Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Monitoring soil-water-nutrient interactions for healthy soils


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Soil, water and nutrients are vital for life and food security. Isotopic technologies play a crucial role in assessing the impacts of changing weather patterns on soil and agricultural water resources. The Joint Food and Agriculture Organization of the United Nations/International Atomic Energy Agency (FAO/IAEA) Division of Nuclear Techniques in Food and Agriculture assists member countries to use nuclear and isotopic techniques to effectively measure real-time changes in soil and water quantity and nutrient movement, thereby improving farming practices that keeps the soil healthy, save water and nutrients and optimize crop yields.

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What FAO does

The use of technical knowledge and expertise supports efficient agricultural and food systems in an emerging climate change. These activities are carried out through strategic and applied research, technology transfer, building capacity of member countries to use isotopic tracers, working in partnership with international and regional organizations, advanced research institutions, policy advice and dissemination of information.

- Develops fallout radionuclide and stable isotope techniques to assess soil erosion and land degradation so appropriate soil and water conservation management practices can be effectively targeted to reduce erosion;
- Develops and improves nitrogen-15 analytical techniques and promotes the extensive use of biological nitrogen fixation by legumes to capture more nitrogen from the atmosphere and improve soil fertility, enabling farmers to save millions of dollars that they would otherwise use to purchase nitrogen fertilizer;
- Refines procedures for using the isotopes of oxygen, phosphorus and nitrogen to provide more efficient tracing methods to understand the movement of nutrients between soils and plants that help to save fertilizer and water;
- Assists and develops the capacity of member countries through training both at its own laboratories at Seibersdorf and through workshops and training courses on-location in member countries.

Contributes to FAO's Strategic Objectives 2, 4 and 5

Make agriculture, forestry and fisheries more productive and sustainable
Enable inclusive and efficient agricultural and food systems
Increase the resilience of livelihoods to threats and crises

Monitoring soil-water-nutrient interactions for healthy soils

Understanding the context

The persistence of widespread food insecurity and malnutrition, especially under continuing pressure on natural resources and concerns over the sustainability of ecosystems, highlight the need to optimize food production while maintaining soil health. Identifying and applying cutting-edge isotopic techniques is vital to keep pace with many of the agricultural challenges to improve food security and sustaining the natural resource base.

Cases of successful implementation of the isotope tracer techniques from the laboratory to the field have been recorded worldwide.

In Kenya the introduction of low-cost, small-scale irrigation technologies compared to traditional hand watering has shown Maasai farmers increase their vegetable yields by 100% with only 55% of the water applied, and make a profit from the surplus produce. Similar successes in water and nitrogen savings have been recorded in Sudan, Libya and Ghana.

In Benin, the Joint Division assisted 5 000 rural farmers to identify high nitrogen fixing legumes that are compatible with the dominant cereal cropping systems to optimize crop and soil productivity. The national scientists are now able to identify the specific bacteria needed for legume roots to produce the nodules that fix nitrogen and to use the ^{15}N isotopic methodology to quantify the amount of nitrogen fixed. This has resulted in 50 percent increase in maize yield and 70 percent savings in nitrogen fertilizers. The Government of Benin supports a laboratory that produces the inoculum locally and makes it available to farmers.

In the mountainous region in Morocco, the use of fallout radionuclide technologies helped identify the most erosion prone areas and, through appropriate conservation agricultural practices, reduced soil erosion in the watershed by 40% and optimized agricultural productivity.

Current on-going research includes the development of isotopic techniques and protocols (i) to evaluate soil and water pollutants in intensive agricultural production areas and (ii) measure greenhouse gases.

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MORE INFORMATION

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