Improving Soil Fertility and Crop Production while Mitigating Land Degradation Effects

**THE CHALLENGE**

The Philippines is predominantly an agricultural country with a total land area of about 30 million hectares (ha). Sloping lands (18 to 50%) in Philippines comprise an estimated 9.4 million ha and supports nearly 30% of the population. Agriculture in Philippines thus plays an important role in its economy contributing 11.2% to the GDP. However, high soil erosion rates as much as 100 t/ha/y, depending on the amount and intensity of rainfall, soil type and slope, can have catastrophic effects on losses of topsoil, organic matter, essential plant nutrients, crop productivity, the country’s economy and its vital soil-water ecosystem services.

**THE PROJECT**

Through an IAEA Regional Technical Cooperation Project, and the technical support from the Joint FAO/IAEA Division of Nuclear techniques in Food and Agriculture, the Philippines Nuclear Research Institute (PNRI) quantified soil erosion losses from selected croplands in the Inabanga watershed (an area of 56.7 km²) in the Bohol Island and identified land use practices that contributed to soil erosion. The Be-7 contents of the selected ‘cultivated’ study site were compared with Be-7 contents of soil from an undisturbed reference site, with quantification of erosion/sedimentation rates being accomplished using models. The soil redistribution rates provided information on the soil movement and its occurrence pattern in the study area. This information can then be used to assess the effectiveness of soil conservation measures which will be formulated, developed and utilized in selected agricultural watersheds in Philippines.

Study areas for Be-7 radioactivity measurements showing the field with (right) and without (left) the use of vegetative hedges conservation agriculture measures

**THE TECHNOLOGY**

Fallout radionuclides (FRNs) such as caesium-137 (¹³⁷Cs), lead-210 (²¹⁰Pb), and beryllium-7 (⁷Be) when landing on the soil surface, are strongly bound to fine soils particles. These radioisotopes are ideal soil tracers which can assist in establishing soil erosion and sedimentation rates and in evaluating the efficiency of soil conservation measures to control soil erosion and associated sedimentation. Compound-Specific Stable Isotope (CSSI) techniques are based on the measurement of carbon-13 (¹³C) natural abundance signatures of specific organic compounds (natural fatty acid biomarkers) in the soil. By linking fingerprints of land use to the sediment in deposition zones or transported sediment, CSSI techniques are being used for determining the source of eroded soil and thereby identifying areas sensitive to land degradation.
The project is being jointly carried out by the Department of Agriculture, Agricultural Promotion Center in Bohol and the Australian Centre for International Agricultural Research (ACIAR). Quantifying short term erosion rates associated with extreme weather events or land use changes, using Be-7 and identifying the exact source of the soil sediments has helped to assess the effectiveness of adopting conservation agricultural practices. By adopting conservation agricultural practices (hedging), erosion rates were reduced from 30 t/ha/y to 11 t/ha/y, representing a 63% reduction in soil erosion in the project area. The project outputs thus provided science-based information to the farmers and land owners who had actively participated in the project.

Study site with hedging, contour and terracing to reduce soil erosion

Such scientific information on the extent of land degradation, and its sources, has enabled land users in the watershed area to apply appropriate conservation agriculture practices to reduce soil erosion in the most vulnerable areas (i.e. sloping lands). Assuming the 9.4 million ha of sloping lands for the country with 1% soil organic matter (which contains 5% nitrogen and 0.5% phosphorus), the 63% reduction in soil erosion will retain significant amounts of nitrogen and phosphorus in soil, with estimated fertilizer value of USD 59 million for N and USD 20 million for phosphorus. By retaining these essential nutrients (nitrogen and phosphorus on farm), farmers will benefit from reduced cost of fertilizer inputs, which will also lead to reducing the amount of nutrients that enters waterways.

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2 World Bank: Agriculture, value added (% of GDP).
3 Based on internal data.
4 RASSOS: Improving soil fertility, land productivity and land degradation mitigation.

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For further information, please visit:
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