

- GEF directed complementary resources to the project through the PALM mechanism
- The United Nations University (UNU) helped to coordinate project activities.

These partners are working with the same Tajik counterparts as the IAEA, in particular the Tajik Soil Science Institute and the Tajik Academy of Agricultural Science, to offer complementary services and assistance.

Increased awareness of Tajik soil erosion trends and the appropriate mitigation and control options will provide the basis for land use planning and decision making and will promote soil and water conservation techniques for sustainable agriculture development in Tajikistan. The establishment of capacity and facilities for efficient and accurate soil erosion assessment in Tajikistan will support soil erosion surveillance not only within the country, but also in the vast mountainous territories of Central Asia. The collaborative work of this project is an example of how partnerships can optimize land resource use to benefit the socioeconomic development of a country and a region.

More information on the PALM project can be found at <http://www.ehs.unu.edu/palm/>

Fallout radionuclides as indicators of soil degradation and potential loss of agricultural production in Latin American and Caribbean countries

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Background

Land degradation affects about 300 million ha of land in the Latin American and Caribbean region: 51% of this is agricultural land (180 million hectares). The ARCAL Regional Strategy Profile identifies the deficient use of agricultural soil and the resulting permanent loss of productive agricultural areas as one of the most important environmental and alimentary problems in the Latin American and Caribbean continental areas (Alimentary Security, A3, PER-ARCAL, 2007-2013). In recent times, extensive natural areas have been dramatically diminished by various human interventions. In this continental context, regional or national difficulties normally present specific characteristics and relevancies and distinct intervention needs. Indicators of the present soil conservation status are essential for an assessment of national economic impact and an evaluation of social consequences.

Large-scale soil erosion evaluations cannot be based on direct conventional measurements because of methodological restrictions and excessively high temporal and spatial variability. Quantitative predictions which are more precise than a qualitative erosion risk determination must be carried out. Three Fallout Radionuclides (FRNs), such as Caesium-137 (¹³⁷Cs), Excess Lead-210 (²¹⁰Pb_{ex}) and Beryllium-7 (⁷Be), have proved to be by far the most successful tracers of soil movement. A key feature of the use of ¹³⁷Cs is its ability to provide retrospective information on medium-term rates of soil redistribution based on a single sampling campaign. ¹³⁷Cs measurements provide information on rates of soil redistribution averaged over a period of about 50 years, while ⁷Be, with its short half-life of 53 days, offers a potential for documenting soil redistribution over much shorter-timescales than ¹³⁷Cs and ²¹⁰Pb_{ex}. A number of studies have exploited this potential and have used ⁷Be measurements to document the soil redistribution rates associated with individual events (one month of heavy rainfall) or recent short periods of heavy rainfall.

In view of the above, the project ‘Using Environmental Radionuclides as Indicators of Land Degradation in Latin American, Caribbean and Antarctic Ecosystems’, RLA/5/051, was approved for 5 years from 2009-2013. The project aims to enhance regional capacity for sound assessment of land degradation and improved national and regional policies for soil conservation in Latin America, Caribbean and Antarctic ecosystems through the use of fallout radionuclide based techniques.

Within the framework of the ARCAL RLA/5/051 project, research groups from 15 countries in the region (i.e. Argentina, Bolivia, Brazil, Chile, Cuba, Dominican Republic, El Salvador, Haiti, Guatemala, Jamaica, Mexico, Nicaragua, Peru, Uruguay and Venezuela) have started in 2010 to implement intensive field campaigns and laboratory and modelling activities focused on employing fallout radionuclides as tracers of soil erosion and redistribution in representative agroecosystems of the region. It aims to assess soil degradation in the region and to assist policy makers in the participating countries to select the right approaches and tools to diagnose the state of land degradation and the consequences of human intervention under different agro-ecological conditions.

Case study from Argentina

As part of the RLA/5/051 project activities, the Grupo de Estudios Ambientales (GEA, IMASL, Universidad Nacional de San Luis/Conicet), in Argentina, identified the best strategy for using FRNs (in particular ^7Be) in this part of the region. The study site was located in central Argentina (S 33°9'; W 66°18'); 15 km north of San Luis City (Province of San Luis). In this region the average annual temperature is 17°C, while in summer (December–March), the mean temperature is 23°C. Annual rainfall ranges from 600 mm to 800 mm.



In San Luis rainfall varies seasonally, with a dry season from May to October and a rainy season from November to April. Rain samples were collected using rainwater collectors placed, one meter above the ground to avoid soil contamination and they were filtered without further treatment. In total 58 precipitation events were collected and ^7Be activity concentrations were measured by gamma spectrometry.

The ^7Be activity concentrations in rainwater ranged from $0.7 \pm 0.3 \text{ Bq l}^{-1}$ to $3.2 \pm 0.7 \text{ Bq l}^{-1}$, with a mean value of 1.7 Bq l^{-1} (sd = 0.53 Bq l^{-1}). The magnitude of precipitation ranged from 1 to 59 mm. Taking into account the ^7Be content in rainwater and the regional precipitation regime, the ^7Be atmospheric depositional flux was estimated at $1140 \pm 120 \text{ Bq m}^{-2}\text{a}^{-1}$. As a consequence of this rainwater activity concentration was independent of rainfall, with a linear relationship found between the activity density deposition and the rainfall (Figure 1).

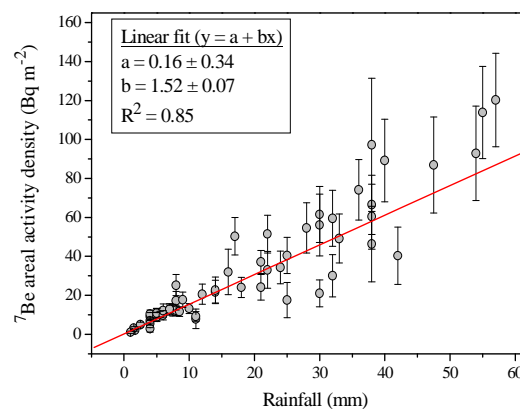


Figure 1. ^7Be areal activity deposition (Bq m^{-2}) vs. rainfall (mm) the ^7Be content and vertical distribution in soil, an area was selected where land

The distribution of ^7Be in the soil reached to a depth of 1 cm. No differences in the ^7Be content of the soil have been found between samples taken within and outside of the exclusion runoff plots. This result suggests that in this site there is no soil mobilization (sedimentation or erosion), and therefore it can be identified as a reference site for studies using ^7Be as an indicator of soil erosion and redistribution rates.

Figure 2 shows, in two soil profiles, the typical exponential decrease, with mass depth (x , kg m^{-2}), of areal activity density (A , Bq m^{-2}) of the ^7Be within the soil ($R^2 \geq 0.9$ for all profiles). These soil profiles correspond to September (dry season) and February (rainy season). Fitting has been performed with the equation: $A(x) = A_{\text{ref}} \exp(-x/h_0)$, with A_{ref} (Bq m^{-2}) representing the initial total areal activity density at an uneroded stable site or reference site in the study area, h_0 (kg m^{-2}) the relaxation mass depth of the initial depth distribution of the ^7Be areal activity density in the soil, and x the mass depth. These parameters are indicated in the figure.

The annual depositional flux for the region was estimated based on consideration of annual precipitation values and ^7Be activity content in rainwater. The areal activity density in soil was estimated, considering both the rainwater mean activity concentration and the precipitation regime of the sampled region. The research predicts a marked seasonal variation in the ^7Be soil content. Soil activity density reaches 400–500 Bq m^{-2} in the annual wet period (December – March),

while diminishing to 100-150 Bq m⁻² in the dry period. The results of this work allowed good characterization of the ⁷Be inputs into the soils of the study site, and indicated its potential application for assessing soil erosion and redistribution rates during short rainfall events and eventually improving current agricultural land management (e.g. conservation agriculture) in the region.

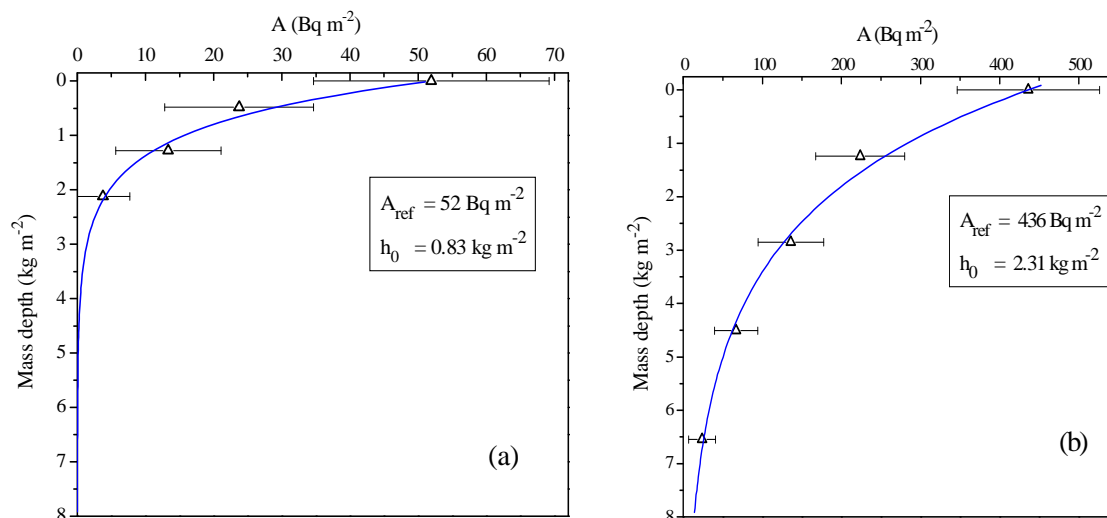


Figure 2. ⁷Be distribution in soil for (a) September and (b) February

Project activities, action plans and strategies for each of the involved countries and more detailed information can be found on the project website: <http://gea.unsl.edu.ar>.

N2AFRICA: Putting nitrogen fixation to work for smallholder farmers in Africa

By K. Giller

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Capturing free nitrogen from the atmosphere, also called nitrogen fixation, through the use of legumes as a rotation crop is a step forward in feeding the soil and improving farmers' incomes. Nitrogen fixation as measured by the stable nitrogen-15 isotope is a potentially important technique in the following project N2AFRICA, lead by Ken Giller from Wageningen University.

N2AFRICA is a large scale research project focused on 'Putting nitrogen fixation to work for smallholder farmers in Africa'. N2AFRICA is funded by 'The Bill & Melinda Gates Foundation' through a grant to Plant Production Systems, Wageningen University, in the Netherlands. It is led by Wageningen University together with CIAT-TSBF, IITA and has many partners in the Democratic Republic of Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe.

Goals

At the end of the 4-year project we will have:

- identified niches for targeting nitrogen fixing legumes
- tested multi-purpose legumes to provide food, animal feed, and improved soil fertility
- promoted the adoption of improved legume varieties
- supported the development of inoculum production capacity through collaboration with private sector partners
- developed and strengthened capacity for legumes research and technology dissemination
- delivered improved varieties of legumes and inoculant technologies to more than 225,000 smallholder farmers in eight countries of sub-Saharan Africa.

Rationale

Successful BNF by legumes in the field depends on the interaction:

$$(G_L \times G_R) \times E \times M$$

that is: (Legume genotype \times Rhizobium strain) \times Environment \times Management