

## **15 years in promoting the use of isotopic and nuclear technique for combating land degradation and soil erosion: the contribution of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture**

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The world population will exceed 9 billion by the year 2050 and food production will need to be approximately doubled to meet this crucial demand. Most of this increase will occur in developing countries, where the majority of the population depends on agriculture and their land for their livelihoods.

Reports from the Intergovernmental Panel on Climate Change (IPCC) predicted negative impact of climate change, threatening global food security. In addition, the intensification of agricultural activities has increased pressure on land and water resources, resulting in different forms of soil degradation, of which soil erosion and associated sedimentation are worsening. Worldwide economic costs of agricultural soil loss and associated sedimentation downstream have been estimated at US \$400 billion per year. As a result of climate change, world average soil erosion is expected to further increase significantly.

Adapting to climate change requires agricultural soil and water management practices that make agricultural production systems resilient to drought, floods and land degradation, to enhance the conservation of the natural resource base for sustainable upland farming. These current concerns with ensuring sustainable use and management of agroecosystems create an urgent need for reliable quantitative data on the extent and magnitude of soil resource degradation over several spatial and time scales to formulate sound policies and management measures. Integrated isotopic approaches can help in targeting adapted and effective soil-water conservation measures to control soil degradation and therefore contribute to positive feedback mechanisms to mitigate climate change impact on soil and water resources.

Set up 60 years ago as the world's centre for cooperation in the nuclear field, the International Atomic Energy Agency (IAEA) promotes the safe, secure and peaceful use of nuclear technologies. Since the end of the 1990s, the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has developed research and development activities and capacity building to combat soil degradation (especially soil erosion) and to foster climate smart agriculture. More than 70 FAO/IAEA Member States have benefitted from the technical support and guidance in using fallout radionuclides (FRNs) and Compound-Specific Stable Isotope (CSSI) techniques to trace soil movement and assess soil erosion at different spatial and temporal scales, and to evaluate the effectiveness of soil conservation strategies to ensure sustainable land management.

This contribution summarizes the historical background and the latest innovative activities conducted by the Joint FAO/IAEA Division, as well as the main advantages and complementarity of stable and radioisotopic tracers to conventional techniques when investigating land degradation. As examples of the significant role played by the Joint FAO/IAEA Division, two major outcomes achieved in Africa (i.e. Madagascar and Morocco) through the use of isotopic and nuclear techniques will be elaborated. The authors will also report on a new 5-year Co-ordinated Research Project (CRP) funded by the IAEA on "*Nuclear Techniques for a Better Understanding of the Impact of Climate Change on Soil Erosion in Upland Agro-ecosystems*" which involves key research institutions from 12 participating countries.