



Nuclear
Sciences and
Applications



Securing A Better Future For All **Nuclear Techniques for Global Development and Environmental Protection**

Isotope Hydrology

Ensuring Water Now and for the Future

Water Is Essential for Development

Providing adequate freshwater of a desired quality to their populations is one of the foremost development challenges faced by Member States. Although water is a basic human need, it is estimated that nearly one billion people in developing countries do not have access to safe drinking water and more than two billion lack basic sanitation facilities due to inadequate water availability. According to the World Health Organization, nearly five million people – mostly children – die each year from preventable, water-borne diseases. Increasing population, irrigated agriculture and industrial growth together have stressed global freshwater resources over the past several decades. In addition, climate change and the need for greater energy production are now significant drivers of stress on water resources.

Nearly 40% of world food production is achieved by means of irrigated agriculture, which accounts for about 70% of total freshwater withdrawals. A significant proportion of groundwater used for irrigation comes from fossil or non-renewable sources, making the food supply unsustainable for a growing human population. Nearly one in three people depends upon water from rivers that are fed by glaciers and snow melt. Increased variability and vulnerability of river flows in a warmer climate (due to increased glacial melt and changes in precipitation patterns) will drive the need for changes in water use and management practices. These changes may also include greater dependence on already stressed groundwater resources. Nearly four billion people – half of the world's population – may live under conditions of water stress in the next two decades.

Supporting Member States

The IAEA works together on technical cooperation projects to address priority water issues in Member States. Training, meetings, technical expertise and infrastructure support aid in capacity building so that Member States can address their practical problems. Currently, nearly 70 water resource projects exist in Africa, Asia, Europe and Latin America, which address a variety of groundwater and surface water resource issues. These include characterizing and monitoring transboundary aquifers, such as the Nubian Sandstone Aquifer System and the Guarani Aquifer System, as well as river basins, such as the Nile basin. Coordinated research projects support international research efforts to develop new scientific approaches to relevant themes.

The Science

During evaporation and condensation within the water cycle, the concentrations of oxygen and hydrogen isotopes – naturally occurring atoms of different mass – change, allowing distinct identification of water from different environments. There are other isotopes in rainwater, such as tritium (^3H) and carbon-14 (^{14}C), the concentrations of which decrease with time and allow the estimation of water age. The IAEA has played a key role in the development and promotion of isotope hydrology tools in the context of water resource assessment and management.



Meeting Millennium Development Goals

Access to safe water is a basic precondition of all the Millennium Development Goals (MDGs). Specifically, MDG 7 seeks to halve the proportion of the population without sustainable access to safe drinking water. Investigation and assessment of water sources is necessary to provide a comprehensive water resource assessment, thus leading to a sustainable system. The IAEA has projects focusing specifically on this issue, including the IAEA Water Availability Enhancement Project, which is currently developing templates and methodologies for national scale assessments of water resources.

Cooperation Is Key to Success

The IAEA supports technology transfer through the implementation of hydrology projects, training and technical analytical support, as well as by assisting in the procurement of equipment and expert services. The programme works to manage and enhance regional projects, including promotion of exchanges between neighbours. The IAEA supports the development of a community of experts who can oversee local projects. The IAEA grants research contracts to universities, research centres and other Member State institutions to support innovative research in the field of isotope hydrology. The programme works in cooperation with other United Nations (UNDP, UNEP, UNESCO), national (USGS, GTZ, etc.) and international (WB, GEF, OAS) bodies. The Isotope Hydrology Laboratory plays an important role in providing access to laboratory services for analysis and quality assurance and in support of global databases.



Success Stories from the Field

The IAEA has been using isotope techniques – together with other donor agencies – to help mitigate the impacts of arsenic poisoning in Bangladesh, where groundwater is the main source of drinking water. Elevated arsenic concentrations in groundwater had created a major public health crisis. A short study conducted by the IAEA indicated pollution sources linked to young groundwaters, uncovered the nature of the problem and provided information about where to find safe sources.

Groundwater in the Nubian Sandstone Aquifer System has been identified as the largest and in some cases the sole future source of water capable of meeting the growing demands of the four countries overlying the aquifer – Chad, Egypt, the Libyan Arab Jamahiriya and Sudan. Isotopes and models allowed the assessment of intensive pumping, showing how it can lead to local hydraulic effects. Isotopes were used to uncover the nature of the aquifer and determine how pumping effects are linked beyond national boundaries.

