer in terms of adaptation to climate variability and human induced changes, while preserving and enhancing the resource and associated ecosystems through transboundary and local management.

IGRAC's formal involvement in the project started in November 2015 and phase 1 of the project continues until December 2016 (Phase 2 is currently under negotiation). IGRAC's contribution to the project has been to set-up and manage the RIMS, to provide training in three workshops on the use of the RIMS, on processing of information and on assessment as well as contribute to the analyses and reporting and scientific papers resulting from the project. Additionally IGRAC has provided in-depth training to representatives of the Department of Water Affairs (Botswana) and the Department of Water and Sanitation (South Africa) who will be responsible for the long term management of the RIMS once the project is finished.

#### Transboundary Waters Assessment Programme (TWAP)

IGRAC finalised all contractual obligations for UNESCO-IHP under the TWAP programme in 2015. Nevertheless IGRAC has assisted UNESCO-IHP throughout 2016 in finalising the TWAP Groundwater report and in the preparations for the formal launch of TWAP products at the GEF International Waters Conference in Sri Lanka (IWC8) in May 2016. IGRAC also presented TWAP Groundwater together with a representative of UNESCO-IHP during a second launch event organised in Washington DC in July 2016 with presentations for the Global Environment Facility (GEF) and other international organisations in Washington, as well as presentations at the World Bank. IGRAC also represented the TWAP Groundwater component in the final TWAP Steering Committee meeting (also in Washington DC in July 2017).

In 2016 IGRAC also continued to maintain the TWAP information portal (<http://twapviewer.un-igrac.org>) and provided information and assistance to enquiries of professionals working on transboundary aquifers worldwide.

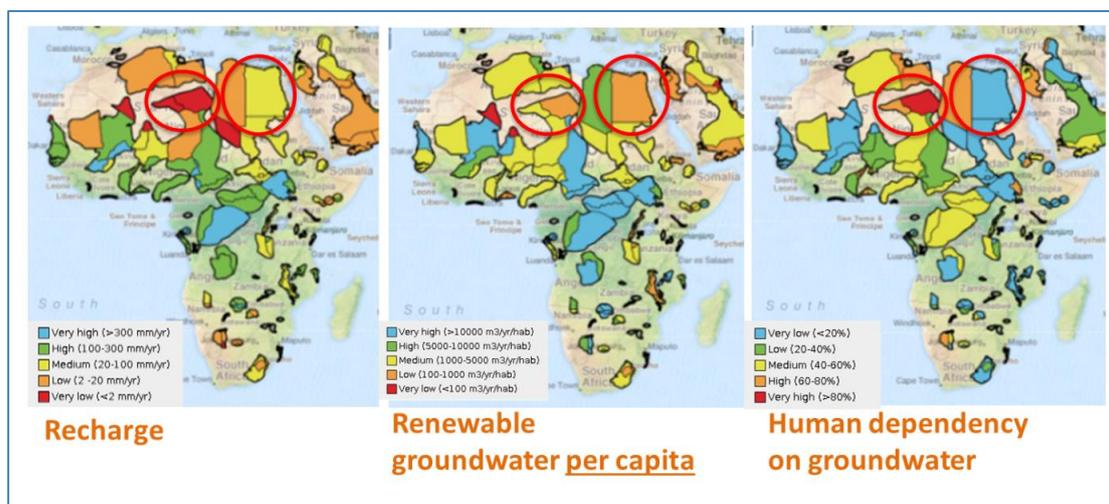


Fig.8 TWAP indicators can provide additional insights

#### DIKTAS project

Protection and Sustainable Use of the Dinaric Karst Aquifer System (DIKTAS) project (<http://diktas.iwlearn.org>) project phase is officially terminated in December 2015. However, requested by project implementing agency, a concise version of the Strategic Action Programme (SAP) was prepared by IGRAC in the first month of 2016. The following planned step was to discuss the SAP with project countries but it has not materialised yet due to capacity restrictions at the project executing agency.

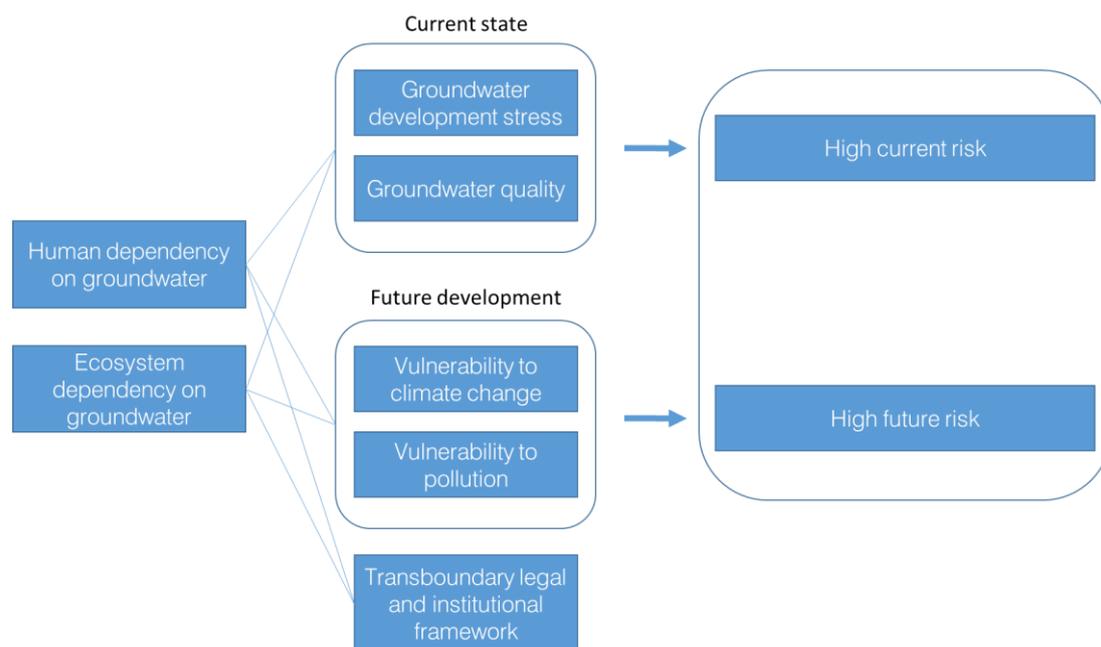
#### The GGRETA project

In the first quarter of 2016 IGRAC finalised the last official deliverables related to the Groundwater Resources Governance in Transboundary Aquifers (GGRETA) project – phase 1. These involved reporting on the Information Management System (GGRETA IMS) and related activities. IGRAC also made final contributions to the case study report on the Stampriet Transboundary Aquifer System. In particular with a section on the information management system, figures of thematic maps and importantly with results from the field study done by PhD fellow Kirstin Conti.

In 2016 IGRAC also continued to maintain the GGRETA web portals for the Stampriet, Triffinio and Pretashkent (<https://ggis.un-igrac.org/ggis-viewer/ggreta/regions>). In the second half of 2016 UNESCO-IHP started activities on phase 2 of the GGRETA project. Despite IGRAC's contributions to the project document for phase II and despite being mentioned as partner, IGRAC was unfortunately not engaged in the project in 2016.

#### Followed-up TWAP analysis

In 2016 IGRAC finalised a follow-up TWAP study whereby a number of transboundary aquifers were evaluated based on their importance for humans and ecosystems, on their ability to sustain current groundwater development rates, on identified pollution and on their vulnerability to climate change and pollution. The analysis was performed in a stepwise manner (see the figure 9 below) which eventually lead to the short-listing of a selection of high-risk aquifers upon which humans and ecosystems heavily rely. The investigation aimed at bringing to the global attention the most important transboundary aquifers facing the highest pressure. It further aimed at highlighting the importance for countries to measure and have access to groundwater data and the benefits of sharing this information. It was concluded that global analyses of the state of groundwater resources following a systematic procedure can facilitate the identification of hotspots in critical state and can help raising awareness and prioritise actions. The study will be published in 2017.



*Fig.9 Risk estimation for TWAP transboundary aquifers*

#### Approach and tools for transboundary aquifer assessments

IGRAC prepared and published an Open Access Paper “A multi-disciplinary approach and tools for comparative and in-depth assessments of transboundary aquifers”. The paper was presented at the 5th Vietnam Water Cooperation Initiative (VACI) and won the best-paper award. A methodology is presented for the assessment of transboundary aquifers; it covers hydro(geo)logical, socio-economical, environmental, legal and institutional aspects of the groundwater systems and transforms those into indicators. Indicators are particularly useful for comparative assessments of multiple aquifers at a regional scale, while the in-depth assessment provides relevant information to develop management actions and governance frameworks at the aquifer level. To facilitate dissemination of assessment results between (international) stakeholders, a web-based Transboundary Aquifers Information Management System (TBA-IMS) has been developed. The TBA-IMS gives users access to thematic maps and underlying data. Functionality to create overlays of thematic maps, to perform map queries and to download additional data and documents enables stakeholders to perform their own analyses in support of sustainable groundwater governance.

#### Transboundary Aquifers of the World Map

There were no updates of the Transboundary Aquifers of the World (TBA map) in 2016. Nevertheless, some improvements are made in the digital version of the map in the GIS.

#### 3.2.3 Thematic Assessment

In 2016, IGRAC conducted a study on governance of transboundary aquifers, continue processing of MAR data and produced a first global groundwater stress map that is primarily based on observations (rather than modelling).

#### Global map of groundwater stress

IGRAC prepared a tentative global groundwater stress map of large aquifers. Calculation of stress, aggregated at aquifer level, was based as much as possible on data deriving from dedicated studies for each aquifer. The map is featured as a background layer in the GIS.

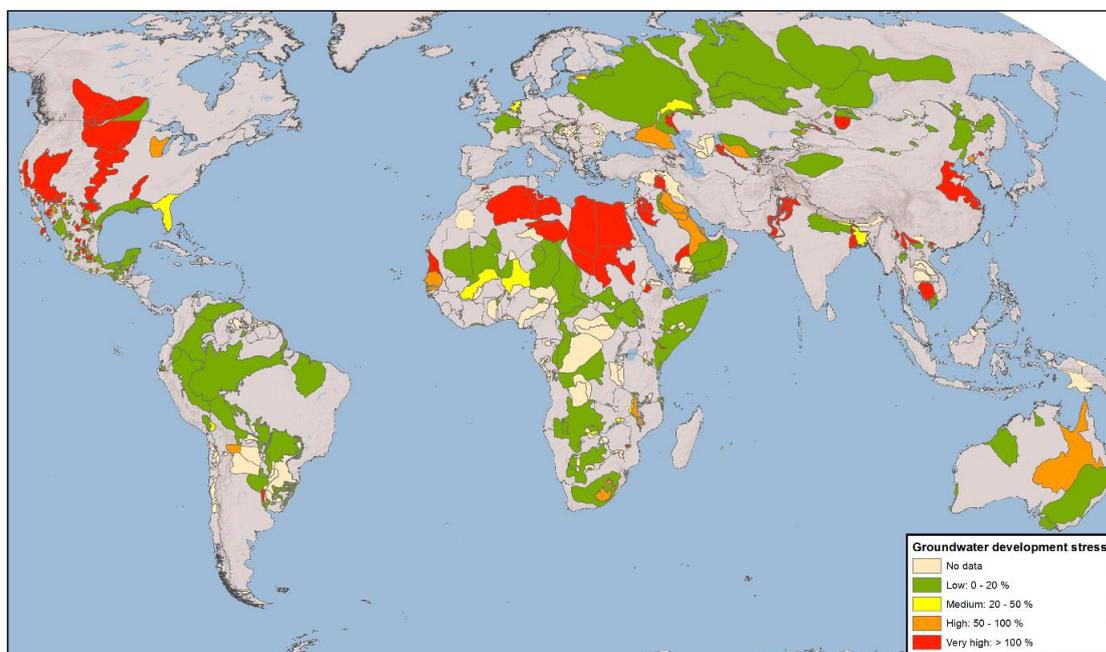


Fig. 10 Groundwater stress for major global aquifers

### Managed Aquifer Recharge

The Mar Portal - the first structured database on MAR sites globally - was presented during the 9<sup>th</sup> International Symposium on MAR (ISMAR9) in Mexico City. The MAR portal is the first structured database on MAR sites globally. The MAR inventory is the result of work by the INOWAS research group from TU Dresden, a consortium of researchers within the EU-funded project DEMEAU (Demonstration of promising technologies to address emerging pollutants in water and waste water) and IGRAC. The project is supervised by the IAH MAR Commission. During the ISMAR conference, a workshop on the global MAR inventory was organised. The workshop introduced the global MAR inventory, the methodology used for data collection, key information collected, and statistical data analysis. Discussion sessions were organised to address various aspects related to: quality of the data (identify missing sites), improvements to the inventory (add more MAR types or information, identify key topics for further research), dissemination of results (identification of main objectives and promotion of MAR), and encouragement of national MAR networks (volunteers for database updating, coordinators of national surveys and data harvesting).

IGRAC is involved in IAH MAR Commission working group on economics of MAR. The financial and economic performance of MAR is a key determinant of the global uptake of MAR. Although financial data cannot by itself make the case for MAR, the publication of such data will help to demonstrate the integrated multidisciplinary management credentials of the MAR sector. The data will provide key reference material for cost effectiveness and cost benefit analysis of MAR schemes. Within the working group a standard framework and measures for accounting the costs are developed and used in a set of case studies. Data from 30 case studies of various countries were collected. The analysis will continue in 2017.

### Understanding the Effectiveness of the Governance of TBAs: A Framework for Analysis

This study was the first ever attempt to provide a framework for the comparative analysis of transboundary aquifer governance from the perspective of effectiveness. It pertains to the cross-comparison of eight case studies – three aquifers in Africa, one in Europe, one in the Middle East, two in North-America, and one in South-America – in terms of institutionalisation and four dimensions of institutional design: (a) knowledge and scientific learning; (b) robustness of principles of international law; (c) legality; and (d) monitoring and data-exchange.

The conclusion is twofold. Firstly, there are large variations in both the type of institutions and institutional design. Secondly, institutional design can hardly be linked to effectiveness in terms of problem-solving in the absence of data on the status of the transboundary aquifer. This suggests that institutional effectiveness is influenced by problem structure rather than institutional design. The overall conclusion is thus that a “one size fits all” solution to effective governance of transboundary aquifers does not currently exist.

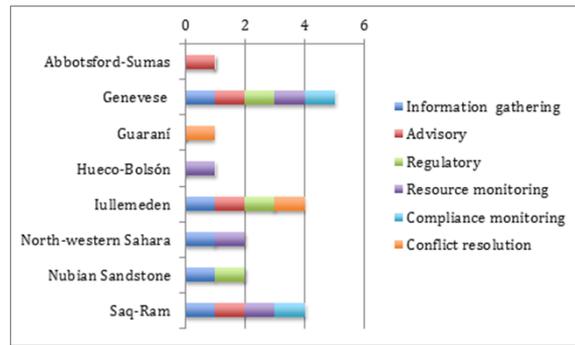


Fig.11 Institutions and their main functions

### Guidelines for Multidisciplinary Assessment of Transboundary Aquifers

In 2015 IGRAC, in cooperation with UNESCO-IHP, prepared draft ‘Guidelines for Multidisciplinary Assessment of Transboundary Aquifers’. Some improvements have been made in 2016, including external contributions but the final version is not formally published yet. It will be the task for early 2017.

### 3.3 GLOBAL GROUNDWATER MONITORING

The Global Groundwater Monitoring Network is a participative, web-based network of networks, set up to improve quality and accessibility of groundwater monitoring information and subsequently our knowledge on the state of groundwater resources. GGMN is a UNESCO programme, implemented by IGRAC and supported by many global and regional partners.

In 2016, IGRAC finalised the software developments of the GGMN web-application. With the launch of a new system also new training material, manuals, data policy and brochures were developed. To strengthen and expand the GGMN People Network and to introduce the new system three groundwater monitoring workshops were organised for South East Asia (Bangkok, Thailand, March 2016), Pacific SIDS (Suva, Fiji, August 2016) and Vietnam (Hanoi, Vietnam, October 2016).



Fig.12 Risk GGMN workshop in Thailand (March, 2016), Fiji (august 2016) and Vietnam (October 2016)

#### Groundwater Monitoring in South East Asia, Bangkok, Thailand

On 15-16 March 2016, the workshop 'Groundwater Monitoring in Southeast Asia' was held in the Asia Hotel, Bangkok, Thailand. The workshop was organised by UNESCO Bangkok Office, Department of Groundwater Resources Thailand (DGR) and the International Groundwater Resources Assessment Centre (IGRAC) under the framework of the GGMN programme. In total 45 groundwater specialists from six countries (Cambodia, Iran, Malaysia, Myanmar, Thailand and Vietnam) attended the workshop. During the workshop, the groundwater experts got acquainted with the GGMN and worked with the newly developed GGMN web-based application. The workshop aimed to provide a platform to discuss groundwater monitoring challenges in Southeast Asia as well as to exchange information, experience and perspectives on groundwater monitoring networks.

#### Advancing Groundwater Monitoring in Pacific Small Island Developing States, Suva, Fiji

IGRAC organised a GGMN workshop entitled "Advancing Groundwater Monitoring in Pacific Small Island Developing States" (Suva, Fiji, 29 August – 2 September). The workshop was jointly organised by WMO, IGRAC, Fiji Meteorological Service (FMS), the Secretariat of the Pacific Community (SPC) and the Secretariat of the Pacific Regional Environment Programme (SPREP). The workshop was set up in the framework of the GGMN programme, a UNESCO programme implemented by IGRAC and set up to improve quality and accessibility of groundwater monitoring information and subsequently our knowledge on the state of groundwater resources.

The workshop brought together regional (ground)water specialists from SIDS to review the state of groundwater resources and monitoring in their country and to learn on groundwater monitoring and assessment techniques. Around 25 participants attended the training from 11 different Pacific SIDS (Cook Islands, Fiji, Kiribati, New Caledonia, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu).

The 5-day workshop consisted of the following components:

- Groundwater in SIDS and the importance of groundwater monitoring
- Groundwater monitoring and assessment techniques
- Field work
- Data analysis and interpretations
- Advanced geophysics (Professor Ian Acworth, University of New South Wales)

#### Monitoring for Regional and Transboundary Groundwater Management, Hanoi, Vietnam

On 4 and 5 October 2016, the international training course 'Monitoring for Regional and Transboundary Groundwater Management' was held at the NAWAPI Headquarters in Hanoi, Vietnam. The training was organised jointly by National Center for Water Resources Planning and Investigation (NAWAPI), Ministry of Natural Resources and Environment (MONRE) Vietnam, and IGRAC. The training was organised back-to-back with the 5th international Vietnam Water Cooperation Initiative (VACI) symposium 'Managing transboundary waters: from policy to practice'. In total 40 participants from various provinces in Vietnam attended the workshop. Participants included water planning professionals, managers, technicians of water services, civil engineers, officials of public water authorities, researchers, and students. The workshop was a first step to introduce the programme in Vietnam.

General outcomes of the three GGMN workshops:

- The GGMN programme provided useful knowledge and access to modern technology. The GGMN portal makes the exchange nationally and internationally much easier. The GGMN portal can assist to improve regional cooperation on groundwater management in the region, but also be used for communication and data sharing within various provinces within countries.
- Participants were enthusiastic about the GGMN software and its functionalities. Participants expressed their interest to use GGMN for risk assessment for salt water intrusion or use the system for prediction/forecasting.

- Participants expressed their interest to learn more on the functionalities of the GGMN Portal and its connection to QGIS. It was requested to provide more in-depth training (~5 days) on spatial interpolation and time series analysis for groundwater data processing and analysis.

### 3.4 KNOWLEDGE SHARING AND GOVERNANCE

Knowledge sharing is a part of all IGRAC activities and involves creating networks of people and development of services for these networks. Some activities listed below can also be seen as thematic developments but they do not necessarily include assessment. These activities are dedicated to knowledge sharing (and governance) beyond the usual management structure. In the chapter below, a distinction is made between project-based activities and dissemination and outreach through publications, social media, events, etc.

#### 3.4.1 Governance

##### Sustainable Development Goals (SDGs)

- IGRAC contributed to the development of the methodology for monitoring indicator 6.3.2 of the SDGs. In collaboration with the United Nations Environment Programme (UNEP) GEMS/Water and UNESCO-IHP, the groundwater component was included in the methodology which provides recommendations on basic water quality parameters, monitoring network density, aggregation and spatial upscaling. IGRAC assisted IWMI with the development of the methodology for monitoring the groundwater component of indicator 6.6.1.
- IGRAC provided a poster presentation on the applicability of the Water Goal (SDG 6) in Small Island Developing States in the Pacific. This included an overview of the implications of monitoring and achieving the targets relevant to SDG6.
- IGRAC attended a number of meetings (see section 3.4.4) and the Delft workshop in September 2016 to advocate for groundwater inclusion in a number of relevant SDG targets.
- Three of IGRAC's researchers in collaboration with our 2016 intern on the SDGs published a 'crowd-sourced' policy brief entitled "Groundwater in the Context of the Sustainable Development Goals: Fundamental Policy Considerations." This brief will contribute to the development of the 2016 UN Global Sustainable Development Report. It highlighted key areas where groundwater will support the achievement of the SDGs and provided key, groundwater-conscious policy considerations for countries and other implementing agencies.

##### IGRAC PhD Fellow Research 2016

The 4-year PhD research project of Kirstin Conti on "Norms in Groundwater Governance and Sustainable Development at Multiple Geographic Levels" is drawing to a close in early 2017. Annex I provides a summary of the research objectives, approach and findings. Portions of this research have been published as peer-reviewed, academic journal articles or grey literature for IGRAC and presented at academic and practitioners conferences.

##### Groundwater Futures in Sub-Saharan Africa (GroFutures)

The GroFutures project is a four-year project that aims to develop the scientific knowledge and participatory processes by which groundwater resources can be used sustainably for poverty alleviation in Sub-Saharan Africa.

In March 2016, IGRAC implemented the Groundwater Serious Game at the Great Ruaha basin in Tanzania. The game session was attended by around 30 participants including farmers, students, basin authority and other stakeholders. The participants were enthusiastic and IGRAC received numerous and valuable feedback. IGRAC participated and contributed further with the GroFutures team to the other activities held during the Inception workshop in Iringa.

In August, IGRAC contributed to the Inception Workshop on the Iullemeden basin case study, held in Niger. This case study has a special character as it is a transboundary one and involves

professionals from Niger, Nigeria and Cameroon. About 30 stakeholders participated in Groundwater Serious Game.

### 3.4.2 Knowledge Sharing and People Networks

#### Free and open source tools for water resource management (FREEWAT)

FREEWAT is a HORIZON 2020 project that is developing an open source GIS integrated modelling environment for the simulation of water quantity and quality. IGRAC has been involved with the FREEWAT project since the end of 2015. The first activity performed was related to the self-training on the FREEWAT software, followed by preparation of a training brochure on the GGIS and GGMN to for the 'Training of the trainers' activity. IGRAC representative also become an accredited trainer, after following a week-long course in Paris.

For one of FREEWAT case-studies, the Stampriet groundwater model. IGRAC prepared a set of data in prescribed FREEWAT format, primarily based on the outcomes from the GGRETA project. The data were delivered to UNESCO-IHP, who will lead the case study. IGRAC presented the FREEWAT project and the Stampriet case-study during the 35<sup>th</sup> International Geological Congress in Cape Town, South Africa. IGRAC is also the task leader of WP3.3, training at national level during 2017.

#### IAH commission on Transboundary Aquifers

The IAH commission on Transboundary Aquifers was re-established in 2014 and the IGRAC representative is one of co-chairs of the commission. IGRAC also provides additional support to the commission in terms of communications, by setting up a web-page for the commission as well as a LinkedIn Group. Currently the LinkedIn Group has 122 members (status 26 October 2016) and postings of news on transboundary aquifers are on the increase. The commission has organised a meeting at the IAH conference in Montpellier, which raised quite some interest.

Also in 2016 IGRAC has initiated efforts to compile and share a bibliography on transboundary aquifer publications, and an overview of recent and ongoing transboundary groundwater initiatives/projects.

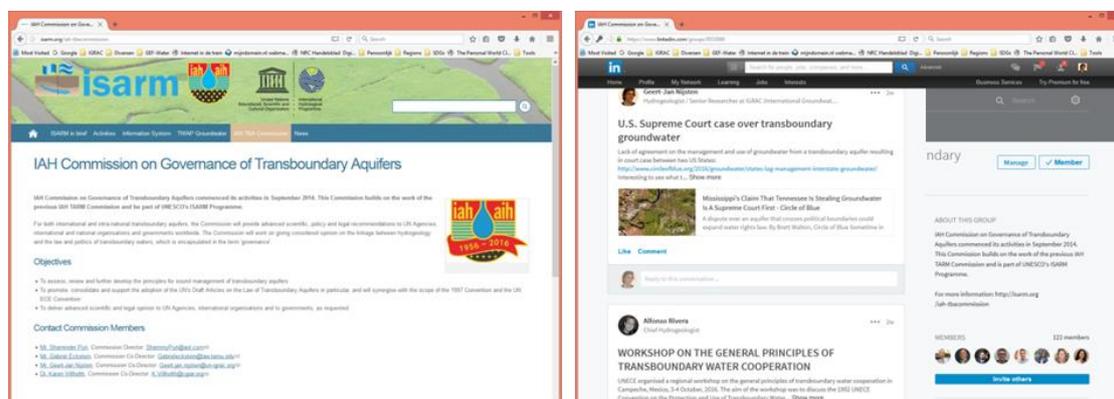


Fig.13 IAH TBA Commission's Webpage and LinkedIn Group

#### Capacity building and education

Even though it is not one of IGRAC's core activities, IGRAC aims to contribute to capacity building in groundwater monitoring, assessment and governance through specialised training workshops and on-the-job training.

In 2016, in collaboration with UNESCO-IHE, IGRAC:

- contributed to the Groundwater Resources & Treatment module (a part of UNESCO-IHE's MSc Water Supply programme);
- provided guest lectures on Groundwater Monitoring and on Internationally Shared Aquifers (a part of UNESCO-IHE' MSc Groundwater and Global Change programme),

- Supervised and serve as external examiner for MSc Thesis at UNESCO-IHE.

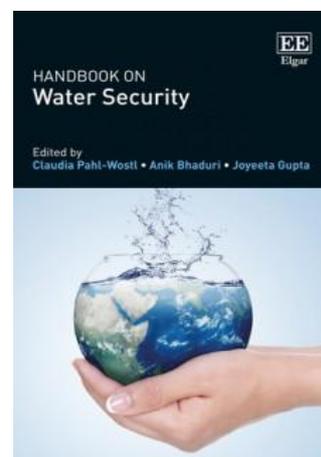
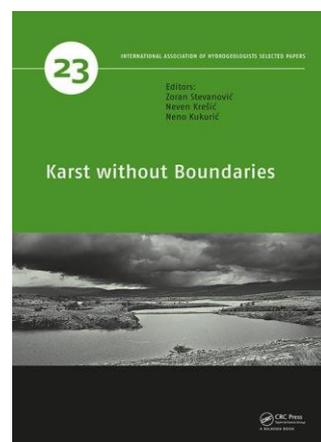
Additionally, a Course on Advanced Groundwater Monitoring and Analyses is developed for water professionals. The core of the course is the conductance of groundwater monitoring and interpretation of monitoring data. Professionals are trained to identify patterns in the groundwater behaviour that could indicate effects of climate change and overexploitation. The course is given in The Netherlands and also comprises field visits and lectures from our Dutch partners.

In 2016, IGRAC reviewed a number of papers for the prominent journals, such as Applied Geochemistry and Hydrogeology Journal. Additionally IGRAC reviewed two international project proposals as requested by VIA Water programme and ISO's proposed standard on "Requirements for Documentation of Groundwater-Flow Models" as requested by WMO.

### 3.4.3 Publications and communications

#### Publications:

- Karst Without Boundaries, Stevanovic, Kresic, Kukurić (2016), Editors, IAH Selected Papers, CRC Press.
- Kirstin I. Conti, Neno Kukurić, Joyeeta Gupta (2016), Groundwater Security, in C. Pahl-Wostl, A. Bhaduri and J. Gupta (eds.), Handbook on Water Security. Edward Elgar: Cheltenham, UK, 161-182.
- G. Nijsten, N. Ansems, N. Kukuric, A. Aureli (2016) A multi-disciplinary approach and tools for comparative and in-depth assessments of transboundary aquifers. 5th International Symposium of Vietnam Water Cooperation Initiative (VACI), Hanoi, Vietnam. \*best paper award.
- C Stefan, N. Ansems (in press) Web-GIS of global inventory of managed aquifer recharge applications. 9<sup>th</sup> International Symposium on Managed Aquifer Recharge. Sustainable Water Resources Management, Springer Journals.
- M. de Chaisemartin, R. G. Varady, S. B. Megdal, K. Conti, J. van der Gun, A. Merla, G.-J. Nijsten, F. Scheibler (2016). Addressing the groundwater governance challenge: A call from the "Groundwater Governance: A Global Framework for Action" Project in Karar, Eiman (eds) Freshwater Governance for the 21st Century, Springer.
- Antoniou E.A, Stuyfzand, P.J., Smits F. (under review) Quality assessment of deep-well recharge applications in the Netherlands, Water Science and Technology journal.
- IGRAC contributed to Chapter 6 of the upcoming World Water Development Report 2017 (Wastewater – The untapped resource) by providing a global overview of groundwater salinisation due to large-scale and intensive irrigation and a description of the background processes.
- WMO Water Recourses Assessment Manual (under review), a chapter contribution on Data Requirements and Availability for Water Resources Assessment" and a case study contribution "Groundwater Resources Assessment in the Stampriet Transboundary Aquifer System".
- Benedicto, D., Rossetto, R. and Filali-Meknassi (2016), Y. FREEWAT a water management tool enhancing the participatory approach in the Stampriet aquifer system region. 35th International Geological Congress, Cape Town – South Africa.
- Benedicto, D., Nijsten, G.J. and Ansems, N. (2016) The importance of information management systems (IMS) to good governance of shared groundwater resources. 35th International Geological Congress, Cape Town – South Africa.



- [Groundwater Monitoring in Small Island Developing States in the Pacific](#) (2016): The report is a summary on groundwater monitoring practices in Small Islands Developing States in the Pacific. A brief overview is given for each Pacific SIDS to capture the current groundwater monitoring and assessment practices and their future challenges. IGRAC report.
- [GGIS & GGMN training Material](#) (2016) developed in the framework of FREEWAT, IGRAC report.
- [identifying high-risk transboundary aquifers following an indicator-based assessment](#) (2016) TWAP additional Analysis, IGRAC report.

## Communications

### ONLINE

Also in 2016, most improvements in terms of the communications were made online. While the year 2015 was marked by the development and launch of a new website, 2016 was spent on analysing the user experience and improving the website. Half a year after the official launch in September 2015, website statistics were analysed and the results were not as positive as expected mainly due the poor performance on search engines. The figure 16 shows how visitors get to the IGRAC website. 'Organic Search' indicates the percentage of website sessions that start with a Google search, 'Direct' represents the sessions in which the users directly type in the IGRAC url in their browser, 'Referral' are links in for example newsletters or other websites and 'Social' are from social media channels.

IGRAC started to implement a strategic approach on Search Engine Optimisation (SEO) in May 2016. That included: technical (linking) issues, adjustments to Google algorithm update, identification and implementation long- and short-tail keywords, adjustment of hierarchy of website's pages, etc. The improvement was evident.

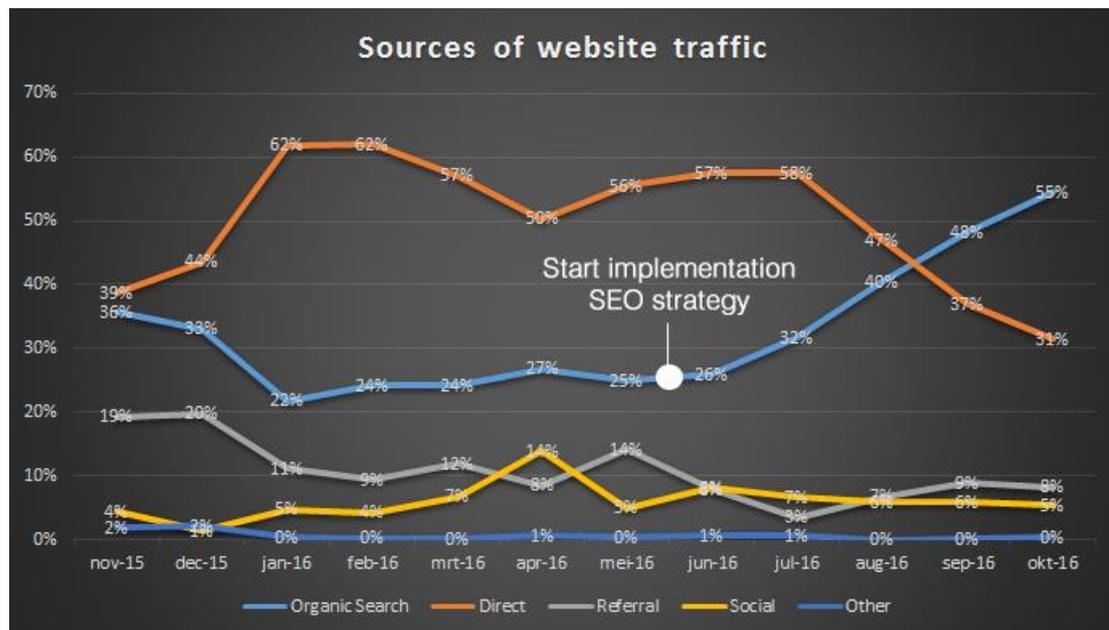


Fig.16 the ways of visiting IGRAC website

### PRINT

IGRAC has produced several print materials, but the main products were the GGIS brochure, the GGMN brochure and the MAR flyer (Figure 18). The GGIS brochure was developed as a marketing product for the system; IGRAC has provided GGIS modules to serve as an information management system for several projects in the last few years and this brochure should assist in getting more similar assignments in the upcoming year. In 2016, IGRAC also developed a new GGMN brochure, which is an updated and restyled version of the previous GGMN brochure from

2013. The MAR flyer gives an overview of IGRAC's MAR activities ranging from local and regional research to the data visualisation within the MAR Portal.

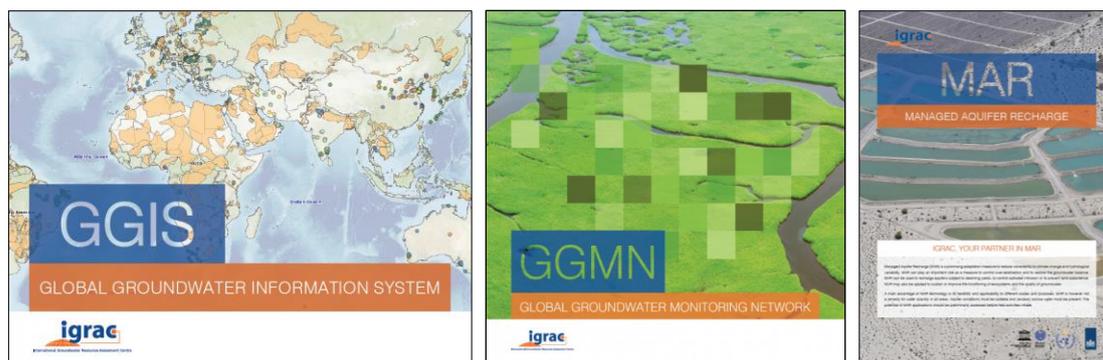


Fig.17 The main IGRAC print material in 2016

## SOCIAL MEDIA

In July 2014, IGRAC started intensifying its social media engagement. Until that moment, IGRAC only had a LinkedIn account with 80 followers. A Facebook page and a Twitter account were set up and within the last 2.5 years they have attracted 19,000 and 900 followers. In addition, IGRAC's LinkedIn fan base grew to 300 followers (see the table below).

	Followers in 2014	Followers in 2015	Followers in 2016
	190	13,234	19000
	74	743	900
	85	175	300

IGRAC's online presence did not only grow in numbers, but also in geographic reach. In 2014, IGRAC's audience was to be found in Western Europe, USA and Australia. One year after implementation of its developed communication strategy, IGRAC successfully reached a few new target groups, namely Latin America, Eastern Africa and South East Asia. In 2016, IGRAC met its goal of global coverage by attracting more followers from Western Africa, Northern Africa, Middle East, Eastern Europe and Central Asia (see the map below).

Possible explanation for this success in 2016 could be the website translations into French, Russian and Spanish. By sharing more French content, IGRAC could more easily connect to its Western and Northern African audience, while the Russian updates and documents were well received in Central Asia. The audience is also extended in Latin America due to Spanish translation.

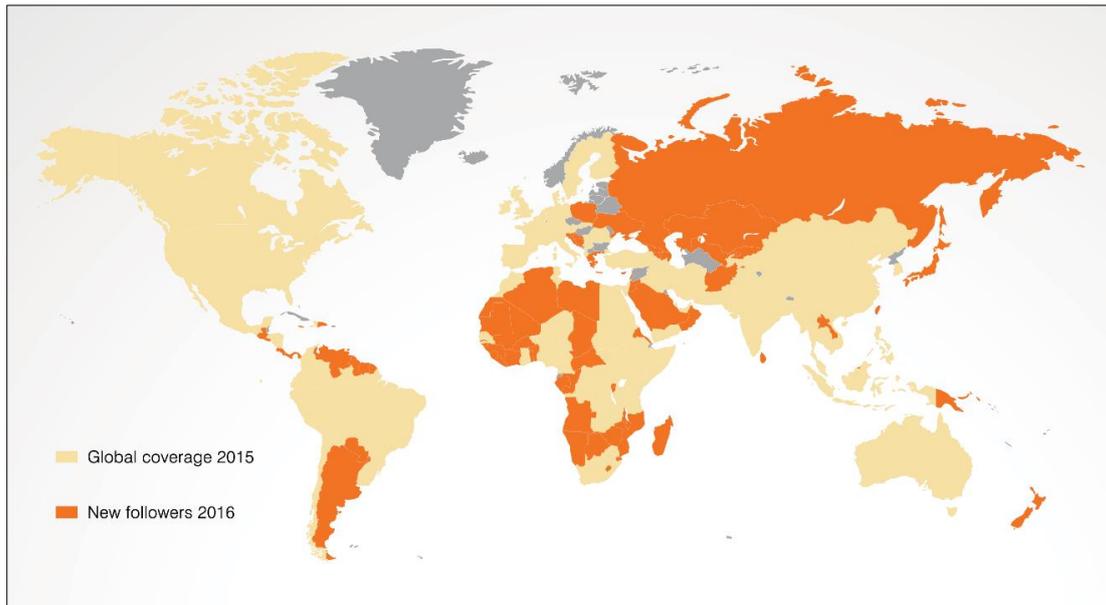


Fig. 17 The global coverage of IGRAC followers on social media

#### 3.4.4 Events

- GEMI Stakeholders Meeting - February, Geneva, Switzerland  
The first meeting of parties involved in the preparation of the water-related Sustainable Development Goals.
- World Bank technical visit Balkan region – March 2016 in Delft, The Netherlands  
IGRAC attended a WB-organised technical visit of a delegation of senior staff of Water Directorates and Agencies from Bosnia & Herzegovina, Serbia, Montenegro, Albania; and the Sava Commission. IGRAC gave a presentation on the DIKTAS project as a concrete example of successful "international" water-sharing.
- Adaptation Futures 2016 – May 2016 in Rotterdam, The Netherlands  
At this biennial conference, IGRAC made presentation on 'Normative architecture for groundwater governance: redesign to facilitate adaptation and inclusion' and presented a poster on 'Ecosystem-based adaptation approaches as an integral component of sustainable groundwater management'.
- European Space Solutions - May 2016 in The Hague, The Netherlands  
IGRAC representative was a panellist in the 'Smart Information Solutions for Water & Climate in the Urban Delta' session and provided a presentation on the Global Groundwater Monitoring Network Portal.
- South Asia Groundwater Forum – June 2016 in Jaipur - Rajasthan, India  
IGRAC, together with World Bank, gave a presentation on Groundwater and Climate change, including an adaptation framework. IGRAC also prepared 10 case profiles of location specific groundwater issues for group work at the conference and facilitated this group work.
- International Water Association (IWA) Specialist Groundwater Conference 2016 – June 2016 in Belgrade, Serbia  
IGRAC presented on 'Quality assessment of deep-well recharge applications in the Netherlands' and on 'Groundwater: Making the Invisible Visible'. Additionally, IGRAC arranged and supported a lecture of a TU-Delft researcher at the Faculty of Civil Engineering of the University of Belgrade on 'Concise introduction to Dutch water management and the Amsterdam Water Supply Dunes'.
- International Symposium on Managed Aquifer Recharge (ISMAR) – June 2016 in Mexico-city, Mexico  
IGRAC presented the recently launched MAR portal, the first structured database on MAR sites globally. The MAR inventory is the result of work by the INOWAS research group from

TU Dresden and IGRAC. The project is supervised by the IAH MAR Commission. IGRAC also co-organised a Global Mar Inventory Workshop prior to the conference.

- TWAP launch – July 2016 in Washington DC, United States  
Together with UNESCO-IHP, IGRAC provided presentation on 'TWAP Groundwater component: Transboundary aquifers & Groundwater systems in Small Island Developing States'
- Central Asia Water Future Forum – September 2016 in Almaty, Kazakhstan  
IGRAC director was one of invited speakers during the session on 'Modernising Water Data and Analysis'. The purpose of the international event was to reflect on progress on the management of water resources in the region, through a knowledge forum that showcases global best practices on modernisation of water management information systems and exhibit state of the art water technologies.
- Launch of SADC Groundwater Management Institute – September 2016 in Johannesburg, South Africa. SADC organised a 2 day event to launch the SADC Groundwater Management Institute under the Sustainable Groundwater Management Project in SADC Member States Project. A presentation 'IGRAC activities & SADC Groundwater' was part of the programme.
- 43rd IAH International Congress – September 2016 in Montpellier, France  
From 25 till 29 September, the 43rd IAH International Congress was held in Montpellier, France. IGRAC presented on the role of SIDS within the SDGs and the role of monitoring information technology for international cooperation and studies.
- VACI2016 Symposium – October 2016 in Hanoi, Vietnam  
IGRAC contributed to the Panel discussion on 'Improving water management in transboundary basins: challenges and opportunities', provided presentation on 'Groundwater monitoring and mapping of transboundary aquifers' and an award-winning conference paper
- G-Wadi Conference – October 2016 in Beijing, China  
IGRAC presented its tools for sharing information on groundwater resources during the session 'Data tools and methodologies: G-WADI and integrated water management'.
- Law of Transboundary Aquifers seminar, October, New York, USA  
The seminar was organised by European Union and UNESCO-IHP. IGRAC provided presentation on Internationally Shared Aquifer Resources Management (ISARM) programme.
- Budapest Water Summit – November 2016 in Budapest, Hungary  
The Budapest Water Summit 2016 was the first global conference that could summarise the results achieved since the Sustainable Development Goals were adopted and, in addition, could contribute to setting out tasks for the following 15 years.
- 7th Rural Water Supply Network (RWSN) Forum – December 2016 in Abidjan, Côte D'Ivoire  
IGRAC contributed with a video presentation, entitled "Global Groundwater Monitoring Network: The role of information technology in international cooperation and global studies", played during the BGS-sponsored seminar "An Understandable Approach to Developing and Using Groundwater".
- 30th EU Groundwater Working Group meeting, April 2016, Amersfoort – The Netherlands  
IGRAC provided a presentation about its work and experience in Europe entitled 'IGRAC – Making the invisible visible - European Experience'.
- 35th International Geological Congress, August 2016, Cape Town – South Africa  
IGRAC provided a presentation on 'The importance of information management systems to good governance of shared groundwater resources' and a poster on 'FREEWAT a water management tool enhancing the participatory approach in the Stampriet aquifer system region'. IGRAC also contributed to the pre-congress workshop 'Understanding the role of groundwater in 21st Century'.
- WMO Commission of Hydrology meeting, December, Rome, Italy

## 4. BUDGETING

The state of IGRAC's budgetary affairs at the end of 2016 is summarised in the table below. There is a Financial Statement Report (in Dutch, 26p) produced by an external bureau for the IGRAC Foundation Board and it is available on request. Following the core funding requirements IGRAC has been financially audited by an independent accountant.

Budgetary items (in Euro)	
	Calendar year 2016
<b>INCOMES</b>	
Core funding	400000*
Projects and services	62179
Revenue	15339
<b>Total</b>	<b>477518</b>
<b>EXPENCES</b>	
Direct project costs	311376
<b>Gross company result</b>	<b>166142</b>
Wages and salaries	162615
Social security contributions	46333
Pensions	36918
Staff subcontracted (advisory, PhD, interns)	83493
<i>Total staff costs</i>	<i>329359</i>
Software & ITC costs	47475
Office rent	17744
Office costs	10778
Depreciation	2271
General costs (insurance, fin. admin, etc.)	23953
<b>Total company expenses</b>	<b>431580</b>
Bank account interests and costs	-1326
<b>Result 2016</b>	<b>-266764</b>
Previous year balance	559331
General reserve condition	<b>292567</b>

\* Core funding for 2016 was 400.000€ 80% of the funding was received in September 2016; the rest will be received upon the approval of the report, mid 2017.

## ANNEX I: Summary of the PhD Research: “Norms in Groundwater Governance and Sustainable Development at Multiple Geographic Levels”

### Problem statement, knowledge gap, and research question

Groundwater constitutes 98-99 % of the world's available freshwater resources. Approximately, 25% of humans rely on groundwater for their domestic needs and 50% use it for potable water supply. Groundwater supplies over 40% of irrigation, 50% of municipal, and 40% of industrial needs globally. Consequently, humans abstract 200 time more groundwater than oil annually and the number of groundwater depletion hot spots is growing. Although most groundwater has naturally good quality, various human activities are degrading groundwater quality including poor sanitation management, agricultural practices, industrial activities, and increasing use of emerging organic compounds. These challenges are exacerbated by climate change, which may shift groundwater recharge dynamics, and international trade, which may virtually export groundwater outside of its location of origin in food stuffs and other commercial products. Yet in many locations, groundwater resources are underutilised due to financial, technological, and/or geographic limitations and can offer potential for improved livelihoods, if governed sustainably.

Existing groundwater governance literature focuses on the state of groundwater resources and their day-to-day management; governance and management of groundwater as a common pool resource; country-based analysis of groundwater governance; and legal instruments for transboundary aquifer governance at the global level. However, many aspects of groundwater governance have yet to be thoroughly explored, analysed and examined through the assessment of patterns and trends in existing laws and policies for groundwater governance. There is indication that groundwater is receiving increasing, although still marginal, attention in water governance frameworks. Yet, most frameworks are grounded in approaches focused on river-basin management; short-term prevention of degradation; and averting interstate conflict over transboundary resources. Consequently, the design of groundwater governance frameworks, including their normative and rule-based aspects are insufficiently tailored to account for the specific physical attributes of groundwater and to counter the human activities driving groundwater depletion and quality degradation. Further, these frameworks do not discuss groundwater from either a hard sustainability perspective that equally considers the environment, social, and economic dimensions or an inclusive development perspective that focuses on the marginalised and the poorest of the poor.

Given the groundwater resources problem and the gaps in knowledge regarding groundwater governance, the thesis responds to the overarching question: What kind of normative framework for groundwater governance supports sustainable and inclusive development and what is required to achieve this framework at multiple geographic levels?

### Methodological Approach

The thesis developed a conceptual framework for institutional analysis, which integrated the concepts of multilevel governance, sustainable and inclusive development, ecosystems services, and legal pluralism (i.e. the co-existence of multiple laws regulating the same issue in the same location). To operationalise this framework, literature and available databases were reviewed to identify groundwater resources problems and map them across the global, regional-transboundary, national and sub-national levels. Then, the state of groundwater governance at these levels was assessed by (1) constructing a database of over 200 groundwater laws and policies, (2) examining the temporal evolution of groundwater governance instruments; (3) assessing patterns in groundwater governance principles by analysing the content of groundwater laws and policies via mapping and descriptive statistics; (4) and determining groundwater governance's potential contribution to sustainable and inclusive development using a legal pluralism analysis. This approach was also applied to the case of the Stampriet Transboundary Aquifer System (straddling Botswana, Namibia and South Africa) and was augmented by stakeholder interviews and field observations.

### Conclusions and Recommendations

The multi-level and legal pluralist analyses of groundwater governance frameworks yielded six conclusions. First, the principles addressing the environmental aspects of groundwater governance are prevalent in laws and policies but are infrequently tailored to the specific dynamics of groundwater resources. Further, the hydrological link between surface and groundwater is greatly overemphasised reducing the potential for sustainable development of groundwater resources, particularly in aquifers with low-yield, low-recharge, or risk of geogenic contamination. Second, the social and relational aspects of groundwater governance remain underdeveloped due to sustainable development principles, such as public participation public education and awareness, poverty eradication, rights of marginalised groups (i.e. women, youth indigenous peoples) and intergenerational equity, being sporadically included in groundwater governance frameworks. These gaps leave the framework vulnerable to a lack of inclusivity. Third, the frameworks hardly focus on global-level drivers of groundwater resources problems, namely climate change and international trade, risking that groundwater governance is not able to cope with these highly-influential processes. Fourth, taking advantage of the context-specific linkages between groundwater governance and governance of related domains such as food, forests and energy is critical for sustainability, especially in the absence of groundwater specific data. Fifth, the pluralist nature of co-existing legal and policy frameworks can support groundwater governance by facilitating context specificity and enabling day-to-day practice to fill the framework's gaps or reconcile incongruence. But, pluralism can also undermine frameworks by allowing forum-shopping (e.g. ratifying some water conventions and not others) as well as the over-emphasis of sovereignty and the securitisation of natural resources (e.g. declaring groundwater a resource of strategic importance). Sixth, the frameworks do not directly address opportunities for increased groundwater exploitation in locations where it is underutilised.

Based on these conclusions, six recommendations are proposed for the further advancement of groundwater governance frameworks. First, the frameworks need to bring into appropriate balance the norms that address groundwater-specific issues with those originally designed for surface water governance. Second, the social and relational elements of groundwater governance require deeper integration into the frameworks, ideally stemming from the inputs of key stakeholders and groups at risk of marginalisation. Third, the issues of climate change and trade need to be moved from the background into the foreground. Groundwater governance should directly address climate uncertainty and address externalities resulting from trade of groundwater-dependent products. Fourth, capacity building across water-related sectors as well as and increased data gathering is necessary for improved governance but are often challenging and progress slowly. However, the potential to improve management of agricultural practices, land use planning, energy generation and extractives exploration can greatly improve groundwater governance in the short term. Fifth, further assessment of equivalence and/or pluralism between groundwater laws and policies (both formal and customary) is needed to understand how governance frameworks can better support sustainable and inclusive development. Sixth, governance frameworks need to address opportunities for increased, yet sustainable and inclusive groundwater resource use where it may further advance human well-being.

## ANNEX II: Minutes from the Governing Board meeting, Dec. 2016

Held in Delft on 20<sup>th</sup> December 2016

### Present:

- Ms. Elaine Alwayn, chair (Ministry of Infrastructure and the Environment, NL)
- Ms. Alexandros Makarigakis, member (UNESCO-IHP, replacing Ms. Alice Aureli)
- Mr. Dominique Berod, member (WMO)
- Mr. Fritz Holzwarth, member (UNESCO-IHE, replacing Mr. Johan Aad van Dijk)
- Mr. Joop de Schutter, chair of the IGRAC Foundation Board
- Mr. Neno Kukurić, director IGRAC & secretary of the Board (IGRAC)
- Mr. Geert-Jan Nijsten (IGRAC)

### Absent:

- Ms. Monique Berendsen, IGRAC liaison at the Ministry of Infrastructure and the Environment, NL

The chair **Ms Alwayn** opened the meeting at 13.00, welcomed the participants and asked for a quick introductory round.

Subsequently, **Ms Alwayn** asked for adoption of the agenda. She noted that the suggested agenda is - as usual - about the reporting and planning, but also about the agreements from the extraordinary meeting in July, namely future of the centre and the related strategy. **Mr Berod** suggested informing the Governing Board on main outcomes of the 15 session of the WMO Commission of Hydrology. The suggestion was accepted, this could be done under the agenda item "Any other business". The agenda was adopted without changes:

### AGENDA

13.00 - 13.15: Welcome, adopting the agenda

13.15 - 13.45: Adoption of previously sent documents:

- Governing Board Minutes of the Meeting December 2015
- Governing Board Minutes of the Meeting July 2016
- IGRAC Report 2015

13.45 - 14.05: IGRAC State of Affairs (December 2016)

14.05 - 14.25: IGRAC Work Plan 2017

14.25 - 15.10: Discussion on State of Affairs & Work Plan

15.10 - 16.00: Future of the Centre (2017-2021) including:

- Strategic Planning 2017-2021
- Strategic and Technical Advisory Committee
- Governing Board additional members

16.00 - 16.15: Conclusions and agreements

16.15 - 16.30: Any other business

16.30: Closing the meeting

### ADOPTION OF PREVIOUSLY SENT DOCUMENTS

**Ms Alwayn** introduced the documents, noting that the commented and revised Minutes from December 2015 were distributed in January 2016, the IGRAC Report 2015 in April 2016, and the Minutes from July 2016 in November 2016, together with audio-recording. Ms Alwayn reminded the Board on conclusions and agreements from the Governing Board in December 2015. Some of the related actions are still on-going, like continuing effort of UNESCO and WMO to find an opportunity of issuing a joint statement on groundwater/monitoring/IGRAC. **Mr Kukurić** briefly informed the Board on activities carried out as IGRAC contribution to the International Water Ambitions (IWA) programme of the Dutch Government. **Ms Alwayn** suggested to reflect upon the conclusions and agreements from July 2016 while discussing the future of the centre, further in this meeting.

With the exception of a typo (noticed by **Mr Berod**) in the Minutes from July 2016, there were no additional comments and the previously sent documents were adopted.

## **IGRAC STATE OF AFFAIRS AND THE WORK PLAN**

Invited by the chair, **Mr Kukurić** presented the IGRAC's State of Affairs (as of November 2016) and the Work Plan for 2017. Mr Kukurić stressed that 2016 was a transition year for IGRAC, marked by substantially decreased number of common activities with UNESCO-IHP Secretariat and by financial uncertainties. Consequently, IGRAC is entering 2017 with a reduced staff and decreased budget. Therefore, IGRAC needs to increase extra-budgetary activities in 2017 in order to maintain the current level of activities. 2017 also marks a new five-year period of cooperation with UNESCO and of the core-financing from the Dutch Government, providing a necessary foundation for operation and further development of the centre. The presentation of Mr Kukurić is available on request.<sup>1</sup>

Subsequently, the chair opened a discussion on IGRAC performance in 2016 and the plans for 2017. **Mr Holzwarth** stressed the importance of showing the impact of the centre, also in order to justify investments made. According to Mr Holzwarth, IGRAC is doing a good work but needs to express results not only in terms of outputs but also in outcomes and impact. He also noted that cooperation with IWMI is promising. **Mr Nijsten** provided an example of IGRAC's position papers on SDGs, hence influencing the policy level; however, the level of influence is difficult to measure. **Mr Makarigakis** noticed that the use of inland saline groundwater is certainly worth of exploring; however, attention should be paid to limitations as well, especially regarding soil salinization. Regarding the monitoring, Mr Makarigakis suggested exploring possibilities to join the ISO (environmental) standards developing community. Further, he expressed his appreciation of clarity of communication products and suggested that IGRAC should make a further step in reporting, including not only deliverables/outputs but also outcomes and possibly the impact as well. Hence, the suggestion is not to change a way of doing business but on how you report on it, Mr Makarigakis stressed; moreover, defining indicators/targets is instrumental in this process. **Mr Berod** supported the suggestion of having more explicit reporting in a broader context, describing the outcomes and not only the outputs. We need to specify where IGRAC can exactly contribute to programmes and other activities that WMO and UNESCO are involved, such as SDGs and UNFCCC COPs **Mr Berod** noted; there is a uniqueness of the centre and a great potential but it asks for a joint effort of all parties.

**Mr de Schutter** agreed as well that the quality of products and services of IGRAC is certainly good but the modality of cooperation with some of its partners should change in order to provide IGRAC more financial benefit and stability. This is a task for all of us, stressed Mr De Schutter, to review the current situation and take actions to make IGRAC more sustainable on the longer run.

**Ms Alwayn** agreed that IGRAC has an important role and doing a good content work; after all, those are the reasons that the ministry is continuing to provide the co-funding to IGRAC. Nevertheless, Ms Alwayn also agreed with Mr Holzwarth and Mr De Schutter that IGRAC is providing a lot but it receives too little for its products and services. She took GRIPP and GGMM as examples and asked about financial benefits of these activities for IGRAC. **Mr Nijsten** explained that in GRIPP, IGRAC is doing precisely what Mr De Schutter is suggesting: using core funding and developed products and services as a leverage to get new projects. Mr Nijsten also added that IGRAC invested a substantial time during 2016 in preparing proposals, some of them with UNESCO-IHE and the main one (for the Adaptation Fund) with UNESCO-IHP. Only one of these proposals, if successful, would have substantially changed the IGRAC financial situation because of IGRAC's small size.

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<sup>1</sup> The audio recording of the Governing Board meeting (47MB, 3h 40min) is also available on request.

After some further discussion, the overall conclusion was that IGRAC is providing a good content work but needs to review and revise the modalities (as specific measures used to accomplish objectives) in order to provide a stronger leverage for extra-budgetary financing. IGRAC Work Plan for 2017 is eventually adopted but it will be revised if necessary after the revision of the IGRAC modalities. **Mr Makarigakis** pointed out that the STAC (Strategic and Technical Advisory Committee) should also assist IGRAC in brainstorming and setting the priorities.

## FUTURE OF THE CENTRE

Invited by the chair, **Mr Kukurić** briefly introduced the documents prepared for the meeting, namely: 'Concept notes for IGRAC Strategic Planning 2017-2021' and the 'Terms of Reference for STAC'.

During the discussion, the members of the Governing Board found the suggested growth presented in the concept notes too optimistic. Mr Kukurić explained that the notes are an internal document prepared for discussion. The conclusion of the discussion was to prepare three scenarios, one with the core funding, the other with a modest growth and the third one optimistic. **Mr de Schutter** stated that these scenarios should be based on an analysis/revision of IGRAC leverage, complementarity and modalities. It was agreed that IGRAC will be assisted in this analyses by an advisory group consisted of Mr de Schutter, Mr van Dijk and Mr Tuinhof. Firstly, terms of references (with realistic goals) should be prepared for this group. **Ms Alwayn** noted that the notes for the strategic planning look more back than ahead. **Mr Kukurić** replied that intention was to connect with the previous strategic document but it is a fair point to be taken while improving the document.

In continuation, the Governing Board thoroughly discussed the criteria and potential members of the STAC. It was agreed that STAC should not have more than 5-6 members and that the gender should be taken in account. Although the STAC membership is on personal title, representation of various sectors (e.g. NGOs, private sector) has also taken in consideration.

The suggested list is as follows:

- Stephen Foster
- Marcus Wijnen
- Theodora Szoch (IAH)
- NGO representative (preferably IUCN, if not, then WWF)
- Private Sector representative (Unilever, contact Mr De Schutter, if not then Coca Cola or Vitens, contact Ms Alwayn).

Gender criterion is still applicable while choosing remaining members.

Subsequently the Governing Board discussed potential new members of the Governing Board; eventually no new concrete suggestions were adopted. **Mr Makarigakis** noted that the Governing Board will change anyway because of the renewed agreement and that for example UNESCO-IHE will not be a member of the Governing Board anymore. The chair, **Ms Alwayn** noted that she was very surprised by this interpretation of the agreement. **Mr de Schutter** added that UNESCO-IHE is, although it is not explicitly mentioned in the renewed agreement, an international organisation of special importance for IGRAC and can remain in the Board. **Mr Kukurić** stressed that IGRAC was once moved to Delft and the UNESCO-IHE building because of this important synergy. Mr Kukurić also asked what would be a reason for removing UNESCO-IHE from the board if that is not in interest of IGRAC. It was agreed that both UNESCO and the Ministry check this issue with their respective legal affairs departments in January.

In continuation of the meeting, the chair **Ms Alwayn** reminded on the agreed actions of the Governing Board meeting in July 2016. The action of UNESCO to 'engage IGRAC in new (extra-budgetary) activities as soon as opportunities arise' is pending, all the other agreed actions are completed.

The concept notes for the strategic planning need to be developed further and include various scenarios. This will be done after the analysis/revision of IGRAC leverage, complementarity and modalities (with assistance of selected advisors) is carried out. This activity will also be discussed by the Foundation Board, whose next meeting is tentatively planned for March 2017. The new version of the document should be ready for the first STAC meeting. However, a new version of the concept notes for the strategic document will firstly be sent to the Governing Board, prior being shared with STAC. According to the previous Governing Board agreements on TAC, the agreements from June 2016 and the STAC ToR, the strategic document will be developed together with STAC, based on prepared concept notes. The final approval of the strategic document is, alike other IGRAC's planning and reporting documents, with the Governing Board. UNESCO-IHP already offered to host the first STAC meeting in Paris. The STAC should become operational in the first half of 2017.

IGRAC Work Plan for 2017 will be revised if deemed necessary after the analysis of IGRAC modalities. **Mr de Schutter** noted that the strategic analysis itself is a new activity in the planning for 2017. The suggested budget for 2017 is considered realistic for a planning document; unlike the work plan for 2017, the strategic document will have more budget scenarios for the period 2017-2021.

## **ANY OTHER BUSINESS**

**Mr Berod** informed the Governing Board about the 15<sup>th</sup> session of the WMO Commission of Hydrology, held in December in Rome: (<http://meetings.wmo.int/CHy-15/SitePages/Session%20Information.aspx>).

Several decisions of the Commission were related to groundwater and IGRAC, including the launching of a new Global Hydrometry Support Facility (the WMO HydroHub). One of the components of the Facility is the WHYCOS programme and its HYCOS components, where IGRAC might become involved. Another component of HydroHub is an Innovation Hub dedicated to innovative solution in water monitoring, including low-cost technologies, citizen observations, remote sensing including satellite, etc. some of these future activities could be of interest for collaboration with IGRAC. **Mr Berod** noted that WMO is building a task team to assess the global data centres (IGRAC, GRDC, HYDROLARE). Finally, Mr Berod reminded IGRAC that the Memorandum of Understanding (MoU) needs to be renewed in 2017.

## **CONCLUSIONS AND AGREEMENTS**

Tasks/activities:

- IGRAC will engage an advisory group of three members to assist in analysis/revision of IGRAC's leverage, complementarity and modalities. The advisory group will operate according to the ToR, to be prepared by Mr Kukurić and Mr De Schutter in January 2017.
- The STAC member list will be completed (with representatives of NGO and the private sector) and the prospective members will be contacted.
- The new version of the notes for the Strategic Planning will be prepared for the first meeting of STAC (and shared with the Governing Board in advance of this meeting). The STAC should become operational in the first half of 2017.
- It is envisaged to hold the first STAC meeting at UNESCO-IHP in Paris.
- UNESCO-IHP and the Ministry will check with respective legal departments whether, according to the renewed agreement, UNESCO-IHE can remain in the IGRAC's Governing Board.
- WMO and IGRAC will take necessary steps required to renew the MoU.

## **CLOSING THE MEETING**

The meeting of the Governing Board was closed by the chair **Ms Alwayn** at 16.40.







International Groundwater Resources Assessment Centre