ADDRESSING GROUNDWATER SUSTAINABILITY NEEDS

Photo: J. Perez Vargas | IAEA

Two-thirds of the Earth is covered by water yet less than one per cent of the world's freshwater is accessible for use. Groundwater is the largest component (about 70%) of the accessible freshwater. The amount of water stored in groundwater systems is greater than that of all rivers, lakes and the largest man-made reservoirs combined. More than half of the global freshwater supply for drinking, industrial uses and irrigation comes from groundwater. Without detailed knowledge of the characteristics of a groundwater system – the amounts of water available, replenishment rate and threats to water quality – it is impossible to use groundwater resources sustainably.

ISOTOPES: UNIQUE TOOLS

Using isotope techniques, water resource managers can quickly obtain information that may normally require decades of measuring rainfall and groundwater levels. The picture that emerges from isotopic investigations allows hydrogeologists to map the extent and age of groundwater, to determine its flow rate and to determine its sources as well as the rate of recharge.

Isotopic analysis also allows one to understand and evaluate groundwater interactions with other aquifers, rivers, lakes, and wetlands.

Importantly, isotopes help build a deeper understanding of how groundwater systems have behaved in the past and help predict what may happen due to impact of urbanization, water use and climate change in years to come, providing a sound scientific basis for water resources planning and protection.

The IAEA's Water Resources Programme supports the application of isotope techniques to help its Member States to develop and implement their groundwater management strategies and policies. Currently, it is supporting the implementation of over 60 technical cooperation projects related to groundwater management. It also undertakes coordinated research projects to develop new approaches to specific issues.

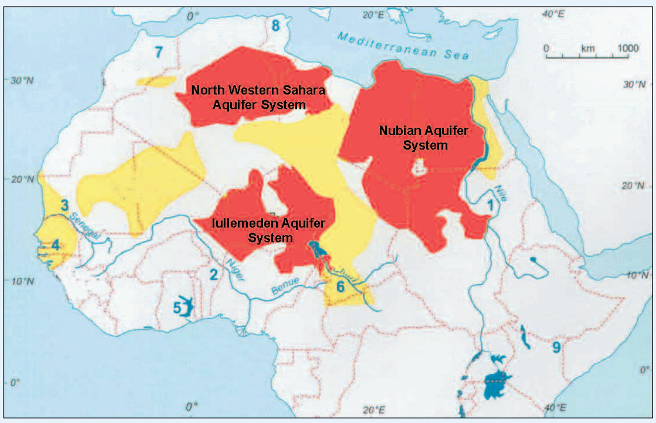
Isotopes, unique tools:
Chuho Springs, Kisoro, Uganda

Chuho Springs, located north of the town of Kisoro in southwestern Uganda, are being tapped for the local water supply. Long-term sustainability of these springs in terms of both quality and quantity of water was difficult to establish using traditional methods. An isotope study was undertaken with the assistance of the IAEA, to delineate the source of water in the springs. This study revealed that water in the springs originated from a swampy area uphill, and not from surrounding lakes in the mountains that were assumed to be feeding the springs. This knowledge on the source and pathways of recharge to the springs made it possible to develop appropriate strategies for protecting the quality of spring water from pollution by urban and agricultural activities.

Photo: C. Tindimugaya, Uganda

Chuho Springs, Kisoro, Uganda.

MANAGING TRANSBOUNDARY AQUIFERS



Major transboundary aquifers (shown in red) in arid regions of northern Africa.

Freshwater resources shared by more than one country present special management challenges. Exploi-tation practices are often inconsistent and disagreements may arise over water withdrawal rights. Aquifers may receive the majority of their recharge on one side of an international border while discharge or water withdrawal might occur on the other side. Some transboundary aquifers contain huge quantities of freshwater enough to provide safe drinking water for centuries. Equitable and effective management of transboundary aquifers could be achieved using sound scientific information.

Managing transboundary aquifers: Guarani Aquifer, South America

The Guarani is the largest aquifer in South America, shared by Argentina, Brazil, Paraguay, and Uruguay. The principal threat to this aquifer system comes from uncontrolled pollution in extraction and recharge areas. Isotope techniques are helping these four countries to assess water quality and contamination patterns as well as determine the origin and age of groundwater. A comprehensive database is being developed to share this information to help build greater trust among the four countries.

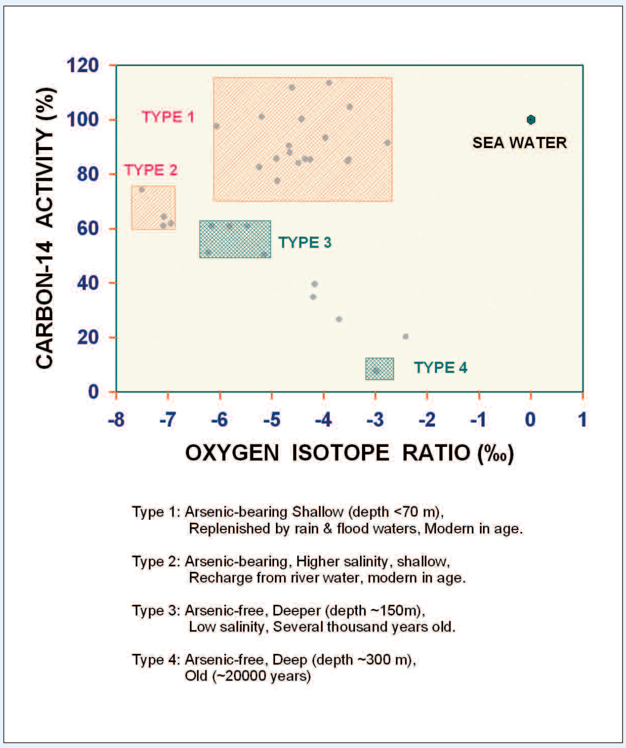
PROTECTING GROUNDWATER QUALITY

In many cases, groundwater sustainability may be constrained not by the amount available, but by deterioration of quality as a result of excessive pumping. This may be caused either through entrainment of poor quality saline water from adjacent aquifers, or seawater intrusion in the case of coastal aquifers. Isotopes play a key role in identifying the relationships between different water bodies as well as in locating recharge protection zones.

Isotopes are also used to trace sources of contaminants and predict their fate in groundwater systems. One can assess the vulnerability of groundwater to pollution by understanding the source of recharge and the time it takes to reach the water table. Isotopes also serve as early warning indicators of pollution when chemical or biological indicators may not give cause for concern.

Photo: G. Bizarri | UN FAO

Assuring groundwater quality is vital for safe drinking water and agricultural production.

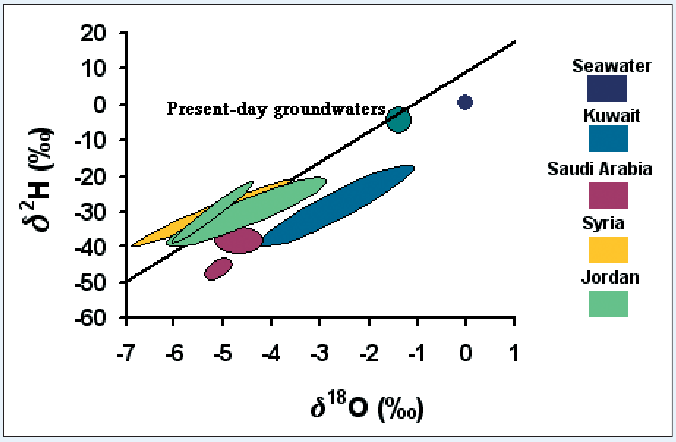


Isotopes helped in characterizing arsenic contaminated groundwaters in Bangladesh.

Protecting groundwater quality:
Arsenic Contamination in Bangladesh

One of the options to mitigate the adverse health effects of arsenic contamination of groundwater in Bangladesh is to use deep aquifers as alternative sources of safe drinking water. Isotopic fingerprints of groundwater in Bangladesh showed that depth alone was not a reliable criterion to locate arsenic-free groundwater. However, with the increased use of much deeper groundwater (~300 m) potential groundwater "mining" was likely. The sustainability of exploitation of deeper groundwater is being evaluated through detailed mapping of isotopes and hydrogeological assessments resulting in policies to more judiciously use this deeper groundwater for domestic purposes.

MAPPING FOSSIL WATERS



Isotopes form a valuable tool for fingerprinting fossil waters of different ages.

Water resources in many parts of the world are severely stressed as witnessed by declining water levels. Over wide areas water withdrawal exceeds natural recharge and it is apparent that fossil waters are being mined in arid and semi-arid regions. Isotope studies have been particularly useful in understanding the origin of fossil waters. A new initiative has been launched by the IAEA to map the extent of fossil waters. The aim is to create an understanding of the finite nature of these resources, and to provide a sound technical basis for their management.

IAEA Water Resources Programme

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