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Isotopic multi-tracer approaches to track pollutants from agricultural fields to water bodies

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Pollution from agriculture and other sources has direct negative impacts on human health. A major knowledge gap regarding pollution in agro-ecosystems is source identification and apportionment, which requires more data, research and integration of approaches. When contamination from multiple sources to an agro-ecosystem occurs, traditional techniques cannot help in evaluating the relative contribution of the different sources. Complementarily to conventional monitoring and mass balance approaches, stable isotopes of major elements (H, C, N, O and S) have the potential to characterize and quantify sources and transport of solutes in agro-ecosystems. Studies showed that depending on the origin of the polluting source, the isotopic signature of each element can be a fingerprint of the source which is unique in the investigation. The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has developed standard operating procedures (SOPs) that provide step-by step instructions on how to collect, prepare and preserve soil and water samples from intensive agricultural watersheds for stable multi-isotope analysis. 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, (5) the application of oxygen-18 isotope signatures in inorganic phosphate and (6) compound specific isotope analysis (CSIA) to monitor pesticides in soil and water. These SOPs, assembled in a multi-isotope toolbox is being tested in fifteen (15) countries to trace sources of agro-pollutants from soil to water bodies, and hence to develop soil and water management practices to reduce agro-pollutants in the environment. Data from case studies of agricultural catchments in Asia (Cambodia, China, India, Myanmar Vietnam), Africa (Morocco, Ghana) and the Caribbean (Jamaica) are being carried out and selected studies will be presented. The integrated use of stable multi-isotope fingerprinting with conventional analytical approach will result in more accurate environmental assessments with unambiguous identification of pollution sources, thus contributing to more efficient agro-ecosystem management practices and the adoption of appropriate remediation tools.