# Enhancing Water Availability in a Changing Climate

Changing climatic conditions are affecting both the quantity and quality of global water resources.

The strategic importance of groundwater, for both global water and food availability, is expected to grow as the effects of global warming on the water cycle intensify, threatening access to water and sanitation.

Groundwater, which accounts for the majority of the earth's freshwater supply, is the largest reservoir of stored water. Despite its significance, the complex network of underground aquifers is poorly understood, posing challenges in managing and protecting this vital resource.

In Europe and Central Asia, many countries are facing groundwater depletion, a deterioration in water quality and ongoing pollution linked to human activities. To develop adequate mitigation and adaptation strategies, national authorities and decision makers need to understand how climate change can affect water resources and water-related infrastructures.

Sustainable water management is a key step towards creating a more resilient and sustainable future.

To protect groundwater from the threats of overextraction and pollution, and to manage it sustainably for the future, it is essential to understand where groundwater in specific locations comes from, its quality and how quickly it replenishes. Scientists can analyse the characteristics of water by looking into the isotopic variations of oxygen and hydrogen in water molecules that make up the unique 'fingerprint' of specific water resources.

In 2020, the IAEA launched a regional technical cooperation project in Europe and Central Asia to support national efforts to integrate isotopic techniques into national hydrological assessments. The project brought together staff from water laboratories in 28 countries in Europe and Central Asia

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to build national capacity to apply isotope hydrology to answer fundamental questions about the future availability of groundwater resources. Key regional and transboundary challenges included:

- identifying the impact of climate change on karst aquifers and groundwater–surface water interactions in the Western Balkans;
- assessing nitrate contamination of aquatic systems in Eastern Europe and the Caucasus;
- examining the vulnerability of stratified transboundary aquifers to over-abstraction and pollution;
- addressing contamination problems in selected coastal aquifers in Europe;
- studying the linkage between glacier retreat and water resource availability; and
- reviewing water balance and quality control in Central Asia.

Through technical cooperation activities including scientific visits, fellowships, regional meeting, water sampling and analysis exercises, as well as networking, water experts involved in the project were able to enhance their understanding and expertise in applying isotopic techniques. These techniques help to identify vulnerabilities that impact vital local and transboundary groundwater resources. Additionally, the professionals gained the ability to accurately calculate recharge rates and develop models for regional water cycles and enabled them to use isotopic techniques effectively in their work, contributing to improved management and protection of groundwater resources.

## The Science

**Isotope hydrology** is a field that uses environmental isotopes and other geochemical tracers to assess the origin and movement of water within the hydrological cycle. Environmental tracers such as stable water isotopes provide unique information that is used to characterize and define the sources and flows of water, as well as interactions between different water bodies, including mixing processes.

In addition, naturally occurring radionuclides such as tritium and carbon-14 are commonly used to estimate the age of groundwater. This information is essential to assess the current rate of groundwater replenishment, as well as transport processes in aquifers and their vulnerability to pollution.

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