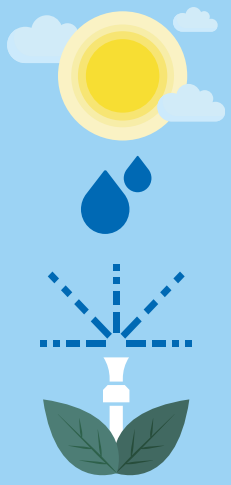
Source, Age and Recharge Patterns of Groundwaters in South East Europe (SARGE)

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

Romania, Republic of Moldova, Ukraine, Bulgaria

Case Study Focus

Influence of climate change on the water resources used for irrigation in the SW East-European plain



The East-European Plain, stretching between the Balkan and Carpathian Mountains in the southwest and the Ural Mountains in the east, is one of the main agricultural production areas in Europe, with the potential to feed more than 200 million people. However, due to regional historic, economic and as-of-yet poorly understood hydroclimatic restrictions, this potential remains unrealized.

The recent rise of water-demanding monocultures in this drought-prone area has led to a surge in irrigation, which has placed Bulgaria, Romania and the Republic of Moldova in the top ten worldwide exporters of per-capita groundwater depletion (= non-renewable groundwater abstraction) embedded in food trade.

Falling annual precipitation and a continuously growing risk of drought, particularly in parts of Southern Europe, are expected to shape a different climate in Europe's future. Considering the above facts, intensified agricultural activities in the East-European Plain will require a further increase in irrigation, which, under warming and drying conditions, will apply greater hydrological stress on already-limited water resources.

The opportunity

The source apportionment of irrigation waters (e.g. the proportions of surface water use vs. groundwater abstraction) has not yet been investigated in this area. Moreover, information regarding the age, timing and mechanisms of groundwater recharge is limited, and no sound scenarios of future water-use have been established.

This study aims:

- to determine the sources of irrigation water supply (river water, young and old groundwaters) in the south-western regions of the East-European Plain;
- to investigate the recharge patterns of young groundwaters; and
- to determine the age of old groundwaters.

The findings can directly inform and assist water administrators and local stakeholders to manage their available water resources sustainably.

IAEA International Atomic Energy Agency

Partners: Emil Racovita Institute of Speleology, Romanian Academy, Romania; Stefan cel Mare University, Romania; Institute of Chemistry, Republic of Moldova; National Institute of Meteorology and Hydrology, Bulgaria; Ukrainian Hydrometeorological Institute, National Academy of Sciences, Ukraine

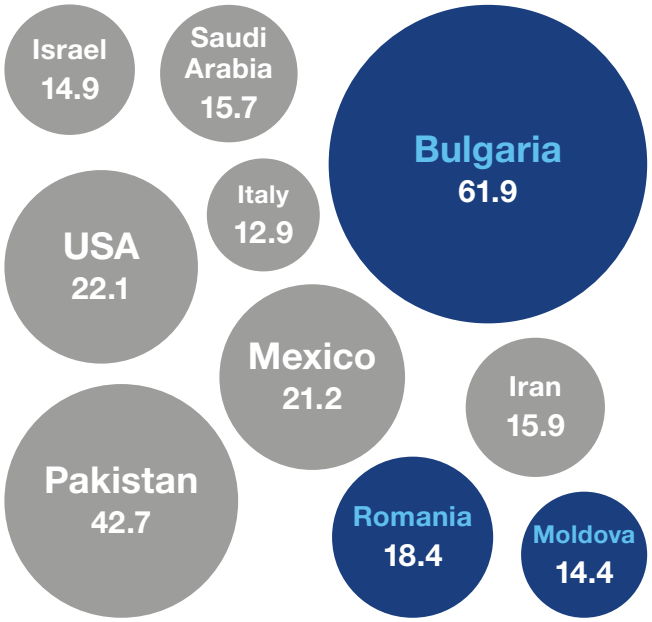


Figure 1. Per-capita groundwater depletion exported by top ten worldwide exporters in year 2010 *($m^3 yr^{-1}$ percap)* (based on Dalin et al., 2017)

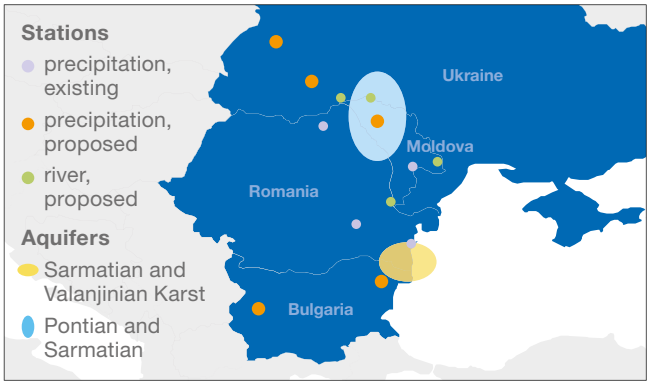


Figure 2. Location of the study sites within the SARGE project. Two of these aquifers are located in the border region of Bulgaria and Romania (the shallow Sarmatian aquifer and the deep Valanjinian Karst aquifer), while the other two straddle the border region of Romania, the Republic of Moldova and Ukraine (shallow Pontian aquifer and deep Sarmatian aquifer). The other points indicate the location of stations for monitoring the stable isotope composition of water.

The proposal

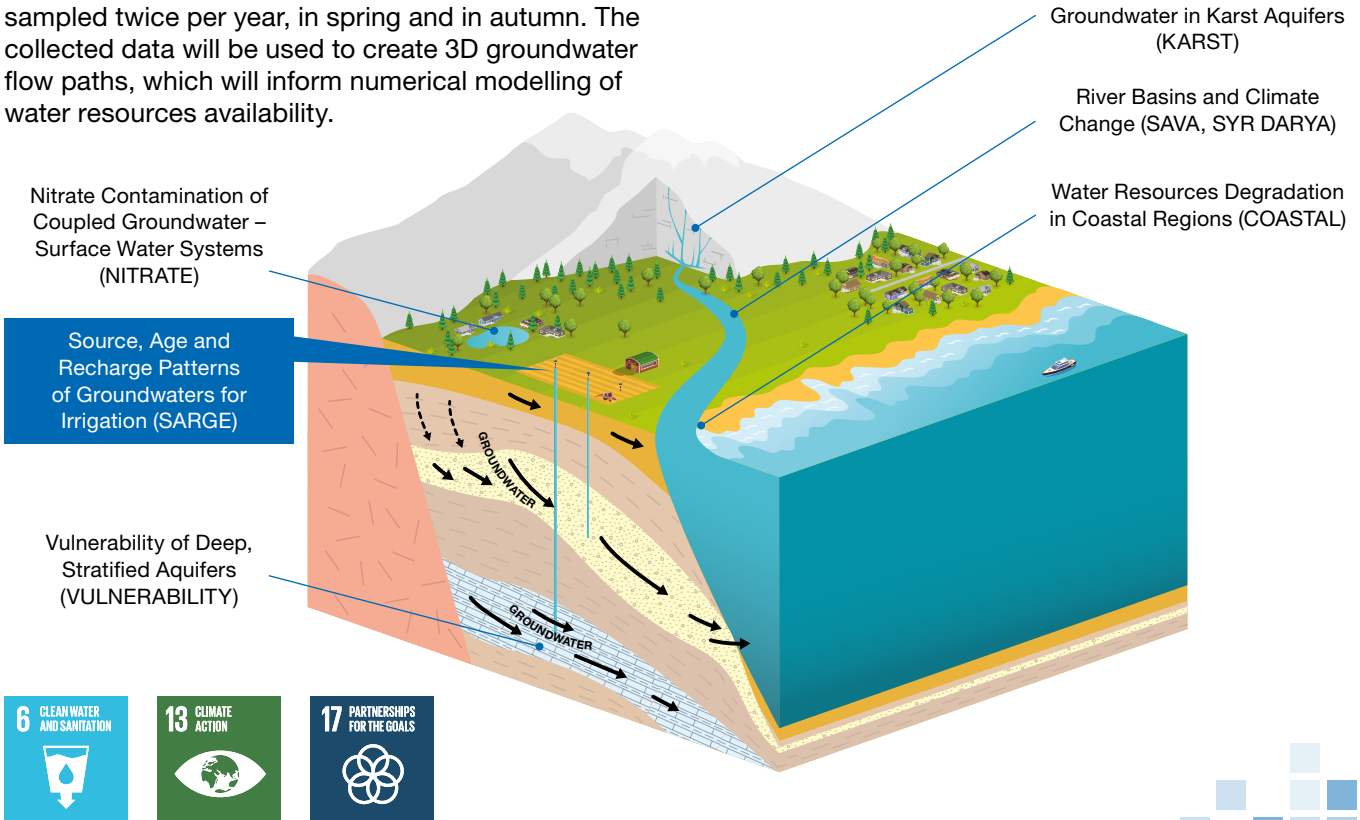
This case-study will investigate the isotopic composition of both groundwater and precipitation in four large transboundary aquifers (two surface and two deep). Two of these aquifers are located in the border region of Bulgaria and Romania, while the other two straddle the border region of Romania, the Republic of Moldova and Ukraine. No information exists on the age and residence time of some of the groundwaters.

Under the auspices of the study, groundwater will be sampled twice per year, in spring and in autumn. The collected data will be used to create 3D groundwater flow paths, which will inform numerical modelling of water resources availability.

The benefits

This case study is a pilot project for future transboundary, isotope hydrology-based assessments of water resources used for irrigation in Southeast Europe.

The study will provide scientific evidence and develop a tool which may inform the improved management and usage of water in a region that is prone to face various climatic, environmental and economic risks in the future. The results will help decision- and policymakers to adjust and adapt existing irrigation practices to the changing climate conditions and to improve groundwater management, while addressing the needs of multiple stakeholders.



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