

# Multi-isotope fingerprints to identify agricultural contaminants from soil to water

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## INTRODUCTION

- Intensification of agricultural systems often leads to overuse of agrochemicals
- Identification and apportionment of pollutants from multiple sources require an integration of approaches
- Conventional techniques are not effective to evaluate the relative contribution of the different sources.
- Stable isotopes of the major chemical elements are key to quantify sources and transport from soil to water bodies.
- The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has launched a five-year coordinated research project (CRP) to develop protocols and guidelines to trace sources of agro-pollutants from soil to water bodies using multiple stable isotopes.

## OBJECTIVES

- Develop protocols and methodologies for using multiple stable isotope tracers to monitor soil, water and nutrient pollutants from agriculture.
- Establish proof-of-concept for an integrated suite of analytical stable isotope tools.
- Create guidelines to adapt the new toolkit to a variety of agricultural management situations.

## METHODOLOGY

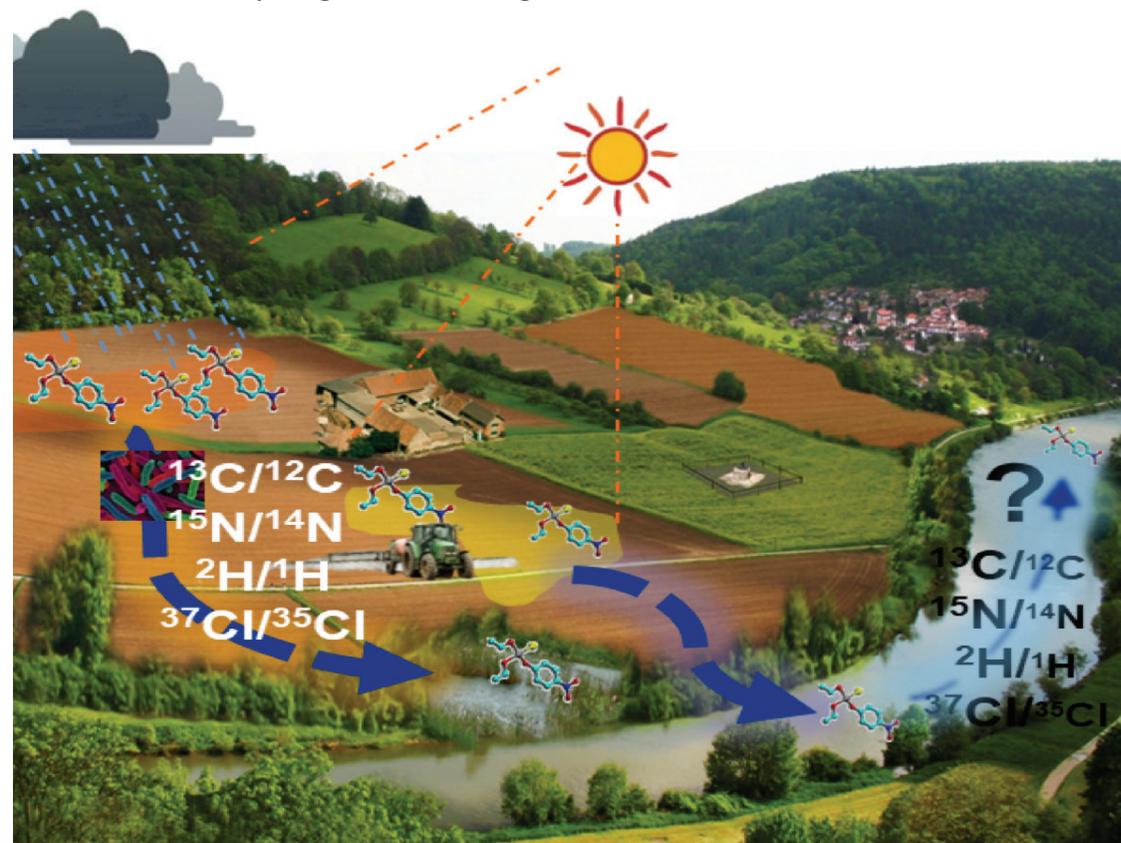
- Methodologies that provide step-by step instructions on how to collect, prepare and preserve soil and water samples from intensive agricultural watersheds for multiple stable isotope analysis will be developed.
- This includes (1) nitrogen and oxygen composition of nitrates in water, (2) hydrogen and oxygen composition of water, (3) sulphur and oxygen composition of sulphates in water, (4) nitrogen and carbon composition of dissolved and particulate organic matter.
- Similarly, the application of oxygen-18 isotope signatures in inorganic phosphate and of compound specific isotope analysis (CSIA) to monitor pesticides in soil and water will be fine-tuned.
- The protocols will be tested and validated on three major transboundary rivers and agricultural watersheds in at least ten countries.

## MAIN RESULTS

- Establishment of an integrated approach to apportion and evaluate sources of agro-contaminants
- Development and assembly of an analytical multiple stable isotope toolbox for use by member countries
- Validation of protocol procedures for the use of this toolbox, including guidelines for the adaption.

## CONCLUSION

- Many pollutants originate from agricultural practices.
- These pollutants spread in dynamic ways, including through rainfall and irrigation, runoff and sediments.
- The use of integrated multiple stable isotopes of C, H, N, O and S will provide information on the origins and pathways of such pollutants and hence facilitate more accurate and appropriate mitigation actions.



Excessive fertilizers



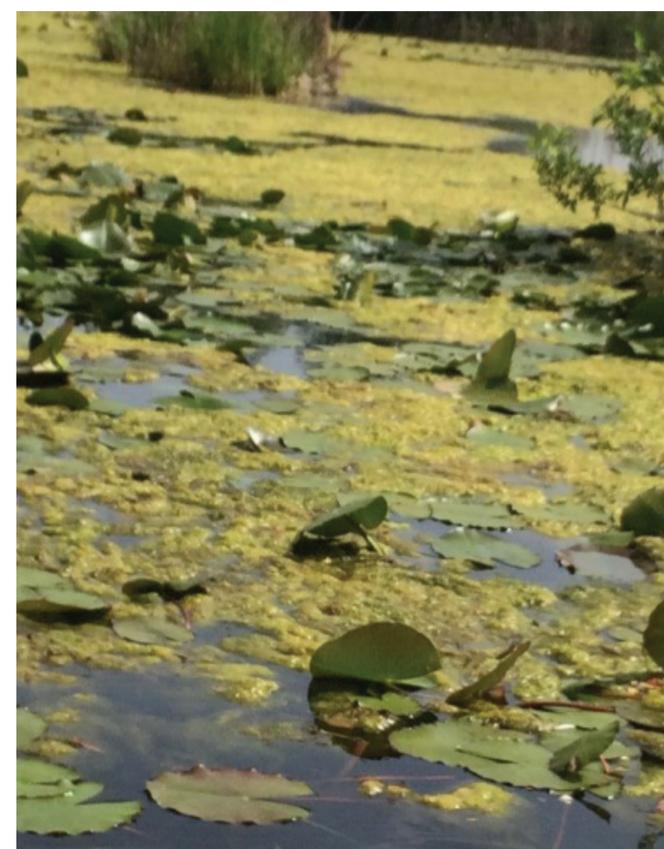
Excessive irrigation



Excessive pesticides



Drug residues in urine of cows



**Fig. 1:** Left: Schematic diagram of pollutants from agriculture in an agro-ecosystem environment (Photo credit: Gwenaël Imfeld, CNRS, France), Middle: Sources of agro-contaminants, Right: Water quality in the Danube Delta affected by pollutants (Photo credit: IAEA-FAO)



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