# Isotope hydrology applications for monitoring hydrological changes in the Syr Darya River Basin

A case study under **IAEA TC Project RER7013** – Evaluating Groundwater Resources and Groundwater – Surface Water Interactions in the Context of Adapting to Climate Change

Kazakhstan, Tajikistan, Uzbekistan

Case Study Focus

Evaluating changes in water quantity and quality in the transboundary Syr Darya River Basin
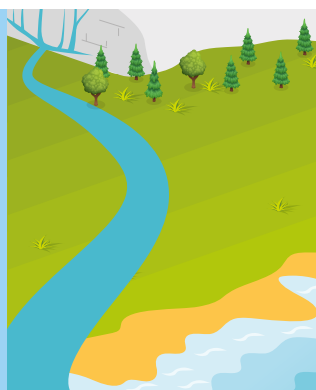
The opportunity

The Syr Darya River is the longest and the second largest (according to discharge) river in Central Asia. The river forms part of the Aral Sea catchment, and its basin is shared between Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan.

In the 1960s, the Syr Darya River started to be used intensively for irrigation. As agricultural activities increased, the river volume decreased, and today it is more than 10 times less (from 400 m³/s to 30 m³/s) than it was 60 years ago.

The decrease in the Syr Darya flow level has affected the Aral Sea, which has dried up and split into the North and South Aral Seas. As the Aral Sea receded from its initial coastline, the seabed was exposed, and sea salts, pesticides and other chemicals were uncovered.

The analysis of the Syr Darya River Basin will help countries to sustainably manage water resources that are becoming increasingly limited due to climate change and agricultural use.

Isotopic techniques can be used to study the different hydrological components of the Syr Darya River Basin. These techniques can provide better assessments of the quantity, quality and future sustainability of the now limited water resources.

Groundwater is the least studied hydrological component in the Syr Darya River Basin. Using naturally occurring isotopes as tracers, it is possible to determine whether groundwater in the basin is replenished, where it comes from, how it moves underground and whether it is at risk of pollution, affected by the exposed pesticides and chemicals, or vulnerable to climate change.

The project

Water from different parts of the Syr Darya River Basin has different isotopic compositions. These 'isotopic fingerprints' can be used to track the movement of water throughout the hydrological cycle.

Groundwater, surface water and rainwater are being examined in nineteen different locations, three in Tajikistan, seven in Kazakhstan and nine in Uzbekistan – all spanning the border regions of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan.

Groundwater samples are taken three times annually, in spring, summer and autumn, to measure the stable isotopic ratios of oxygen and hydrogen in the water

IAEA
International Atomic Energy Agency

Schematic overview of the sampling sites along the Syr Darya River Basin.

Kazakhstan
Uzbekistan
Tajikistan

North Aral Sea

molecules, as well as a range of physical and chemical components (major cations and anions, salinity, total dissolved solids, electrical conductivity etc.).

Collecting samples in the Aral Sea region for isotopic and chemical analyses.

The benefits

The first transboundary assessment of the Syr Darya River Basin will lead to a better understanding of water flow regimes in this region. This can be used to inform the development and implementation of sustainable water management policies and practices aimed at protecting water resources.

In particular, a comprehensive assessment will enable the calculation of the water balances in the river basin and irrigation channels.

Glacier retreat and availability of water resources (GLACIER)

Groundwater in Karst Aquifers (KARST)

River Basins and Climate Change (SAVA, SYR DARYA)

Water Resources Degradation in Coastal Regions (COASTAL)

Nitrate Contamination of Coupled Groundwater – Surface Water Systems (NITRATE)

Source, Age and Recharge Patterns of Groundwaters for Irrigation (SARGE)

Vulnerability of Deep, Stratified Aquifers (VULNERABILITY)

GROUNDWATER

GROUNDWATER

6 CLEAN WATER AND SANITATION

13 CLIMATE ACTION

17 PARTNERSHIPS FOR THE GOALS

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