Water Resources

Objective:

To enable Member States to sustainably use and manage their water resources through the application of isotope techniques for hydrology.

The Agency continued to implement the IAEA Water Availability Enhancement (IWAVE) project in three pilot countries: Costa Rica, Oman and the Philippines. The IWAVE project aims at assisting Member States in conducting sound water resources assessments at national or regional levels, leading to the establishment of water policies for a more rational allocation of surface and groundwater resources. The pilot studies in the three countries have advanced through a preliminary phase involving the main stakeholders in each country aimed at identifying gaps in the current hydrological information and understanding. A number of activities, including seminars and workshops, were held to initiate actions addressing the gaps.

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In 2011, testing and development of the use of long lived radionuclides and noble gases continued on selected large transboundary aquifers including the Guarani aquifer in South America and the Mekong River aquifer in Vietnam, among others. Several field sampling campaigns were conducted in Argentina and Brazil involving revision of previous isotope work in the area. The use of carbon-14 to determine the age of groundwater was also facilitated in many national and regional technical cooperation projects (Figs 1 and 2).

The operation of isotope monitoring stations around the world for the collection of precipitation and river isotope data continues to be a major activity for the Agency. The Global Network of Isotopes in Precipitation (GNIP), managed by the Agency in collaboration with WMO, is the primary isotope database used in hydrology and climate studies. The network has reached 50 years of operation and has collected isotope data for more than 1000 meteorological stations. A new on-line platform for facilitating access to global isotope data and maps is being developed. In addition, the ability to use precipitation isotope data in global climate models was improved through a new interpolation map of GNIP data.

A CRP on 'Quantification of Hydrological Fluxes in Irrigated Lands Using Isotopes for Improved Water Use Efficiency' was completed in 2011. The objective of the CRP was to enhance the application of water

FIG. 1. Sampling for carbon-14 dating of groundwater in Niger.

FIG. 2. Testing groundwater in rural areas of the Central African Republic.

use efficiency techniques for irrigated lands at the field and basin scales in Member States. The focus was on the development and implementation of isotope methods for quantification of deep percolation and evaporation, two of the major fluxes that control the water balance of irrigated lands and thus can be used to measure the degree of water use efficiency. Research projects collected isotope data from precipitation, soil water, percolation water, groundwater, atmospheric vapour and plant water samples as well as related meteorological data. The results of the CRP clearly indicate the large effect irrigation practices have on water use efficiency, affecting both deep percolation pulses and the potential transport of fertilizers and other contaminants to groundwater. Irrigation via flooding was shown to lead to higher evaporative losses than other methods. In addition, isotope results show how strongly evaporation varies under different crop types.

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Strengthening Analytical Capabilities in Member States

Recent developments in laser spectroscopy systems have led to instruments which can more simply and inexpensively measure stable isotopes of water with the analytical precision required for isotope hydrology applications. Today, the use of such laser analysers has become standard practice and many Member States have acquired commercially available units with the assistance of the Agency through its technical cooperation programme, resulting in easier and faster access to isotope results for hydrological investigations. The Agency contributed to the adaptation of these instruments for use by Member States.

Over the past five years, the Agency has organized nine one-week training courses, involving a total of 64 participants. The Agency has also provided assistance to Member States by developing tools for processing isotope data, and by organizing meetings of laser analyser users to exchange experience, compile tips, and offer trouble-shooting advice as well as tools for analysing in-house isotope standards.

The fourth interlaboratory comparison exercise for laboratories engaged in the analysis of the hydrogen and oxygen stable isotope composition of water samples was completed in 2011. More than 135 laboratories from 53 countries submitted their isotope data sets to the Agency and had their performance assessed. The results of the exercise are expected to help stable isotope laboratories to identify analytical problems and improve their overall performance.

An Agency training course on the installation and operation of laser isotope analysers.

Another CRP, on 'Isotopic Techniques for the Assessment of Hydrological Processes in Wetlands', was completed in 2011. A number of methodologies integrating isotope and hydrological tools were applied and evaluated to assess the role of groundwater in maintaining the supply of water, dissolved salts and nutrients to wetlands. Various isotope dating tools were used to obtain insights on the temporal scale of water fluxes, while stable isotopes were mainly used to track the sources of water and solutes as well as to delineate mixing processes. Several participants of the CRP made presentations on this issue at the European Geosciences Union General Assembly in 2011.

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An Agency technical cooperation project in Mauritania utilized stable water isotopes, tritium and carbon isotopes, as well as hydrochemistry, to investigate the coastal Trarza aquifer, where the capital Nouakchott is located. The project showed that there were different water bearing layers, namely the shallow horizons recharged from direct infiltration of rainwater and surface water runoff, and a confined aquifer isolated from the influence of nearby surface waters. The findings of this project will contribute to sustainable development and management of the scarce water resources of this predominantly desert country.

A technical cooperation project dealing with the assessment of groundwater resources in the Santa Elena Peninsula, in Ecuador, was completed in 2011. A conceptual hydrogeological model, based on hydrogeological, hydrochemical and isotopic information, was developed. The project identified important differences in hydrological functioning between the northern and southern sectors of the study area. Tritium and carbon-14 were used to date shallow groundwater and assess the recharge processes in both areas. The northern sector is characterized by a more active groundwater flow than the southern sector, which has lower groundwater potential. The conceptual model has also served as a basis for identifying areas where it is necessary to undertake in-depth studies with a view to assessing the feasibility of artificial recharge.

In Thailand, an Agency project on the use of isotope hydrology for the management of groundwater resources supported the introduction and application of isotope hydrology techniques in integrated water resources management, which is a top priority for the socioeconomic development of the country. As a result of the project, an isotope hydrology laboratory was established for national research services. Hydrological processes in the Upper Chi watershed and Lower Nan River basin were assessed using isotope techniques combined with other relevant techniques, and a national database of isotopic data on the groundwater of Thailand was established. Regulations for water resources management were proposed, and human resource capacity in the field of isotope hydrology was significantly strengthened.