IAEA

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

The goal of the IAEA is to aid Member States in assessing and managing all aspects of their water resources and to ensure their secure and equitable use into the future. Isotopes provide unique information about water characteristics in a cost efficient, accurate and easy-to-use way. Isotopes are water's 'fingerprints' and are used to gain information about the age, origin and renewal rate of groundwater, its dynamics, as well as its vulnerability to sources of pollution, salt water intrusion and climate change. During evaporation and condensation of water within the water cycle, the concentrations of oxygen and hydrogen isotopes – naturally occurring atoms of different mass – change, allowing distinct identification of water in differing environments. There are other isotopes in rainwater, such as tritium and 14C, the concentrations of which decrease with time.

Global monitoring isotope programmes are an important feature of the IAEA. These provide Member States with global isotope data for water resource investigations and climate modelling. The Global Network of Isotopes in Precipitation (GNIP), undertaken in collaboration with the World Meteorological Organization, has been in existence since 1961. GNIP data have become increasingly important, allowing unique insights into hydrological and climatic processes at the local, regional and global scales. The IAEA GNIP database now includes over 120 000 monthly data records, and can be downloaded from the IAEA website (www.iaea.org/water). Two other programmes are still in their infancy: the Global Network of Isotopes in Rivers and the Moisture Isotopes in the Biosphere and Atmosphere.

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.

Who We Are

Isotope hydrology is a relatively young science, dating back to the 1950s. Extensive nuclear research, leading to the discovery of isotopes in natural systems and measurements of atmospheric radioactivity following nuclear bomb tests, then led to the discovery the stable isotopes of hydrogen, oxygen and carbon as well as the radioisotopes of carbon (radiocarbon, 14C) and hydrogen (tritium, 3H). The use of stable and radioactive isotopes has ever since provided unmatched insights into both atmospheric and terrestrial elements of the water cycle. 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 resources 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.

International Cooperation 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, quality assurance and in support of global databases.

The Difference We Make

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.

Ground water in the Nubian Sandstone Aquifer System has been identified as the biggest and sole future source of water to meet the growing demands of the four countries overlying the aquifer – Chad, Egypt, 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 boundaries.