



United Nations  
Educational, Scientific and  
Cultural Organization



International  
Hydrological Programme

# G-WADI

## GLOBAL NETWORK ON WATER AND DEVELOPMENT INFORMATION FOR ARID LANDS



International Hydrological Programme  
Division of Water Sciences



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# THE CONTEXT

## **Arid and semi-arid areas face the greatest pressures to deliver and manage freshwater resources.**

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It has been estimated that by the mid-1990s, 40% of the world's population was suffering from serious water shortages. This is now increasing, with two-thirds of the population projected to be living in water-stressed countries by 2025, most of these in North Africa, the Middle East and West Asia.

Prolonged droughts affect many countries in semi-arid areas such as the Sahel, southern Africa, northern China, India, the western coast of South America, and Australia. Southern Europe and the Great Plains of the United States also suffer from water stress, over-abstraction of groundwater and desertification. Moreover, many arid regions are the focus of potential conflicts over water scarcity and there is a need to develop strategies to support peace and security.

Challenges facing water managers in these areas include population growth, food security, salinity increases and pollution from various sources. Superimposed on these pressures, climate change is expected to increase water scarcity and the frequency of floods and droughts in many arid and semi-arid areas.

Accurately assessing and managing the available and renewable water resources is more difficult in semi-arid regions, compared with water-rich countries; the science base is limited, data are scarce and the humid zone experience is of limited applicability.

Rainfall is less predictable in these regions, floods are difficult to quantify and estimating recharge to aquifers is particularly difficult. Few surface water diversions are accurately gauged and groundwater levels are rarely metered. Much of the water being withdrawn from deep aquifers is non-renewable and is extracted beyond safe-yield levels.

Improved scientific understanding, cooperation and data sharing provide ways to better manage water and support conflict resolution. UNESCO's Global Network on Water and Development Information for Arid Lands (G-WADI) programme was established in 2004 to strengthen the global capacity for management of water resources in arid and semi-arid regions, one of the priorities of the International Hydrology Programme's (IHP) seventh phase (2008-2013), entitled "Water Dependencies: Systems under Stress and Societal Responses".

# G-WADI MISSION AND OBJECTIVES

**G-WADI's mission is to strengthen the capacity to manage the water resources of arid and semi-arid areas around the globe through a network of international and regional cooperation.**

G-WADI aims to build an effective global community through the integration of selected material from networks, centers, organizations and individuals. The network promotes regional and international cooperation in arid and semi-arid areas.

## G-WADI'S OBJECTIVES:

- **Improved understanding of the special characteristics of hydrological systems and water management needs in arid areas**
- **Capacity building of individuals and institutions**
- **Broad dissemination of understanding of water in arid zones to the user community and the public**
- **Sharing data and exchanging experience to support research and sound water management**
- **Raising awareness of advanced technologies for data provision, data assimilation, and system analysis**
- **Promoting integrated basin management and the use of appropriate decision support tools**

## Improved understanding

Significant data and information gaps exist in arid areas due to the difficulty of collecting data. New and existing knowledge will be shared through the network.

Priorities are to:

- Develop linkages with existing international water-related programmes
- Promote targeted studies related to spatial and temporal variability of rainfall, flash floods, drought, water harvesting and groundwater recharge, ecohydrology, salinization and other geochemical processes
- Facilitate data exchange and development as well as testing of new and existing models using common data sets
- Promote a series of G-WADI basin studies to compare semi-arid zone hydrology and hydrogeology at different scales, linking as appropriate to ecology and socio-economic aspects



## Capacity building

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The G-WADI network acts as a focal point for information exchange and training initiatives in three specific areas:

- Information exchange between UNESCO and other expert centers through the sharing of teaching materials, with some translation to other languages
- Integration of capacity building activities of individuals and institutions, and facilitation of partnerships
- Organization of network workshops in priority areas

## Dissemination of information

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G-WADI acts as a demand-driven filter of scientific and management information, aiming to improve understanding of water in arid regions for non-specialists in four areas:

- Provision of relevant web-based information, including CDs and newsletters
- Linkage with existing centers such as the Center for Hydrometeorology and Remote Sensing (CHRS) at the University of California at Irvine, UNESCO centres, IHP National Committees, the UNESCO freshwater portal and other related international initiatives
- Development of news items and educational opportunities on water such as extreme or unusual hydrologic events
- Provision of links to popular publications relevant to network activities and website

## Exchange of experience

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Many problems can be resolved through the experience of others.

- Facilitation of information exchange on both the application of advanced technologies and adaptation of traditional knowledge (such as rainwater harvesting, groundwater management during extreme events and water scarcity)
- Development and exchange of case studies of successes and failures in arid zone water protection
- Identification and analysis of emerging global trends in water management issues, including issues of rapid, often unplanned, growth in urban areas, and the associated demand management questions
- Provision of easy web access to near-real-time data and data projects, with emphasis on areas where gauges and other ground-based instruments are sparse
- Promotion of web-based discussion to identify the potential and limitations of modelling systems and advanced technologies such as remote sensing, geographic information systems (GIS) and isotopes

## Integrated basin management

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G-WADI promotes initiatives that support holistic water management for human consumption, food production, socio-economic development, and ecosystem services through two specific activities:

- Development of Integrated Water Resources Management (IWRM) and linkages with international programmes (such as HELP, FRIEND, ICIWaRM and other UNESCO centres\*) and the promotion of pilot projects (G-WADI basins) for integrated studies
- Promotion of dialogue between the scientific community, the user community and policy makers in studies related to arid zones and the management of water



\* HELP: Hydrology for the Environment, Life and Policy programme and FRIEND: Flow Regimes from International Experimental and Network Data are cross-cutting IHP programmes. The International Center for Integrated Water Resources Management (ICIWaRM) in Virginia, USA is a water-related centre under the auspices of UNESCO and serves as the technical secretariat for G-WADI.

# G-WADI ACTIVITIES

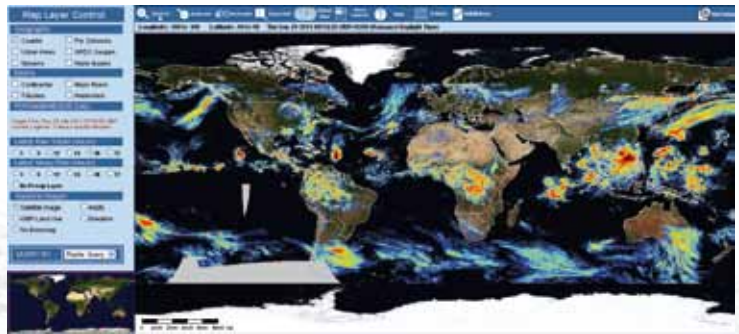


## REMOTE SENSING DATA FOR IMPROVED GLOBAL FORECASTS

The Center for Hydrometeorology and Remote Sensing (CHRS) at the University of California, Irvine has been collaborating with IHP since the inception of the G-WADI programme.

### G-WADI Geo-server Development

CHRS provides access to global satellite estimates of precipitation at high spatial and temporal resolutions that are relevant to the monitoring of precipitation input, especially important in transboundary basins and aquifers in areas where ground observation networks are lacking.

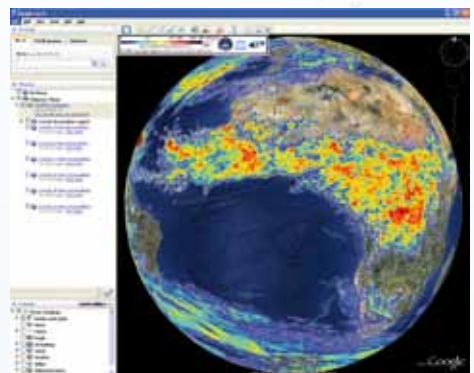


The website contains applications and tools for water resource managers that can improve flood forecasting and warning, as well as drought monitoring.

A training video demonstrating the functions of the global high resolution precipitation server is available on YouTube.

### Google Earth Precipitation Mapper

CHRS recently launched a real-time Google Earth precipitation mapper. This application is gaining in popularity, particularly in the developing world. It will strengthen the capacity to manage water resources around the globe by allowing operational hydrologists and water resources managers access to satellite-based global precipitation estimates within one to two hours of the actual acquisition of the global infrared imagery.





## CHEMICAL AND ISOTOPIC TRACERS

The G-WADI network is facilitating the use of both conventional chemical tools and state-of-the-art isotopic tracers in arid and semi-arid regions to further local applications in water management, without the need for specialist laboratories. Chemical and isotopic tracers provide powerful and inexpensive tools for hydrologists and water managers seeking to answer questions such as the sources of solutes, including contaminants, in water.

G-WADI seeks to define the tracers and isotope material needed by a wide range of users and is working to make isotopic tests understandable and available. Environmental or isotopic tracers can be used as “fingerprints” to better understand water origins and movement, groundwater residence times, groundwater recharge, salinity and pollution. This activity is central to the assessment of the renewability of water in arid areas, as well as identifying where irreversible groundwater mining is taking place. Case studies and further information are available on the G-WADI website.

The website also includes information on how to address several hydrological questions, uses of various isotopes and tracers, and explanations of analytical methods. An interactive periodical table links elements to additional information about their isotopic systems. Information is provided about the isotopes important to hydrology, their applications, how they are measured, and how much analysis costs.

## WORKSHOPS

Through workshops G-WADI brings together international experts, scientists, policymakers, researchers and stakeholders to discuss key research topics related to climate change impacts, risk assessment and management of water resources of arid and semi-arid regions. Leading experts have provided training to professionals from the arid regions in workshops on water harvesting and modelling in China, India, Iran and Syria. Training materials and related publications are available on the G-WADI website.

## G-WADI WEBSITE:

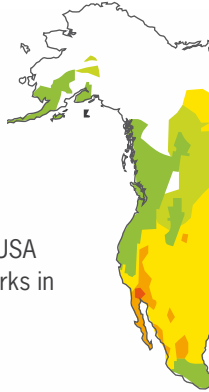
The G-WADI site was developed in collaboration with the University of Arizona's Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA) initiative. The University of Arizona continues to host the website, and collaborates with the technical secretariat at ICIWaRM and the regional G-WADI networks to maintain and update content. The site provides access to software and software libraries, and is the home site for all G-WADI network projects.

[www.gwadi.org](http://www.gwadi.org)





# G-WADI GLOBAL NETWORK



## HOW G-WADI WORKS

The International Center for Integrated Water Resources Management (ICIWaRM) in Virginia, USA serves as the host for the technical secretariat of the programme, which has regional networks in Asia, Africa, Latin America and the Arab region.

## G-WADI NETWORK

G-WADI network membership is open to everyone. The objectives of the networks are linked to several international programmes, and involve activities both within UNESCO as well as those of other partners.

Links and partnerships are being further developed with other programmes, with the aim of building on synergies and avoiding duplicating efforts.



## REGIONAL NETWORKS

The G-WADI program has been successful in stimulating networking across a number of regions.

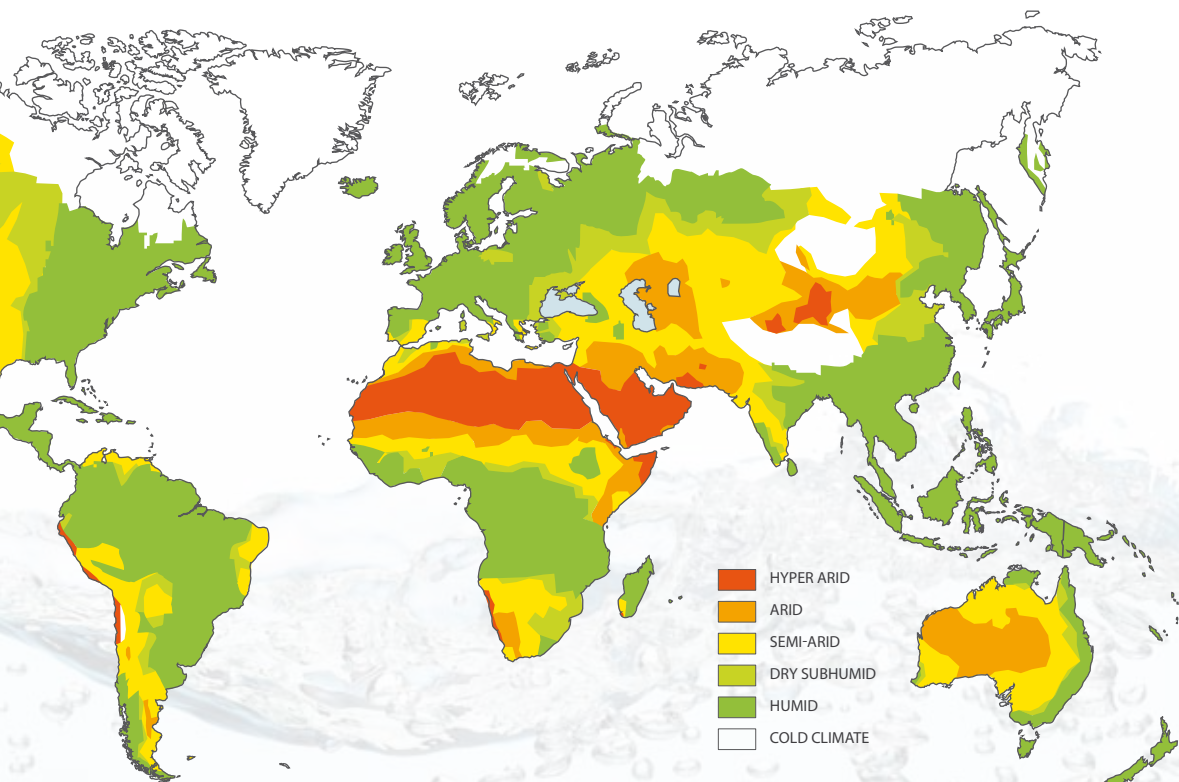
### Asian G-WADI

The Asian G-WADI network was established in March 2005 by representatives from Afghanistan, China, India, Iran, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, and Uzbekistan to confront the urgent need for increased regional cooperation for sustainable development of arid and semi-arid zones. The secretariat is housed by the Cold and Arid Regions Environmental and

Engineering Research Institute of the Chinese Academy of Sciences in Lanzhou, China.

A website for the Asian G-WADI network was launched in 2007, which provides an introduction to the network, access to training materials and other relevant publications. The network has organized training workshops in which global experts provide training to participants on climate change, the application of new models and techniques in groundwater management, the management of artificial recharge, and rainwater harvesting.

Regional network meetings have been held in Tehran, Iran (2011), Beijing (2010) and Lanzhou (2007), China, as well as Roorkee, India (2005).



**World Map of Aridity Zones**  
© Climate Research Unit, University of East Anglia (CRU/UEA) and United Nations Environment Programme, Division of Early Warning and Assessment (UNEP/DEWA)

### Pilot Basins:

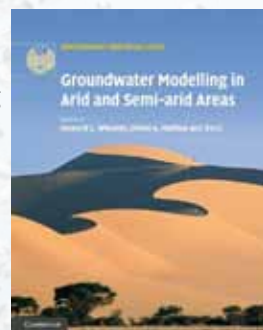
Pilot basins will allow for better evaluation of data and methodologies across the region. The following basins have been selected:

- Heihe River Basin (HRB), China
- Jaisamand Lake Catchment (Gomti River Basin), India
- Granite watershed in Krishna-Godavari Basin, India
- Kashafrud Basin/Mashhad, Iran
- Taleghan-Hashtgerd Basin, Iran
- Chu River Basin, Kyrgyz Republic
- Vakhsh River Basin (VRB), Tajikistan

### Publications:

“Groundwater Modelling in Arid and Semi-Arid Areas”, published in 2010, brings together the experience of experts to fill a gap in the scientific and technical literature on the special challenges this field presents. It provides state of the art methods for modelling groundwater resources, illustrated with examples from around the world.

<http://asian-gwadi.westgis.ac.cn/>





## Latin American and Caribbean G-WADI

Representatives from Argentina, Bolivia, Brazil, Chile, Mexico and Peru are active in the Latin American and Caribbean (LAC) G-WADI network. The Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean (CAZALAC) in La Serena, Chile has served as the secretariat for the network since December 2010.

After its July 2011 meeting in Juan Dolio, Dominican Republic, the network is focusing on developing activities, creating a Latin American GWADI website and widening the Latin American and Caribbean network. CAZALAC and ICIWaRM are collaborating on regional frequency analysis software and applications to assist water managers during droughts.

[www.cazalac.org/](http://www.cazalac.org/)

## Sub-Saharan African G-WADI

The G-WADI Network for Sub-Saharan Africa was formally established in December 2010 in Paris, France, following the recommendation of the participants of an April workshop held in Dakar, Senegal on issues related to arid and semi-arid areas in the region.

The network will facilitate knowledge exchange and best practices among the different sub-regions, which will, in turn, contribute to capacity building of institutions and individuals for better management of arid and semi-arid lands in Sub-Saharan Africa. The International

Development Research Centre (IDRC) is a partner of the network, whose secretariat is currently hosted by the AGRHYMET Regional Centre in Niamey, Niger. An experts group, composed of the AGRHYMET Regional Centre, the Intergovernmental Authority on Development's (IGAD) Climate Prediction and Applications Centre (ICPAC), the Southern African Development Community (SADC), Cheikh Anta Diop University (UCAD), and UNESCO, oversees the activities of the network.

[www.agrhymet.net](http://www.agrhymet.net)

## Arab G-WADI

Better management of the scarce water resources in the Arab region is a key element in attaining sustainable development in the region. Capacity building and networking are two important vehicles for sharing information and building an effective scientific and technical water management community in the Arab region.

The Arab G-WADI network was officially established in Muscat, Oman in June 2011 at a meeting of Arab representatives. The participants identified a list of priority areas with a focus on the theme of coping with water scarcity. The Arab League Educational, Cultural and Scientific Organization (ALECSO) and the Islamic Educational, Scientific and Cultural Organization (ISESCO) are supporting further developments of the network. More information is available on the G-WADI website.



## THE WAY FORWARD

Thus far the G-WADI programme has supported a wide range of activities, from sharing of information and experiences to state-of-the-art projects with developing countries. It has created a global information resource, developed regional networks and contributed to capacity building and training through workshops.

### Linking Science with Policy

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Looking ahead, the programme will further develop its activities, training resources, and the G-WADI website, as well as improve access to global data products. G-WADI will use a series of representative study basins to stimulate and integrate regional activities, attract new research and integrate scientific outcomes with the needs of local communities.

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