Minimizing land degradation using isotopic and nuclear techniques in Asia

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Description

- Regional training in China, Austria (Seibersdorf) and Sri Lanka on the use of fallout radionuclides (FRNs) to assess soil erosion rates and compound specific stable isotope (CSSI) technique to identify soil erosion sources in a landscape;
- Expert missions to help individual counterparts (CP) in the selection of the experimental site, soil sample collections for FRNs and CSSI analyses and their preparation before analysis;
- Analytical support for FRNs and CSSI analysis and technical support for data interpretation;
- Financial support for attending international conference to presents results of IAEA technical cooperation project RAS5055;
- Site demonstration for key stakeholders to disseminate the knowledge of FRNs and CSSI for soil erosion assessment.

Problem/issue

Soil erosion leads to global land degradation, particularly in developing countries in Asia. Intensive/persistent farming, inappropriate soil management and climate change strip the soil of carbon and essential plant nutrients, leading to the deterioration and loss of soil fertility, poor agricultural productivity, and therefore falling income and food insecurity.

Nuclear techniques such as the measurement of radionuclides (Caesium-137 (137Cs), Beryllium-7 (7Be) and Lead (210Pb)) help researchers to assess soil erosion rates, while CSSI techniques can identify sediment sources by different land uses. Data on the

Categories:

1. Country Programme Framework/ Regional Profile Process

2. Programme Cycle Management (PCM) (Interrelationships between the different phases of the PCM (Farmers, UNCCD, MOA, MOE); Interrelationship and continuous dialogue between different stakeholders; Data Base of FRNs in Asia)

3. Logical Framework Methodology

5. Regional and Interregional Cooperation

6. Partnership: Strategic (UNCCD, MOE and MOA); Technical (Labs); Financial (Australia for Site Demonstration visit in Dalat, Viet Nam)

precise measurement of soil erosion and sources of sedimentation using nuclear techniques in Asia is crucial for researchers to design appropriate technology for reducing soil erosion and to convince decision makers to take concrete actions to address this critical issue for sustainable agriculture.

How & who

Through the IAEA regional technical cooperation project,RAS5055 ‘Improving Soil Fertility, Land Productivity and Land Degradation Mitigation’, trainings in Member States and in Seibersdorf, Austria, were conducted to train researchers on how to assess soil erosion and identify erosion sources using nuclear and isotopic techniques (FRNs and CSSI), and to put in place mitigation measures to reduce such losses. Experts were also sent to individual Member States to train researchers on soil/land, degradation, management and conservation in different agro-ecosystems. Financial support was provided to Member States lacking an analytical facility for FRNs and CSSI analyses. Technical assistance was also provided by the technical officer who facilitated the establishment of a network among the CPs of the project and experts to share technical information and knowledge.

Approach

1. Technological approach: Regional training in FRNS, CSSI and modelling approach to assess soil erosion and identify sediment source;
2. Managerial approach: Field testing, site demonstration involving decision and policy makers;
3. Partnerships: During the four years of the project, all CPs invested in networking, by liaising and working closely with relevant local, regional and international organizations such as government bodies, civil societies, non-governmental organizations, the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Convention to Combat Desertification (UNCCD) in their respective countries, to raise awareness of the issue of land degradation and the role of nuclear and isotopic techniques in developing sustainable management solutions to reduce it.

How effective

With the partnership of UNCCD, FAO and regional organizations, decision-makers adopted research recommendations for soil conservation. FRNS and CSSI provided precise and reliable information on soil erosion and sedimentation as well as their exact sources, which were well adopted by farmers, land users and scientists.

Lessons learned

1. Selection of CP outside the IAEA Secretariat, can lead to less active CP participation;
2. Outreach to decision and policy makers is necessary to achieve the project outcome. This was hampered by non-active CPs;
3. The allocated budget of the project was realistic to achieve the outputs described in the Logical Framework Matrix, providing financial support for expert missions, scientific visits, fellowships, regional training, analytical services and procurement of minor field equipment. To cover expenses of additional activities, these countries drew financial support from national TC projects or government sources.

Key success factors

1. Developed a database of FRNs and CSSI to be used for future activities;
2. Selected field sites for testing in coordination with Ministry of the Environment/Ministry of Agriculture;
3. Produced several web stories and seven country success stories;
4. Published one article in the National Geographic magazine;
5. Conducted several presentations at international conferences.

Beneficiaries

Land users, farmers, environmental and agriculture decision makers, scientists, researchers and policy makers.

1. Almost 30.7% of China's territory (295 Million ha) suffers from soil erosion, including water erosion and wind erosion causing at least 200 billion yuan (US$ 29.4 billion) of economic losses since 2000. Through the IAEA TC project, the Chinese Academy of Agricultural Sciences implemented activities in four locations through southwest to northeaster China. After applying appropriate conservation practices, soil erosion rates were reduced by approximately 48%. The Yanhe River Basin Management Office (Loess Plateau) and the Liaohe Water Conservancy Commission (northeast China) are currently implementing these practices to control soil erosion.
2. Soil erosion in Indonesia has increased, which has resulted in economic losses of US$ 400 million per year. The project study site is in Java Island, where soil is fertile and widely used for agriculture. However, with Java's rapid population growth and improper soil management practices, associated with the intensification of agriculture and changes in land use, serious increases in soil erosion have occurred. This has contributed to an appreciable loss of soil fertility, diminished crop productivity and deterioration of water quality. After initiating conservation measures, soil erosion losses were reduced to 50% at the catchment level.
3. Timah Tasoh is a manmade reservoir in Perlis, Malaysia. The nuclear and isotopic techniques employed in this project helped Malaysia to address the sedimentation problem in both rivers and a water reservoir, allowing scientists to design soil conservation measures within the catchment. The Sultan Idris Education University (UPSI) and the Perlis State Agriculture Department have set up a knowledge transfer programme that works through community engagement and school projects aimed at promoting the use of 'conservation agriculture' methods by farmers and rural communities.
4. Pakistan is predominantly a dry land country with a significant area of land susceptible to land degradation. Adopting appropriate conservation practices in Potwar Plateau, by development authorities and local communities, to appropriate landscapes, significantly reduced soil erosion rates, between 7 and 53% under different land use activities.
5. In the Philippines, the RAS5055 project outputs provided science-based information to the farmers and land owners, enabling land users in the watershed area to apply appropriate conservation agriculture practices to reduce soil erosion in the most vulnerable areas (e.g. sloping land). By retaining the essential nutrients nitrogen and phosphorus in the soil, farmers benefit from lower fertilizer input costs, and reduced the amount of nutrients entering waterways.

6. In Vietnam, the soil is prone to high erosion losses. Adopting appropriate conservation practices led to a 47% reduction in soil erosion.
7. The Central Highlands of Sri Lanka produce a considerable amount of world class tea, rubber, spices and vegetables, and contributes to around 20% of the national gross domestic product. They are also home to Sri Lanka's five major hydropower reservoirs. Soil erosion in agricultural and non-agricultural land, and siltation in the reservoirs, had a serious impact on Sri Lanka's national economy Through the IAEA regional TC project RAS5055, nuclear and isotopic techniques enabled researchers to precisely assess soil erosion rates, and to identify its sources, enabling implementation of conservation practices to reduce soil erosion.

Quality criteria

Effectiveness: Project results will be used by the decision and policy makers; Ownership: Technology transfer was successfully adopted in CP labs/institutions; and Relevance: Increasing land degradation in participating Member States is a major problem.

Special conditions

Good practices in agriculture were identified using nuclear techniques such as terracing, contour cropping, use of minimum tillage, mulching, cover and alley crops, and building of small stone walls and fences. These were used and adopted by some CPs of RAS5055 and are robust enough to be applied to most soils.

The majority of the countries involved not only assessed land degradation and identified its source, but also placed appropriate mitigation options to control soil erosion. In addition, these CPs worked closely with national and local government agencies and decision makers that are responsible for, or contribute to, land and water management in agricultural regions and catchments, and were thus successful in bringing decision makers and funding providers on board.

TC project: RAS5055 "Improving Soil Fertility, Land Productivity and Land Degradation Mitigation"