Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Soils Newsletter

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To Our Readers

During the 68th UN General Assembly, 2015 was declared the International Year of Soils (IYS), a year to raise awareness and understanding on the importance of soil for food security and essential ecosystem functions. The Soil and Water Management and Crop Nutrition Subprogramme is joining international organizations in celebrating and commemorating the IYS, with participation at several international events. In March this year, our Subprogramme participated, together with scientists from IAEA Technical Cooperation projects across the world, at an IAEA side-event on "The importance of quantitative soil erosion data: How isotopic techniques can provide evidence for combating desertification and climate change", organized at the 3rd UNCCD Scientific Conference in Mexico on "Combating desertification/land degradation and drought for poverty reduction and sustainable development: The contribution of science, technology, traditional knowledge and practices". Several success stories of socio-economic and environmental importance have also been published on the websites of IAEA and the Joint FAO/IAEA Division, and these articles were included in a special edition of the IAEA Bulletin on peaceful uses of nuclear technology. Furthermore, an animated infographic was made to explain how the use of fallout radionuclides (caesium-137) techniques and how they can become the basis for developing soil conservation measures and strategies.

During the Global Soil Week in April 2015, an exhibition was held in the IAEA HQ to further increase awareness of the importance of soil. In June, the SWMCN will be participating in the FAO Global Soil Partnership (GSP) 3rd Plenary Assembly at the FAO Headquarters in Rome. The purpose of the assembly is to review and prioritize GSP actions, and to facilitate a balanced regional decision-making process. We will also be attending the 2015 International Soil Conference in Thailand in August 2015, where the work of FAO/IAEA will be showcased. The SWMCN Subprogramme will also be organising a side event during the annual IAEA General Conference in September to highlight the work of the Joint FAO/IAEA Division in climate-smart agriculture. In December this year, we will be co-hosting a one-day international workshop celebrating World Soil Day with the International Union of Soil Science (IUSS). During this event, FAO/IAEA achievements in soil management in Member Countries as well as IUSS

2015 International Year of Soils

representatives from Africa, Asia, Europe, Latin America and America Soil Science Societies will be reporting their respective IYS achievements. Future challenges facing soil sciences in each region will be discussed. For more information of this event, please refer to the announcement section of this newsletter. We hope to see your participation at the side-event in September and during the international workshop in December.

The agricultural uplands, particularly the mountain regions, are among the most vulnerable places on earth. These regions will be facing major challenges relating to food security and climate change in the coming decades. The soils in these regions will become increasingly unstable, with less water being available for communities and possibly with increasing greenhouse gas emissions, causing major changes to the Earth's climate. The SWMCN Subprogramme is embarking in an IAEA inter-regional TC project involving 23 countries and six international organizations to assess the climate change concerns and to identify what needs to be done. A consultants' meeting on soil and water conservation for climate change adaptation in agricultural uplands was held in December 2014 to develop a new Coordinated Research Project (CRP) on Soil and Water Conservation for Climate Change Adaptation in Agricultural Uplands, which is planned for early 2016 with project proposals opening for applications in 2015.

The Soil and Water Management and Crop Nutrition Laboratory (SWMCNL) bid farewell to another long serving staff member, Martina Aigner, Senior Laboratory Technician. Martina retired this February, after working at the SWMCNL for 30 years. Martina contributed to the work on phosphorus-32 isotopic techniques in the assessment of available soil P. The expertise and contributions of Martina have been enormous and I am grateful for her dedication and support over these many years.

I would like to end this note by thanking all of you, our readers, for your continuing support. Do drop us a line for any suggestion for improvement of our Newsletter.

Best wishes,

Lee Heng
Head
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Staff News

Martina Aigner, Senior Laboratory Technician, retired in February 2015 after nearly 30 years of service to the SWMCN Subprogramme. On behalf of the Section and the Laboratory, Lee Heng and Gerd Dercon thank Martina for her dedication and support to the sustainable development of Member States. Over three decades of excellent service Martina played an important role in the development and adaptation of isotope and nuclear techniques for improving soil and water management and crop nutrition at the SWMCN Laboratory. Martina also helped scientists and technicians from across the world to improve the quality of isotope analysis. Her professional attitude can be considered without doubt exemplary, and she put the standards for precision in the laboratory very high. We wish Martina well in her retirement.

Agneta Krukle joined the SWMCN on 1 December 2014 as an intern for four months to work on the measurements of stable isotopes using Isotope Ratio Mass Spectrometry and Isotopic Laser Analyzers with Christian Resch and contributed significantly to our laboratory analytical practices. Agneta studied engineering in food technologies at the Latvian University of Agriculture, Jelgava, Latvia and engineering in food safety and quality management at the University of Natural Resources and Life Sciences, Vienna, Austria. We congratulate Agneta on completing her work with great dedication and wish her every success in future endeavors.

Feature Articles

Is Snow Gliding a Major Soil Erosion Agent in Steep Alpine Areas?

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Snow cover is a key hydrological characteristic of mountain areas. Nevertheless, a majority of studies focused on quantifying rates of soil erosion and sediment transport in steep mountain areas has largely neglected the role of snow cover on soil erosion rates (Stanchi et al., 2014). Soil erosion studies have focused almost exclusively on the snow-free periods even though it is well known that wet avalanches can yield enormous erosive forces (Freppaz et al., 2010; Korup and Rixen, 2014). This raises the question whether annual snow cover and particularly the slow movement of snow packages over the soil surface, termed ‘‘snow gliding’’, contribute significantly to the total soil loss in these areas.

Three different approaches to estimate soil erosion rates were used to address this question. These include (1) the anthropogenic soil tracer ^{137}Cs, (2) the Revised Universal Soil Loss Equation (RUSLE), and (3) direct sediment yield measurements of snow glide deposits. The fallout radionuclide ^{137}Cs integrates total soil loss due to all erosion agents involved, the RUSLE model is suitable to estimate soil loss by water erosion and the sediment yield measurements yield represents a direct estimate of soil removal by snow gliding. Moreover, cumulative snow glide distance was measured for 14 sites and modelled for the surrounding area with the Spatial Snow Glide Model (Leitinger et al., 2008).

The mean measured snow glide distances varied from 2 to 189 cm in the fourteen investigated sites (Figure 1). Most of this variability can be explained by the slope aspect and the surface roughness determined by land use/cover. With increasing surface roughness, the snow glide distance decreases. The modelled snow glide rates from the Spatial Snow Glide Model compared reasonably well with the snow glide measurements and revealed that snow gliding is not a punctual phenomenon but an extensive process especially at the south facing slopes (Figure 1).

The soil erosion rates estimated from the sediment yields of the snow glide deposition ranged from 0.03 to 22.9 t ha^{-1} yr^{-1} with a mean value of 8.4 t ha^{-1} yr^{-1}. The 2012/2013 winter precipitation of 407 mm was quite representative of the long-term average (i.e. 430 mm). However, to verify the effectiveness of snow gliding for a longer temporal scale, the authors additionally used an indirect quantification approach. It was assumed that the difference between total net erosion rate (estimated by the ^{137}Cs approach) and the water soil erosion rate (estimated by RUSLE), termed excess RUSLE erosion rate, corresponds to snow glide triggered soil erosion.

The mean ^{137}Cs based soil erosion rates of 17.8 t ha^{-1} yr^{-1} are four times higher than the average RUSLE estimates. Congruent with RUSLE the ^{137}Cs-based average soil erosion rate on the north facing slopes is lower than on the south facing slopes (by 8.7 t ha^{-1} yr^{-1}). The observed excess RUSLE erosion rate that could be interpreted as snow glide triggered soil erosion is correlated to the measured snow glide distance (Figure 2). With increasing snow glide rates an increase of soil loss is observed. The excess RUSLE erosion rate corresponds well with erosion rates estimated from the sediment yield measurements.

The combined use of RUSLE and ^{137}Cs showed the relevance of the snow glide process for a longer time scale (as compared to the snow glide deposition measurements of one single winter). Additionally, it has highlighted that for an accurate soil erosion prediction in high mountain areas, it is crucial to take into account the erosivity of snow movements. The Spatial Snow Glide Model might serve as a tool to evaluate the spatial relevance of snow gliding for larger areas.

Both approaches indicated that snow gliding is a major soil erosion factor in steep snow-covered mountain grasslands. Surface roughness may reduce snow glide rates particularly on the south facing slopes which are generally more intensively used. This is a key finding with respect to soil conservation since surface roughness can be modified and adapted through an effective land use management.

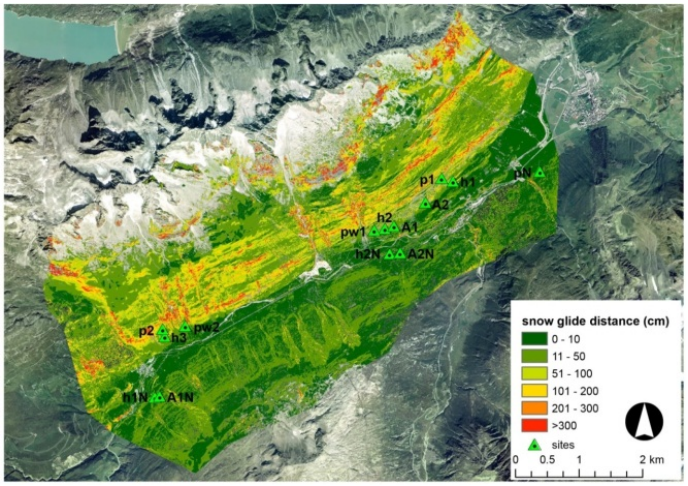

Figure 1. Map of the potential snow glide distance (m) modelled with the Spatial Snow Glide Model of Leitinger et al. (2008).

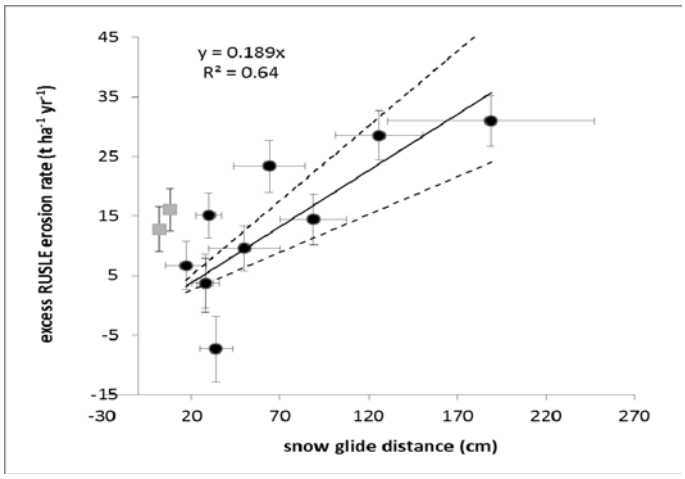

Figure 2. Correlation of the cumulative measured snow glide distances (cm) versus the difference of the ^{137}Cs and RUSLE soil erosion rate (t ha^{-1} yr^{-1}) for the grassland sites (dots, n=10) and the Alnus viridis sites A1N, A2N (squares, n=2). Y-error bars represent the error of both the ^{137}Cs and RUSLE estimates. X-error bars represent the standard deviation of replicate snow glide measurements at one site. Solid line represents a linear regression and the dotted lines the 95% confidence interval.

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Factors Affecting Water Dynamics and Their Assessment in Agricultural Landscapes

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The intensification and extension of agriculture have contributed significantly to the global food production in the last five decades. However, intensification without due attention to the ecosystem services and sustainability of soil and water resources contributed to land and water quality degradation such as soil erosion, decreased soil fertility and quality, salinization and nutrient discharge to surface and ground waters. Land use change from forests to crop lands altered the vegetation pattern and hydrology of landscapes with increased nutrient discharge from crop lands to riverine environment. Global climate change will increase the amount of water required for agriculture in addition to water needed for further irrigation development causing water scarcity in many dry, arid and semi-arid regions. The water and nutrient use efficiencies of agricultural production systems are still below 40% in

many regions across the globe. Nitrogen (N) and phosphorus (P) fertilizer use in agriculture have accelerated the cycling of these nutrients in the landscape and contributed to water quality degradation. Such nutrient pollution has a wide array of consequences including eutrophication of inland waters and marine eco-systems. While intensifying drought conditions, increasing water consumption and environmental pollution in many parts of the world threatens agricultural productivity and livelihood, these also provided opportunities for farmers to use improved land and water management technologies and practices to make agriculture resilient to external shocks.

The authors within the Soil and Water Management & Crop Nutrition Section, International Atomic Energy Agency have recently reviewed major factors and drivers that affect water dynamics and nutrient pollution in agricultural landscapes (Sakadevan and Nguyen, 2015). The manuscript has been approved for publications in "Sustainable Agricultural Reviews". A summary of the review is presented in this article.

The paper highlighted that water flux is the main driver of nutrient pollution and is influenced by land use (vegetation), soil physical and chemical characteristics and climate change. While fertilizer N and P for agriculture increased by 10 and 14% respectively between 2010 and 2015, crop nutrient use efficiencies (25-65% and 10-30% for N and P respectively) were still low leading to losses of N and P from agricultural landscapes. Fertilizer and manure application together with legume cropping contributed almost 60% N and 69% P to surface water systems in agricultural landscapes.

The low crop water productivity and nutrient use efficiency could jeopardize agricultural productivity and the quantity and quality of surface and ground water in agricultural landscapes. Improved agricultural management practices that incorporate efficient fertilizer and water use and conservation agricultural practices are important for sustainable agricultural production and water resources protection. Research has identified the mechanisms controlling water dynamics under different land use, land management practices and agro-ecological regions, but the science is far from having a clear understanding of these mechanisms at different spatial scales (from farm to landscape scales). Although a number of techniques based on ground measurements, modelling approaches and remote sensing have been used to identify and characterize water dynamics and the associated water quantity and quality at field and landscape levels, it has been a challenge to integrate water and nutrient dynamics from farm to landscape scale.

In recent years the concept of ecohydrology combining all aspects of ecosystem functions such as evapotranspiration, vegetation, climate change, groundwater dynamics, runoff and stream flow in land and water management. Its application has rapidly grown to solve some of the critical issues in land and water management related to water quantity and quality in agricultural landscapes. Ground based soil-water sensors and isotopic techniques are currently being used at landscape scale for developing the technology and algorithms for monitoring and data processing. These are fundamental research efforts and further improvements are important in this area.

While direct relationship between land use, evapotranspiration and daily fluctuations in water and nutrient flux have been documented, more attention need to be given to unravelling the relationship between land use (vegetation), hydrology and landscape response under changing climate across different agro-eco regions. Techniques that use stable isotopes of ^{18}O, ^{2}H and ^{15}N play an important role for assessing the dynamics of water and their relationship to land use and land management practices. Capabilities to extrapolate water and nutrient use efficiency information from plant and farm to landscape level will remain a future priority for research. Further information is required on the spatial variability and heterogeneity on factors controlling water and nutrient fluxes and the impact of climate change at these scales. The application of satellite based remote sensing data for water quantity and quality assessment has proven to be an important step forward, but methods and approaches need to be improved for obtaining linear relationship between spectral signatures of the image and water quantity and quality parameters to be investigated.

Reference

Sakadevan, K. and Nguyen, M.L. 2015. Assessment of Factors Affecting Water Dynamics in Agriculture. Sustainable Agricultural Reviews. Volume 18. In press.

Cosmic Ray Neutron Probe: Uses, Calibration and Validation in Austria

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The importance of surface soil water (rooting zone) has become evident with climate change affecting rainfall patterns and crop production. The use of Cosmic Ray Neutron Probe (CRNP) for measuring surface soil water content has become increasingly popular. The advantage of CRNP is that it is a non-invasive technique for measuring soil water content at an area-wide scale (600 meter in diameter), providing an unprecedented scale of observation (Desilets and Zreda, 2013). It also, monitor soil water content integrated over the top 40 cm depending on the wetness of the soil equivalent to snow depth of about 20 cm.

Cosmic-ray neutrons are a by-product of chain reactions initiated at the upper atmosphere by primary cosmic rays. These particles collide with atmospheric gas molecules, unleashing cascades of secondary protons, neutrons and other subatomic particles, some of which penetrate down to sea level. Fast neutrons are generated by cascading particles (primarily cascade neutrons) throughout the atmosphere and in the upper few meters of Earth's crust (Desilets and Zreda, 2014). For a wide range of soil characteristics, a "universal" shape-defining function can be used to convert neutron counting rates to soil water content for typical silica-dominated soils. This function is valid for neutrons in the epithermal to the faster flux of the spectrum (100-106 eV), where neutron absorption is minor. The N_0 method is a site-specific calibration technique that depends mainly on the characteristics of the surroundings. The method is described as:

$$\left(\theta_p\right) = \left(\frac{0.0808}{\frac{N}{N_0} - 0.372} - 0.115\right) * \rho_{bd} \qquad (1)$$

where θ_p is pore (or gravimetric) water content (g/g), ρ_{bd} is dry soil bulk density (g/cm^3), N is the corrected neutron counts per hour (cph), N_0 is an instrument specific calibrated parameter that represents the count rate over dry silica soils, and the values 0.0808, 0.372 and 0.115 are derived from a semi-analytical solution of a neutron diffusion equation (Desilets et al., 2010).

A CRNP (CRS 1000/B model) consisting of two neutron counters (one tuned for slow, the other one for fast neutrons), data logger and an Iridium modem, has been installed at the Technical University Petzenkirchen research station for Water Resource Systems, 100 km west of Vienna (Figure 1). The elevation of the study area ranges from 268 to 323 m a.s.l. with a mean slope of 8%, the surface soil is light-coloured, coarse-textured, with periodic water stagnation. Land use is mainly agriculture (87%) with small parcels of forest and pasture. The climate is humid with a mean annual air temperature of 9.3°C and annual rainfall of 716 mm. Temperature, rainfall and rainfall intensity have their peak in summer (Eder et al., 2010). An Iridium Global Satellite Communications Network – antenna, mounted on top of the CRNP, enables data transfer (http://cosmos.hwr.arizona.edu/Probes/StationDat/087/index.php).

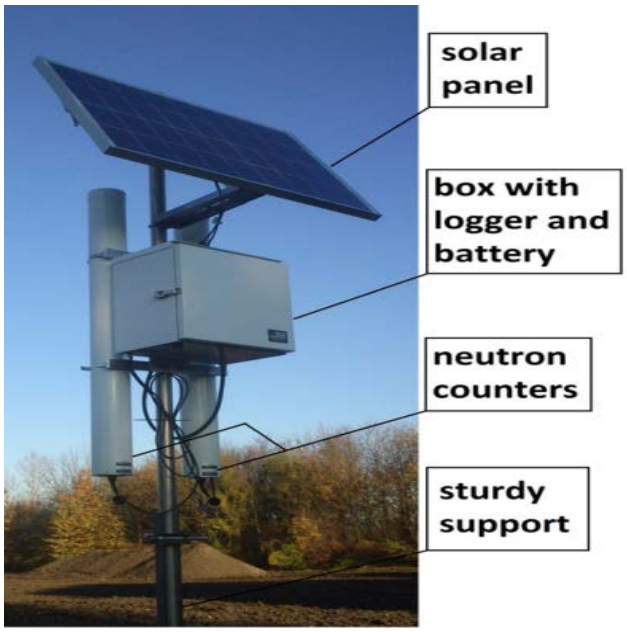

Figure. 1. The cosmic Ray Neutron probe (CRNP).

An in-situ soil water network consisting of 31 stations of electromagnetic probes (Time domain Transmission; TDT) measuring soil water contents at 4 depths (0.05, 0.10, 0.20 and 0.50 m) over an area of 66 ha was established (Vreugdenhil et al., 2013) to provide continuous soil water data for analyzing soil water dynamics (Franz et al., 2013). In addition, soil water content in the upper 15 cm of the soil was measured using TDR probes during two field samplings in April 2014. The pattern of sampling to estimate θ_p was decided such that each sample location (and representative area) is given equal weight in the CRNP sensitivity. A total of 60 undisturbed samples were taken at 0-5, 5-10 and 15-20 cm. and soil water content was determined. At the time of

soil sampling, N was recorded (by CRNP) and N_0 calculated from equation (1), which is used to calculate soil water content. However, the N_0 values have to be tested from time to time to assure their stability at different soil wetness and cropping conditions. Sixteen stations of the TDT network (which are within the footprint of the CRNP) are used to validate the CRNP data.

Because no other instrument operates at a comparable scale, field validation is inherently difficult due to different agricultural practices. Therefore, comparing the CRNP measurements with TDT measurements will provide adequate validation of the CRNP. The preferred method is to compare the CRNP measurements with the gravimetric water contents. This should be done at different time and space. The drawback is that the independent measurements are then indirect, and their accuracy and bias have to be measured also.

The preliminary results showed that the CRNP measured soil water contents reflecting rainfall pattern and snow event (Figure 2). Further, this CRNP derived soil water content is sensitive to the water content of the above ground biomass (mismatched in June-September 2014, as a results of the plant growth; Figure 2). The CRNP is also sensitive to snow cover, leading to a rise in measured surface soil water content, as in Feb-March 2014 comparison (Figure 2).

More field measurements are currently being carried out using TDT, TDR and gravimetric technique to compare with CRNP under different water contents and crop managements to identify the relationship between soil water contents and N_0 with an easy and reliable measure of plant water content to improve the reliability and performance of the CRNP. Better assessment of the effective soil depth will also be an important component to solve.

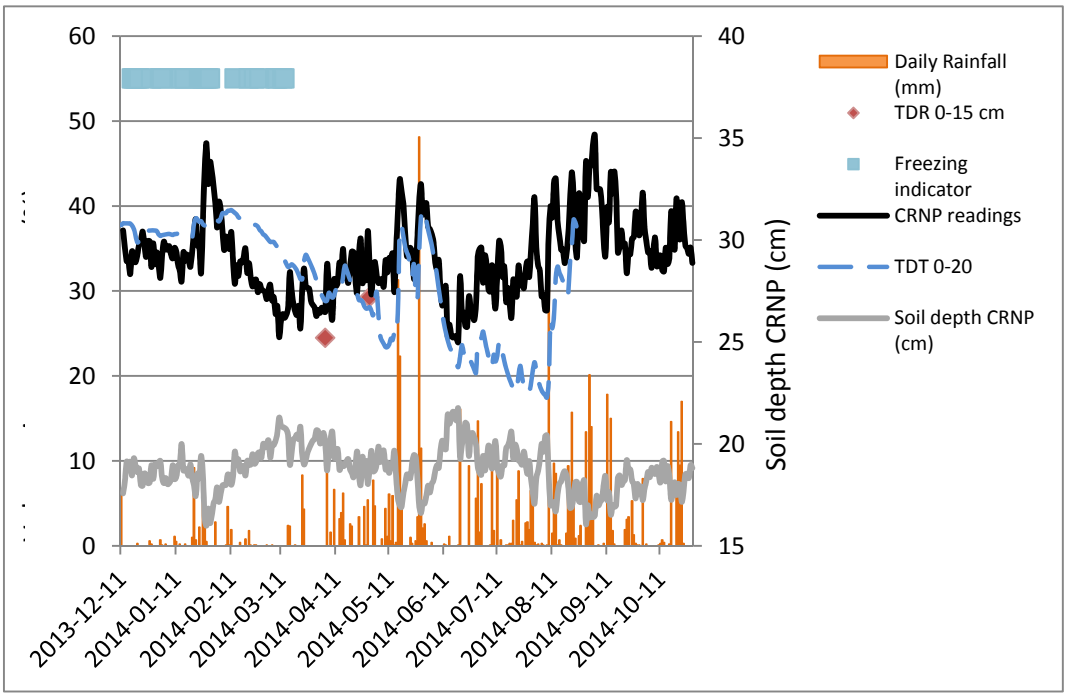

Figure 2. Validation of Cosmic Ray Neutron Probe at Petzenkirchen station (2013-14 seasons).

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Announcements

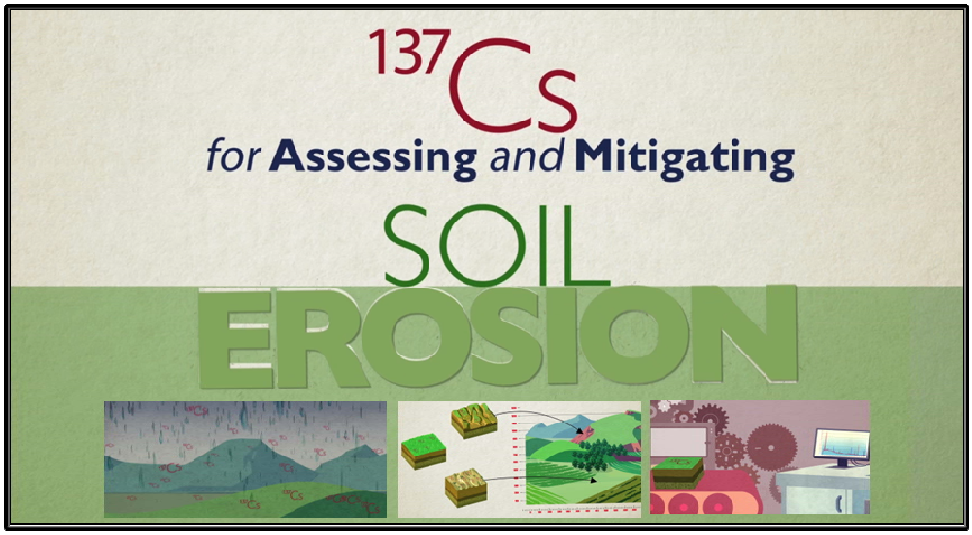
A New Animated Infographic on "^{137}Cs for Assessing and Mitigating Soil Erosion"

Lionel Mabit, Lee Heng, Gerd Dercon, Arsenio Toloza, Mohammad Zaman

The SWMCN Subprogramme is proud to present a new animated infographic highlighting the use of fallout radionuclide techniques (i.e. caesium-137 or ^{137}Cs) to investigate soil erosion and sedimentation processes in agricultural environments. The ^{137}Cs technique is currently being disseminated by the Joint FAO/IAEA Division in 65 IAEA Member States across all continents.

This animation is complementary to the Guidelines for Using Fallout Radionuclides to Assess Erosion and Effectiveness of Soil Conservation Strategies (i.e. IAEA-TECDOC-1721), providing the general audience a simple and comprehensive illustration of the potential use of ^{137}Cs as a soil tracer for estimating soil erosion processes to allow mitigating soil degradation.

Readers can watch this video at: http://www-naweb.iaea.org/nafa/resources-nafa/soil-Erosion-stream32.mp4



Celebration of International Year of Soils 2015: Achievements and Future Challenges

7 December 2015
IAEA/Vienna International Centre, Austria

The International Union of Soil Science (IUSS) joins with the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture in organizing this conference in Vienna, Austria to celebrate the International Year of Soils (IYS) and the World Soil Day (WSD).

Speakers from Regional Soil Science Societies (Africa, Australasia, East and Southeast Asia, Europe, Latin America and North America), the IUSS Council, the chairs and vice-chairs of the IUSS Divisions, Commissions and Working Groups as well as several high level representatives from FAO, IAEA and partners (e.g. European Commission, European Environment Agency, European Geosciences Union, Institute for Advanced Sustainability Studies) will be invited to discuss achievements made through soil research for sustainable food production and environmental protection. Future challenges for soil research and opportunities for international cooperation to address these challenges will also be discussed at the conference.

Technical Cooperation Field Projects

Operational Projects and Technical Officers Responsible for Implementation

Country/Region	TC Project	Description	Technical Officer(s)
Algeria	ALG5026	Increasing the Genetic Variability for the Improvement of Strategic Crops (Wheat, Barley, Chickpeas and Dates) for Enhanced Tolerance to Biotic and Abiotic Stresses and the Development of Biotechnology Capacities	A. Wahbi in collaboration with Plant Breeding and Genetics Section
Algeria	ALG5028	Preserving Arid and Semi-Arid Agro-Ecosystems and Combating Desertification by Using Advanced Isotopic Techniques, Developing Decision-Making Tools and Supporting Sensitization of the Local Population on the Needs of Desertification Control	G. Dercon and L. Mabit
Angola	ANG5011	Monitoring Soil Fertility in Pasture Areas for Their Improvement and Maintenance	L. Heng
Burundi	BDI0001	Supporting Human Resource Development and Nuclear Technology Support including Radiation Safety	A. Wahbi
Benin	BEN5007	Soil, Crop and Livestock Integration for Sustainable Agriculture Development through the Establishment of a National Laboratory Network	L. Heng in collaboration with Animal Production and Health Section
Bangladesh	BGD5029	Evaluating Promising Abiotic Stress Tolerant Crop Mutants/Varieties and Measuring the Suitable Management Practices for the Promotion of Sustainable Production at Saline, Submergence and Drought Prone Areas	A. Wahbi
Burkina Faso	BKF5009	Improving Voandzou and Sesame Based Cropping Systems through the Use of Integrated Isotopic and Nuclear Techniques for Food Security and Poverty Alleviation	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
Burkina Faso	BKF5010	Enhancing Crop Productivity through Small Scale Irrigation Technologies for Peri-Urban Agriculture to Improve the Income and Livelihood of Farmers	L. Heng
Bolivia	BOL5020	Evaluating Soil Fertility Loss by Water Erosion in the Area and Valleys of Intersalar Boliviano, Using Nuclear Gamma Spectrometry and Environmental Radionuclides	G. Dercon
Botswana	BOT5012	Improving Soil and Water Management Options to Optimize Yields of Selected Crops	K. Sakadevan

Country/Region	TC Project	Description	Technical Officer(s)
Central African Republic	CAF5006	Improving Cassava Production through High Yielding Varieties and Sustainable Soil Fertility Management by Using Isotopic and Nuclear Techniques to Ensure Sustainable Farming	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
Chile	CHI5050	Using Isotope Techniques to Quantify the Contribution of Agriculture in Greenhouse Gas Production	M. Zaman
Cameroon	CMR5020	Improving Maize Based Cropping System Productivity through the Efficient Management of Organic Matter, Water, Nitrogen and Phosphorous Fertilizers	M. Zaman
Costa Rica	COS5029	Strengthening of Good Agricultural Practices (GAP) for Food Safety and Security and Environmental Protection	G. Dercon in collaboration with Food and Environmental Protection Section
Costa Rica	COS5031	Consolidating a National Reference Laboratory for the Measurement of Greenhouse Gases	M. Zaman
Dominican Republic	DOM7004	Developing Human Resources and Supporting Nuclear Technology for Addressing Key Priority Areas including Biodiversity and Environmental Conservation	L. Heng
Ecuador	ECU5028	Consolidating Food Security and Environmental Sustainability in Palm Oil Production Using Nuclear Applications	L. Heng in collaboration with Food and Environmental Protection Section
Interregional project	INT5153	Assessing the Impact of Climate Change and its Effects on Soil and Water Resources in Polar and Mountainous Regions	G. Dercon and M. Zaman
Iraq	IRQ5019	Utilizing Nuclear Techniques to Increase Water Use Efficiency and to Improve Soil Management of Degraded Soil	A. Wahbi
Ivory Coast	IVC5033	Contributing to Food Security and Combating Poverty by Improving the Productivity of the Coconut Palm, Plaintain and Leafy Vegetables by Means of Studying the Effects of Organic and Mineral Fertilizers	K. Sakadevan
Cambodia	KAM5001	Improving Soil Fertility and Crop Management Strategies in Diversified Rice Based Farming Systems	L. Heng
Kazakhstan	KAZ5003	Increasing Micronutrient Content and Bioavailability in Wheat Germplasm by Means of an Integrated Approach	K. Sakadevan in collaboration with Plant Breeding and Genetics Section

Country/Region	TC Project	Description	Technical Officer(s)
Kenya	KEN5035	Using Nuclear Techniques for Validation of Integrated Soil Fertility and Water Management Technologies for Increased Agricultural Productivity and Climate Change Adaptation in Arid and Semi-Arid Areas	L. Heng
Laos	LAO5001	Enhancing Food Security through Best Fit Soil-Water Nutrient Management Practices with Mutation Induction for Drought Resistant Rice	M. Zaman
Madagascar	MAG5019	Improving the Use of Agricultural Resources and Combating Soil Erosion by Optimizing Conservation Agriculture and Developing Strategies for Its Dissemination	M. Zaman and L. Mabit
Madagascar	MAG5023	Promoting Climate Smart Agriculture to Face Food Insecurity and Climate Change with regard to Basic National Foods (Rice and Maize)	M. Zaman and L. Mabit
Mexico	MEX5030	Improving Phosphorus Use Efficiency and Agricultural Sustainability in the Acidic Soil of the P'urhepecha Plateau, Michoacan	M. Zaman
Mali	MLI5024	Enhancing Sustainable Intensification and Diversification of Sorghum Production Systems in the Southern Zone by an Integrated and Participatory Approach, Phase 2	L. Heng
Mali	MLI7003	Assessing Erosion, Sedimentation and Water Resources in River Basins by Using Isotope Techniques	L. Mabit
Mozambique	MOZ5004	Improving Nitrogen and Water Use Efficiency of Maize Varieties in Conservation Agriculture under Smallholder Farming Systems	M. Zaman and G. Dercon
Myanmar	MYA5020	Strengthening Food Security through Yield Improvement of Local Rice Varieties with Induced Mutation (Phase II)	M. Zaman in collaboration with Plant Breeding and Genetics Section
Myanmar	MYA5023	Evaluating Nitrogen Use Efficiency Using Low Nitrogen Tolerant Rice Varieties	K. Sakadevan
Myanmar	MYA5025	Monitoring and Assessment of Watershed Management Practices on Water Quality and Sedimentation Rate of Inle Lake	L. Heng and M. Zaman
Namibia	NAM5012	Developing High Yielding and Drought Tolerant Crops through Mutation Breeding	L. Heng in collaboration with Plant Breeding and Genetics Section

Country/Region	TC Project	Description	Technical Officer(s)
Nicaragua	NIC5009	Introducing Integrated Environmental Management in the Watershed of the Nicaraguan Great Lakes and the San Juan River: Responding to Future Challenges with Nuclear Techniques	K. Sakadevan
Philippines	PHI5032	To improve the water and land quality in Typhoon Haiyan- devastated areas using nuclear-based and isotope techniques in a monitored natural attenuation cleanup strategy.	L. Heng
Africa	RAF5063	Supporting Innovative Conservation Agriculture Practices to Combat Land Degradation and Enhance Soil Productivity for Improved Food Security	L. Mabit
Africa	RAF5071	Enhancing Crop Nutrition and Soil and Water Management and Technology Transfer in Irrigated Systems for Increased Food Production and Income Generation (AFRA)	L. Heng
Asia	RAS5055	Improving Soil Fertility, Land Productivity and Land Degradation Mitigation	M. Zaman
Asia	RAS5056	Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
Asia	RAS5064	Enhancing Productivity of Locally Underused Crops through Dissemination of Mutated Germplasm and Evaluation of Soil, Nutrient and Water Management Practices	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
Asia	RAS5065	Climate Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications	L. Heng in collaboration with Plant Breeding and Genetics Section
Asia	RAS5068	Developing Effective Practices for Combating Desertification (ARASIA)	M. Zaman
Asia	RAS5069	Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia	L. Heng and K. Sakadevan in collaboration with Plant Breeding and Genetics, Animal Production and Health and Isotope Hydrology Sections
Latin America	RLA5064	Strengthening Soil and Water Conservation Strategies at the Landscape Level by Using Innovative Radio and Stable Isotope and Related Techniques (ARCAL CXL)	G. Dercon
Latin America	RLA5065	Improving Agricultural Production Systems Through Resource Use Efficiency (ARCAL CXXXVI)	K. Sakadevan

Country/Region	TC Project	Description	Technical Officer(s)
Senegal	SEN5034	Using an Integrated Approach to Develop Sustainable Agriculture in a Context of Degrading Soil Fertility, Climate Change and Crop Diversification	G. Dercon in collaboration with Plant Breeding and Genetics Section
Seychelles	SEY5007	Increasing Crop Production through Effective Management of Soil Salinity in the Coastal Area using Nuclear and Related Techniques	L. Heng
Sudan	SUD5033	Enhancing Productivity of Major Food Crops (Sorghum, Wheat, Groundnut and Tomato) under Stress Environment Using Nuclear Techniques and Related Biotechnologies to Ensure Sustainable Food Security and Well-being of Farmers	L. Heng in collaboration with Plant Breeding and Genetics Section
Thailand	THA5051	Evaluating Soil Erosion-Deposition and Soil Quality using Isotopic and Nuclear Techniques in Agricultural Areas Affected by Flooding	M. Zaman
Thailand	THA5054	Increasing Adaptability for Adverse Environment Tolerance in Rice Germplasm Using Nuclear Techniques	K. Sakadevan
Thailand	THA5055	Using Isotope Tracer and Fingerprint Techniques for the Assessment of Sediment Processes	M. Zaman
Yemen	YEM5013	Evaluating Selected Wheat Varieties for Greater Agronomic Characteristics Using Carbon Isotope Discrimination and Improved Soil and Water Management	A. Wahbi
Democratic Republic of Congo	ZAI5020	Assessing and Improving the Assimilability of Natural Phosphates Composted with Organic Matter in Marginal Soils through the Use of Isotope and Nuclear Techniques for Improved Crop Nutrition	M. Zaman and G. Dercon
Zambia	ZAM5029	Evaluating the Impact of Nitrogen and Water Use Efficiency in Upland Rice	K. Sakadevan
Zimbabwe	ZIM5015	Developing Drought Tolerant and Disease/Pest Resistant Grain Legume Varieties with Enhanced Nutritional Content Using Mutation Breeding and Novel Techniques, Phase II	L. Heng in collaboration with Plant Breeding and Genetics Section
Zimbabwe	ZIM5020	Optimizing Water Use and Soil Productivity for Increased Food Security in Drylands (Phase II)	L. Heng

Forthcoming Events

FAO/IAEA Events

RAS5065: Regional Training Course on mutation breeding, nutrient and farm management strategies; AquaCrop model to improve crop-water productivity, 6–24 July 2015, Los Baños, Philippines.

Technical Officer: Lee Heng

This training course will include the use of nuclear techniques in mutation breeding; nitrogen-15 for nitrogen fertilizer use efficiency and nitrous oxide emission under flooded rice conditions; FAO's AquaCrop model for improving crop-water productivity. It also aims to promote collaborative networks for advanced mutation breeding and best fit soil and water management practices.

RAS5055: Regional Training course (RTC) on integrated soil conservation practices to mitigate soil erosion and the role of Nuclear Technique 27 – 31 July 2015, Colombo, Sri Lanka.

Technical Officers: Mohammad Zaman

The purpose of this one-week regional training course is to provide advanced knowledge and skills on the use of compound-specific stable isotope (CSSI) technique to identify hot spot of land degradation on a catchment basis as well as to place integrated precision soil conservation strategies to reduce soil erosion.

RLA5065: Regional Training Course on the Application of Isotopic and Nuclear Techniques for Quantifying Biological Nitrogen Fixation (BNF) and Nitrogen Use Efficiency in Legume Based Cropping Systems, 3-14 August 2015, Rio De Janeiro, Brazil.

Technical Officer: Karuppan Sakadevan

This training course focuses on the application of isotopic techniques for quantifying BNF and NUE in legume based cropping systems across Latin America and will target professional scientists and technical personnel from across the region. This training course will be held under the Technical Cooperation Project RLA5065 on "Improving Agricultural Production Systems through Resource Use Efficiency".

D15015: 2nd RCM of CRP D15015 on nuclear emergency response in food and agriculture, 28 September – 2 October 2015, Koriyama - Miharu, Japan.

Technical Officer: Gerd Dercon

To conduct the second research coordination meeting (RCM) of CRP D15015 on nuclear emergency response in food and agriculture.

RAF5063: Regional Training Course on Fallout Radionuclides Data Treatment and Interpretation with Special Focus on the Cs-137 Technique for Assessing Soil Degradation, 28 September – 9 October 2015, Rabat, Morocco.

Technical Officer: Lionel Mabit

The main duty of the TO at this training course is to provide advices and supports to the training participants to improve their understanding/interpretation of their own fallout-radionuclide data set collected in the frame of RAF5063.

RAS5064: Final technical meeting of the Technical Cooperation Project of RAS5064 on "Enhancing Productivity of Locally-underused Crops through Dissemination of Mutated Germplasm and Evaluation of Soil, Nutrient and Water Management Practices", 19-23 October 2015, Beijing, China.

Technical Officer: Karuppan Sakadevan

The objective of the meeting is to discuss results obtained from field studies, finalize the project outputs and develop possible success stories from the project.

RAF5071: Regional Training Course of RAF5071 project on Evapotranspiration Partitioning and the Use of Aquacrop Model for Improving Crop Water Productivity, 19-24 October 2015, Rabat, Morocco.

Technical Officer: Lee Heng

This training course focuses on the application of isotopic techniques for quantifying BNF and NUE in legume based cropping systems across Latin America and will target professional scientists and technical personnel from across the region. This training course will be held under the Technical Cooperation Project RLA5065 on "Improving Agricultural Production Systems through Resource Use Efficiency".

RAS5055: Field demonstration visit on conservation agriculture practices for key stakeholders and decision makers under Regional Technical Cooperation Project RAS 5055, 1-2 November 2015, Dalat, Viet Nam.

Technical Officer: Mohammad Zaman

The site demonstration visit aims to provide an opportunity for key stakeholders and decision makers to see the benefit of using nuclear techniques in measuring and identifying soil erosion rates followed by placing

mitigating technologies to reduce land losses through erosion.

RAS5055: Final technical meeting of the Regional Technical Cooperation project RAS 5055 on "Improving Soil Fertility, Land Productivity and Land Degradation Mitigation" 4-6 November 2015, Kuala Lumpur, Malaysia.

Technical Officer: Mohammad Zaman

The final meeting aims to wrap up project progress, achieved outputs, and lessons learnt. The meeting also aim to discuss and develop strategies for disseminating information to land users, key stakeholders and decision makers on measuring soil erosion using fallout radionuclides (FRNs) and identifying its exact source via compound specific stable isotopes (CSSI), use of FRNs and CSSI data base for future erosion studies and modelling, and mitigation measures to reduce soil erosion for sustainable land use.

RAS5065: Final technical meeting of the Technical Cooperation Project of RAS5065 on "Climate Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications", 14-18 December 2015, Dalat, Vietnam.

Technical Officer: Lee Heng

The objective of the meeting is to evaluate results obtained, develop success stories and achievements, wrap up the project and discuss the new phase of the project.

Non-FAO/IAEA Events

7th International Symposium of Interactions of Soil Minerals with Organic Components and Microorganisms, McGill University, 5-10 July 2015, Montréal, Québec, Canada.

Web site:
http://ismom2015.conference.mcgill.ca/index0f50.html

International Soil Conference on Sustainable Uses of Soil in Harmony with Food Security, 17-20 August 2015, Phetchaburi, Thailand.

Web site:
http://www.ldd.go.th/WEB_ISC2015/Index.html

Wageningen Soil Conference: Soil Science in a Changing World, 23-27 August 2015, Wageningen, the Netherlands.

Web site:
http://www.wageningenur.nl/en/Research-Results/Projects-and-programmes/Wageningen-Soil-Conference.htm

5th International Symposium on Soil Organic Matter 2015, 20-24 September, 2015, Göttingen, Germany.

Web site: http://www.som2015.org/

International Interdisciplinary Conference on Land Use and Water Quality: Agricultural Production and Environment, 21-24 September, 2015, Vienna, Austria.

Web site: http://web.natur.cuni.cz/luwq2015/

Soil Functions and Climate Change - do we underestimate the consequences of new disequilibria in soil properties? 23-26 September 2015, Kiel, Germany.

Web site: http://www.soils.uni-kiel.de/de/sustain-2015

2nd International Conference on Global Food Security, 11-14 October 2015, Ithaca, New York, USA.

Web site: http://www.globalfoodsecurityconference.com/

The American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America International Annual Meeting on "Synergy in Science: Partnering for Solutions," 15-18 November 2015, Minneapolis, MN, USA.

Web site: https://www.acsmeetings.org/

7th International Nitrogen Initiative Conference, 4-8 December 2016, Melbourne, Australia.

Web site: http://www.ini2016.com/

Past Events

Meetings at the IAEA

Consultancy Meeting on Soil and water conservation for climate change adaptation in agricultural uplands, 8 to 12 December 2014, Vienna, Austria

Technical Officers: Lionel Mabit and Lee Heng

A consultancy meeting was held from 8 to 12 December 2014 at the IAEA's Headquarters in Vienna to develop a new Coordinated Research Project (CRP) on *Soil and Water Conservation for Climate Change Adaptation in Agricultural Uplands*. Four consultants from Austria, New Zealand, UK and USA attended the meeting.

Participants of the Consultancy Meeting on Soil and Water Conservation for Climate Change Adaptation in Agricultural Uplands (IAEA Headquarters, Vienna)

Upland agro-systems - defined as the less favoured higher altitude environments including areas with low soil quality and/or limited access to water - will face three major challenges related to food security and climate change in the coming decades: (1) increasing food production while enhancing soil fertility and improving water use efficiency, (2) adapting to climate change impact on soil and water resources, and (3) contributing to climate change mitigation.

A new CRP is currently being developed to (i) identify and test combinations of nuclear and conventional techniques to assess the impacts of changes occurring in upland agro-ecosystems, (ii) distinguish and apportion the impact of climate variability and agricultural management on soil and water resources in uplands, and (iii) support adaptive agricultural management for soil and water conservation in uplands to reduce impacts of climate variability. Nuclear techniques including fallout radionuclides (FRNs) such as caesium-137 (^{137}Cs), lead-210 (^{210}Pb), beryllium-7 (^{7}Be) and potentially plutonium-239 and 240 ($^{239+240}$Pu), Compound-Specific Stable Isotope (CSSI) techniques based on the measurement of carbon-13 (^{13}C) natural abundance signatures of specific organic compounds (i.e. fatty acid), Cosmic Ray Soil Moisture Neutron Probe (CRNP) will be used to fulfil these specific objectives.

If successful, the CRP is aimed to start in 2016 with project proposal opened for application at the end of 2015.

Training Course on Nitrogen Management, 4–15 May 2015, Seibersdorf, Austria

Technical Officers: Christoph Müller, Mohammad Zaman, Karuppan Sakadevan, Gerd Dercon, Christian Resch, Maria Heiling and Renato Winkler

The two-week training course on nitrogen (N) management and greenhouse gas emissions under the Regional Project RAS5068 "Developing Effective Practices for Combating Desertification (ARASIA)" was held at the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) from 4 to 15 May 2015, Seibersdorf, Austria. The aim of the training was to provide knowledge and practical training on the use and application of isotopic technique of ^{15}N for developing effective soil and fertilizer management and cropping practices to address issues of low fertilizer use efficiency, biological N fixation, as well as measuring and mitigating greenhouse gas emissions including nitrous oxide (N_2O), methane (CH_4) and carbon di oxide (CO_2) to the atmosphere. During the first week of the training, Mr Christoph Müller and Mr Renato Winkler provided lectures and practical training on greenhouse gas emissions measurements.

Participants of the nitrogen management course of RAS 5068.

During the second week, Mohammad Zaman, Gerd Dercon, Karuppan Sakadevan, Christian Resch, and Maria Heiling provided lectures and practical training in the field as well as in the laboratory on N management, measuring N use efficiency and biological N fixation using ^{15}N technique, case study and practical demonstration. The training was attended by 15 scientists and technical personnel from ARASIA (Iraq, Jordan, Lebanon, Oman, Saudi Arabia, Syria and UAE). A competency test at the end of the training activity gave the organizers an opportunity to assess the effectiveness of the training course. Feedback from the participants showed that this regional training course helped the participants to improve their technical capacity in N management in agricultural production systems.

Duty Travel

France: To participate in the post-2015 Sustainable Development Goals (SDGs) workshop for food security and the environment, 15 January 2015, Paris, France.

Technical Officer: Lee Heng

The Technical Officer travelled to Paris to participate in the post-2015 Sustainable Development Goals (SDGs) workshop for food security and the environment, at the request of the ADG of FAO AG Department, on behalf of FAO. The SDG workshop was jointly hosted by the International Fertilizer Industry Association (IFA) and the Sustainable Development Solutions Network (SDSN) to engage major organizations currently working on nutrient indicators to exchange information, share perspectives, and build consensus. The workshop discussed indicators for the Sustainable Development Goals (SDGs) relating to agriculture and nitrogen use in particular, with a view towards having a practical and measurable set of targets and indicators, as well as means of monitoring. A series of presentations on Goal 2 of the SDGs on 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture' was discussed together with indicators on crop nitrogen use efficiency and on excessive loss of reactive nitrogen and phosphorus, to the environment. The group discussed the definition of indicators which is essentially a set of management tools which require a clear monitoring framework for the SDG. The SDSN and the International Fertilizer Association brought together international and regional organizations, industry, and the scientific community to refine these two indicators. Consensus need to be clearly defined by September 2015.

On the topic of monitoring, the issues of data availability and gaps, novel data collection and monitoring tools and which agencies should lead the monitoring were discussed, these include data on fertilizer at sub-national, crop level, information on manure recycling, amount of biological nitrogen fixation (BNF) for different crops in different regions. The current and past work of the Joint Division in many parts of the world on BNF can be part of the statistics.

Costa Rica: To review the project progress and fine tune the work plan for different project activities including field experimental design for measuring greenhouse gases for the national TC project (COS 5031), 19-23 January 2015, San José, Costa Rica.

Technical Officer: Mohammad Zaman

The Technical Officer travelled to San José, Costa Rica to discuss project activities with the counterpart (CP), Ana Gabriela Pérez and her sub-team members from University of Costa Rica. During the meeting, the project team and the Technical Officer discussed project achievements (refinement of greenhouse gas measurements from pineapples and dairy using different chambers) since 2014 and future work plan including (a) revised work plan for 2015, (b) experimental design of the field trials, greenhouse gas (GHG) measurements and data collection, (c) the two protocols that the Technical Officer wrote for measuring GHGs (d) procurement of equipment for measuring carbon dioxide, methane and their isotopic signatures, and (e) provision of expert technical advice and (f) interpretation of data from ongoing field trials.

The Technical Officer and the project counterpart developed detailed work plan for 2015, designed and set up field trials on a dairy farm near San José on mitigating greenhouse gas emissions. The Technical Officer briefed the country National Liaison Officer (NLO) over the phone about previous and future project activities. To provide additional information, knowledge and understanding on using conventional and nuclear techniques for quantifying GHG, identifying their sources in soil and applying possible mitigation options, the Technical Officer gave two presentations to the CP team members followed by detailed discussion.

Bangladesh: To organize the regional workshop on "Disseminating improved soil, water and crop management technologies and practices to farmers" under the regional technical cooperation project RAS5/064 on Enhancing Productivity of Locally-underused Crops through Dissemination of Mutated Germplasm and Evaluation of Soil, Nutrient and Water Management Practices, 9-13 February 2015, Dhaka, Bangladesh.

Technical Officer: Karuppan Sakadevan

The purpose of the duty travel was to organize the extension workshop to discuss (1) soil, water and crop management technologies and practices implemented in participating countries through field studies, and (2) dissemination approaches for effectively transferring soil, water and crop management technologies to farmers. National counterparts from Bangladesh, Cambodia, China, Indonesia, Malaysia, Myanmar, Sri Lanka and Thailand attended the workshop. Mongolia and Nepal that were not part of the project RAS5/064 were also participated in the workshop for enhancing their capacity on agricultural extension. The extension workshop was jointly organized with the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensing and the International Atomic Energy Agency. Mr Monowar Karim Khan, Director of Research, BINA and local coordinator.

Extension participants attended the workshop

Mr A. H. M. Razzaque, Director General, BINA provided the welcome remarks and highlighted the importance of extension for adopting technologies and practices that can improve productivity and sustainability of agricultural systems. The first three days (9-11 February 2015) of the workshop were focused on the presentation of activities carried out in Member States related to the use of improved crop varieties and soil and water management practices. The last two days of the workshop were focused on group discussions and identification of approaches for disseminating improved soil, crop, water management practices and technologies to farmers. As part of the workshop, the participants were separated into three groups to discuss and identify important soil, water, crop and land management practices and technologies to be included in research and development dissemination to farmers. The participants had an opportunity to share and discuss the current soil, water and crop management technologies and practices in their respective countries. The group discussion include: (1) Identifying and distributing improved crop varieties that are tolerant to specific biotic and abiotic stresses, (2) fertilizer and animal manure application (rate, timing and placement), tillage practices (conservation or no tillage) and appropriate bed system, (3) drip irrigation based on soil water content, spacing and plant growth stage (early seedling, tiller formation, flowering and crop maturity), and furrow irrigation, and (4) Conservation agricultural practices that include rotation, intercropping, legumes, and introduction of tree crops.

The workshop provided an opportunity to share information between participants on current soil, water and crop management practices and extension services in Member States.

UAE: Coordination Meeting to review project progress on RAS5068 "Developing Effective Practices for Combating Desertification" and to design new proposed TC project RAS2014048 for 2016-2017, 15-19 February 2015, Dubai, UAE.

Technical Officer: Mohammad Zaman

The Technical Officer, together with the Project Management Officer (PMO), Mrs. Petra Salame, travelled to Dubai, UAE to organize a coordination meeting at the International Centre for Bio-saline Agriculture (ICBA) to review project progress of the Regional Technical Cooperation (TC) Project "RAS 5068" and to design a new regional TC RAS 2014048 for 2016-2017. The RAS 5068 was started in January 2014 with the major aim to develop effective soil and water management and cropping practices for combating desertification caused by soil salinity, low productivity and water shortages.

The meeting was attended by project participants from seven countries (Iraq, Jordan, Lebanon, Oman, Syrian Arab Republic, United Arab Emirates (Lead Country Coordinator) and Yemen). The lead country coordinator welcomed the participants and presented a brief overview of ARASIA history and program related to food and agriculture.

The Technical Officer and the Project Management Officer described the objectives of the coordination meeting, budget, priorities and project progress of RAS 5068 made since 2014. The Technical Officer gave a presentation, highlighting the role of isotopic and nuclear techniques in studying land degradation, salinization and nutrient and water management. Each project participants presented their individual results, available infrastructure, challenges, needs, local and regional networking developed under RAS 5068 project. The Technical Officer also had discussion with individual project team member to provide feedback on the results obtained since 2014. The Technical Officer and the project counterpart developed detailed work plan for 2015 field trials. Provision of salt tolerant crop varieties for these trials was identified as one of the major need and the Lead Country Coordinator agreed to provide salt tolerant crop seed to each counterpart for free.

During the last two days of the meeting, the Technical Officer and the project team members designed the new RAS 2014048 project by linking its activities with the ongoing RAS 5068 project. A field visit to ICBA farm

was organized by the Lead Country Coordinator to see and discuss different field trials on mitigating salinity using salt tolerant crops, improved methods of irrigation scheduling, nutrient application and management practices.

Mexico: To organize the third research coordination meeting (RCM) of the coordinated research project (CRP) D1.50.13 on "Approaches to improvement of crop genotypes with high water and nutrient use efficiency for water scarce environment, 9-13 March 2015, Mexico City, Mexico.

Technical Officer: Karuppan Sakadevan

The Technical Officer as scientific secretary was in Mexico City, Mexico to organize the third RCM of the project and discussed with the counterparts on the progress of the country projects. The focus of the meeting was to (1) discuss and analyse information collected from field studies in relation to evaluating a number of improved crop varieties (rice, soybean, wheat, pseudo cereals, potato and barley) tolerant to drought, salinity, soil acidity, disease, and extreme temperatures to water and fertilizer management practices under existing soil and climate conditions, and (2) refine the work plan to meet the objectives of the CRP. Twelve researchers from China, Indonesia, Kenya, Malaysia, Mexico, Pakistan, Peru, Uganda and Vietnam participating in the CRP attended the meeting.

The first two days were focused on the presentation of data and information obtained from field studies carried out by counterparts to evaluate the performance of improved varieties of a number of crops (rice, soybean, wheat, pseudo cereals, barley, quinoa, potato) for yield, nutrient and water use efficiencies. On the third day, the participant had an opportunity to visit the International Maize and Wheat Improvement Centre (CIMMYT) and discussed with scientists on crop improvements and conservation agricultural programs for enhancing maize and wheat yields. The last two days were focused on discussing the activities for 2015-2016. Each counterpart presented with a refined work plan and technical support and guidance were provided to each counterpart by other participants to finalize the work plan.

The role of isotopic and nuclear techniques for quantifying water and nutrient use efficiencies was emphasized during the meeting and counterparts were keen to use these techniques over the next eighteen months.

The Technical Officer also attended the 3rd UNCCD Scientific Conference on "Combating desertification/land degradation and drought for poverty reduction and sustainable development: the contribution of science, technology, traditional knowledge and practices" on 10 March 2015. As part of the scientific conference, the Technical Officer jointly with the UNCCD organized the side event on "The importance of quantitative soil erosion data: How isotopic techniques can provide evidence for combating desertification and climate change".

Extension workshop of RAS5064 in Dhaka, Bangladesh

Italy: To visit the Joint Research Centre, European Commission, 25-26 March 2015, Ispra, Italy.

Technical Officer: Gerd Dercon

The Technical Officer travelled to Ispra, Italy, to visit, on behalf of the Joint FAO/IAEA Division and the Department of Nuclear Sciences and Applications, the Joint Research Centre of the European Commission in Ispra. As follow-up on the high level IAEA/NA-JRC meeting (23 January 2015), this visit aimed at discussing, at a technical level, possible collaboration in the fields of soil management, and nuclear emergency response in food and agriculture. Contacts were established with the groups of Nuclear Security Unit and Land Resource Management / Soil Action Unit, and possible joint activities were identified.

Bangladesh: To review project work plan and identify study and experimental priorities, for the Technical Cooperation (TC) project BGD5029 (2015-17) on "Evaluating Promising Abiotic Stress Tolerant Crop Mutants/Varieties and Measuring the Suitable Management Practices for the Promotion of Sustainable Production at Saline, Submergence and Drought Prone Areas", 4-9 April 2015, Mymensingh, Bangladesh.

Technical Officer: Ammar Wahbi

The Technical Officer started his visit to the BINA headquarters in Mymensingh, Bangladesh (north of Dhaka) by meeting with Dr. Asgar Ali Sarkar, Director, Administration and Support Service. The following presentations were then held:
BINA at a glance (Dr. Asgar Ali Sarkar, Director of Administration and Support Service)

Biotechnology (Dr. Mirza Moffazzal Islam, Head, Biotechnology Division)
Plant Breeding (Dr. Md. Abul Kalam Azad, Plant Breeding Division)
Soil Science (Dr. Md. Monowar Karim Khan, Head, Soil Science Division)
Agronomy (Dr. Md. Monjurul Islam, Head, Agronomy Division)
Agricultural Engineering (Dr. Md. Hossain Ali, Head, Agricultural Engineering Division)
Crop Physiology (Dr. Md. Tariqul Islam, Head, Crop Physiology Division)
A soil and bio-technology laboratory tour was conducted and a meeting with senior scientists also held to discuss the work plan of the project.

A field visit was also organized to the BINA research station in Mymensingh to see the different experiments. The work plan was further discussed and refined. The work plan emphasizes on soil water and nutrients management in the saline, dry and flooded areas. Also, socio-economic studies will be initiated to assess the adoption and impact of technology transfer.

Field interaction with farmers in Bangladesh

By the end of the duty travel, the TO visited the Bangladesh Atomic Energy Commission (BAEC), Dhaka to meet and brief the national liaison officer (Dr. Kanai Lal Chakrabarti) and national liaison assistant (Dr. Md. Khairul Islam) about the mission. They were interested to hear about the mission and expressed their thanks to IAEA for continued technical support to Bangladesh.

Haiti: To undertake feasibility study for assessing the counterpart capacity to implement Technical Cooperation (TC) projects in Food and Agriculture and develop the TC project design on "Increasing agriculture sector productivity and exportability through soil and water management and food safety", 4-8 May 2015, Port au Prince, Haiti.

Technical Officer: Karuppan Sakadevan

The Technical Officer along with Mr Johannes Corley from Food and Environment Section and Ms Geraldine Arias from TC Latin America Division (the team) visited Port Au Prince to assess the capacity of the counterpart organization to implement a new Technical Cooperation project to be developed for the biennium 2016-2017. The Government of Haiti submitted two project designs in food and agriculture through the Ministere de l'Agriculture, des Ressources Naturelles et du Développement Rural (MARNDR) in areas of soil and water management and food safety. During the evaluation of these two projects it was decided to have a country mission to discuss with counterpart institutions to better define the objectives and to assess the institutional capacity (human and infrastructure) for implementing these projects.

As the country is slowly recovering from the 2010 earthquake, the institutional capacity is still very weak. The soil and water laboratory within the Faculty of Agronomy, University of Haiti has been destroyed. However, the government is committed to build the Faculty and its associated laboratory facilities as funding sources have been identified. In addition, a soil and water laboratory will be built in Tamarinier within the next ten months and will be used for soil and water analysis.

Discussions with various stakeholders involved in agricultural sector were held to identify partnership and to ensure the sustainability of the project. These include (1) FAO country Representative in Haiti, (2) Deputy Special Representative of the UN Secretary General, (3) The Minister for Agriculture, Government of Haiti, (4) The Director General of MARNDR, and (5) the Inter-American Development Bank Agricultural Sector Specialist.

Stakeholder discussion at the UNDP Haiti Country Office

The project design was developed in consultation with the counterpart during the last two days of the visit. It was decided to integrate both soil and water management and food safety into one project with separate outputs, activities and inputs. The soil and water component involves developing improved soil, water and crop management practices for enhancing crop production, quality and fertility of soil in rice-based cropping systems (rice-beans-sweet potato). A detailed logical framework matrix was developed identifying clearly the design

elements and their respective indicators, verification and assumptions. The project design has been uploaded into PCMF.

Zimbabwe: **Third Research Coordination Meeting (RCM) of the CRP (D1.50.12) on Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-based Cropping Systems in Sub-Saharan Africa, 4 –8 May 2015, Harare, Zimbabwe.**

Technical Officer: Mohammad Zaman

The Technical Officer as Scientific Secretary travelled to Harare, Zimbabwe for organizing the third RCM of the CRP D1.50.12 on "Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-based Cropping Systems in Sub-Saharan Africa". The CRP started in 2012 with the aim to improve the livelihoods of farmers with low socio-economic development and rural communities in Sub-Saharan Africa through restoration of degraded soils and ecosystems and development of productive and resilient agricultural systems. The RCM was hosted by the Ministry of Agriculture, Mechanization and Irrigation Development Harare, Zimbabwe with Mr Chikwari Emmanuel as local coordinator. In addition to our counterpart from Zimbabwe and his two researchers, six research contract holders from Benin, Kenya, Madagascar, Mauritius, Mozambique and Pakistan attended the meeting to review each participant's project progress to ensure the accomplishment of the CRP objective. The Technical Officer presented the objectives of the CRP and the work plan developed during the second RCM. During the five-day meeting, each CRP research contract holder presented results obtained since the 2nd RCM held in Antananarivo, Madagascar, from 14 to 18 October 2013, followed by feedback from the meeting participants. The three year results indicated that liming corrected low soil pH which was causing aluminum toxicity and phosphorus fixation. Co-application of mulch and N fertilizer has the most potential to conserve soil moisture and nutrients which led to significant increase in crop productivity; while no such effect was observed when mulch was applied at lower rate (<30% of surface cover). The Technical Officer also assisted project participants in designing the forthcoming ^{15}N labelled urea experiment to study nitrogen use efficiency under mulch based cropping system.

All participants visited laboratories at the Ministry of Agriculture, which provide analytical and farm advisory services to farmers in Zimbabwe, followed by a field visit outside Harare on mulching in maize cropping system. It was agreed that each research contract holder will submit one draft manuscript to the Technical Officer by September, 2015.

Participants of the CRP D1.5012 during a field visit in Harare, Zimbabwe.

Myanmar: To discuss work plan and develop new activities under MYA5025 Monitoring and Assessment of Watershed Management Practices on Water Quality and Sedimentation Rate of Inle Lake, 11-15 May 2015, Nay Pyi Taw and Inle Lake, Myanmar

Technical Officer: Lee Heng

The Technical officer (TO) travelled to Myanmar to discuss the work plan, develop activities and identify constraints for project implementation for the new national Technical Cooperation project MYA5025. The project started in 2015 and the objective was to improve the monitoring and verification of water quality and sedimentation of Inle Lake through capacity-building on the use and application of isotopic techniques. The technical officer met Dr Khin Maung Latt, Director General, Department of Atomic Energy, Ministry of Science and Technology in Nay Pyi Taw, who emphasized the importance of this project as water quality and sedimentation in Inle Lake is a national concern. The technical officer also met Ms Theingi Maung Maung, Deputy Director, Department of Atomic Energy, and Dr Boni, Director of Watershed Management Division in the Forest Department, Ministry of Environmental Conservation and Forestry. The technical officer gave a presentation on the use of nuclear and isotopic techniques for water, nutrient and sediment/erosion management to some thirty staff in the Department of Agriculture and Forest Research Institute.

Together with project counterpart Ms Cho Cho Win from Forest Research Institute, the technical officer flew from Nay Pyi Taw to Inle Lake to study the situation around the lake, and held talks with staff from the Forest Department in the Inle Lake region to better understand the problem of sedimentation and soil erosion. Deforestation, shifting cultivation practices, intensive cropping and vegetable cultivation on hillslopes contributed to the erosion and sedimentation in the Lake.

On the other hand, floating gardens and the heavy use of fertilizers and pesticides, manufacturing (textile weaving and silver ware), tourism hotels built on the lake, contributed to water quality problems. Together with the counterpart and the staff, the outline of the field sampling campaign for an expert mission was planned.

The technical officer took the opportunity to discuss project results of the Regional Technical Cooperation project RAS5065 on Supporting Climate-Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications. Three project counterparts from Mandalay came to attend the presentation and discussed their work on alternate wetting and drying and nutrient management using nitrogen-15 technique. The technical officer also met and discussed with Dr Su Su Win, from Soil Science, Water Utilization and Agricultural Engineering Division, Department of Agricultural Research, the counterpart of the national project MYA5023 on Evaluating Nitrogen Use Efficiency Using Low Nitrogen Tolerant Rice Varieties. Together, the work plan was reviewed and all activities for 2015 agreed and being implemented.

Inle Lake, Myanmar

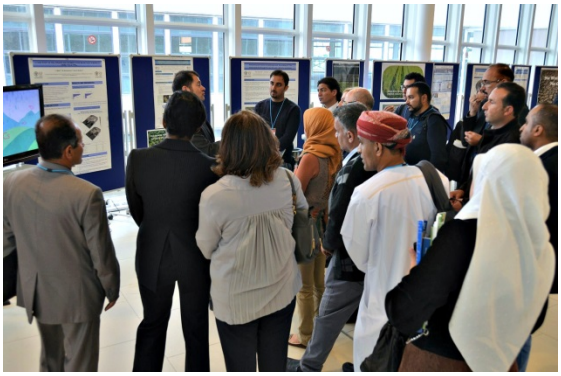
Italy: To attend the AquaCrop core group meeting in the FAO Headquarters in Rome, 25-27 May 2015, Rome, Italy.

Technical Officer: Lee Heng

The Technical Officer (TO) travelled to FAO HQ in Rome to attend the AquaCrop model (http://www.fao.org/nr/water/aquacrop.html) core-group meeting. The group consists of five experts from FAO, Belgium, Spain, USA and IAEA. The purpose of the meeting was to discuss and review new features and updates, new training materials and other technical matters since the group met three years ago. The Deputy Director of Land & Water Division Mr Olcay Unver opened the meeting to welcome the group to FAO. The group then presented an update on model performance, crop calibration and reviewed the recently released new version incorporating Geographic Information System (GIS), which made it possible to perform spatial analysis of the simulation results. Also discussed was the possible linkage with Landsat satellite remote sensing images for regional crop response to water. In addition, the group discussed some misuses of the AquaCrop as it is a relatively easy to use the model, where users did not fully understand the limit of its application (e.g. AquaCrop is not meant for tree crops). The meeting therefore discussed measures to guide users to minimize these misuses. Several proposals include warnings on user interface, written instructions/Web information, different training manual & exercises and training of trainers. The meeting concluded with follow-up decisions and future work plan with distribution of work among the five expert groups. The Director of Land & Water Division Mr Moujahed Achouri joined the last part of the discussion.

Celebrating Global Soil Week 2015

As part of the International Year of Soils 2015, the SWMCN Subprogramme celebrated the Global Soil Week on 7-8 April 2015 with an exhibition at the IAEA HQ to increase awareness of the importance of soil. The event was well attended as shown in the photos below.



Scientific Visitors

- Mr. Geoffrey Shaw, Representative of the IAEA Director General to the United Nations, New York visited the SWMCN Section on 15 January 2015, to understand and better communicate the work of SWMCN to wider UN System in New York. The SWMCN team presented our work relating to the commemoration of World Soil Day as well our work on land degradation and on the use of nuclear techniques to improve soil fertility.

- Ms. Suad A. A. Al-Saedi from Iraq is currently being trained at the SWMCN Laboratory for six months (Feb-August 2015) to develop high-throughput technique for assessing biological nitrogen fixation from wild and mutated rhizobium strains from Iraq. Ms. Saud will be supervised by Maria Heiling, Gerd Dercon and Ammar Wahbi, in collaboration with the Plant Breeding and Genetics Laboratory.

- Mr. Ibrahim Abdulrazzaq, Director General of the Agricultural Research Directorate, Ministry of Science and Technology, Iraq visited the SWNCN Laboratory from 16 to 20 March 2015 to discuss work plan of TC project IRQ5019 with Technical officer Mr. Ammar Wahbi.

- Mr. Trenton Franz, University of Nebraska-Lincoln, USA visited the SWMCN Section on 14-15 April 2015 to discuss the work on Cosmic Ray Neutron Probe with Mr. Ammar Wahbi.

- Mr. Sigbert Huber, Head of Department, Soil & Land Management, Environment Agency Austria, and the Secretariat of the International Union of Soil Sciences, visited the SWMCN Section on 20 May 2015, on co-hosting the international event on 7 December 2015 as part of the celebration of the International Year of Soils.

- Mr. Winfried E.H. Blum, Prof. at the University of Natural Resources and Life Sciences (BOKU), visited the SWMCN Section on 20 May 2015 with Mr. Sigbert Huber, to discuss co-hosting the international event on 7 December 2015 as part of the celebration of the International Year of Soils.

- Mr. Grzegorz Skrzypek, ARC Future Fellow, West Australian Biogeochemistry Centre, John de Laeter Centre of Mass Spectrometry, School of Plant Biology, The University of Western Australia, Australia on 14 April to SWMCN Section and Laboratory on the manifold developed by SWMCNL for sampling water vapor at multiple heights, and to discuss possible future collaboration.

- Mr Moncef Benmansour from the Centre National de l'Energie, des Sciences et des Techniques Nucléaires (CNESTEN), Morocco visited the Section from 20-24 April 2015 to discuss with the TO and PMO to develop possible success stories, five year action plan and 2015 work plan, and data interpretation and analysis under the regional technical cooperation project RAF5063 with Lionel Mabit.

- Mr Naivo Rabesiranana Institut National des Sciences et Techniques, Antananarivo, Madagascar visited the Section from 20-24 April 2015 to discuss with the TO and PMO to develop possible success stories, five year action plan and 2015 work plan, and data interpretation and analysis under the regional technical cooperation project RAF5063 with Lionel Mabit.

Coordinated Research Projects

Project Number	Ongoing CRPs	Scientific Secretary
D1.20.12	Optimizing Soil, Water and Nutrient Use Efficiency in Integrated Cropping-Livestock Production Systems	Karuppan Sakadevan
D1.20.13	Landscape Salinity and Water Management for Improving Agricultural Productivity	Lee Heng and Karuppan Sakadevan
D1.50.12	Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-Based Cropping Systems in Sub-Saharan Africa	Mohammad Zaman and Gerd Dercon
D1.50.13	Approaches to Improvement of Crop Genotypes with High Water and Nutrient Use Efficiency for Water Scarce Environments	Karuppan Sakadevan and Pierre Lagoda
D1.50.15	Response to Nuclear Emergencies Affecting Food and Agriculture	Gerd Dercon and Lee Heng
D1.50.16	Minimizing Farming Impacts on Climate Change by Enhancing Carbon and Nitrogen Capture and Storage in Agro-Ecosystems	Mohammad Zaman and Lee Heng

Optimizing Soil, Water and Nutrient Use Efficiency in Integrated Cropping-Livestock Production Systems (D1.20.12)

Technical Officer: Karuppan Sakadevan

This project was started in 2013 with the objective of enhancing food security and rural livelihoods by improving resource use efficiency and sustainability of integrated crop-livestock systems under a changing climate. The specific objectives are:

1. optimize water and nutrient use efficiency in integrated crop-livestock production systems,
2. identify the potential for improving soil quality and fertility in integrated crop-livestock systems,
3. assess the influence of crop - livestock systems on GHG emissions, soil carbon sequestration and water quality,
4. assess socio-economic and environmental benefits of crop-livestock systems,
5. strengthen the capacity of Member States to use isotopic and nuclear techniques as tools for improving the management of crop-livestock systems, and
6. develop soil, water and nutrient management options in integrated crop-livestock systems for potential adoption by farmers.

Nine research contract holders from eight countries (Argentina, Brazil (two), China, India, Indonesia, Kenya, Uganda and Uruguay, and three agreement holders from France, Nigeria and United States of America are participating in the project. The Second RCM was held from 17-21 November 2014. The CRP is in its third year.

Key activities carried out during June 2013-December 2014 include:

(1) A comparative assessment of crop and livestock production and soil fertility (nitrogen, phosphorus, pH and organic carbon) of no-tillage summer crops and integrated crop-livestock system (ICLS) in the Pampas
(2) The production performance of the system and greenhouse gas emissions were quantified from integrated cropping livestock systems with different land management practices assessed for Rio Grande do Sul and Parana States in Brazil.
(3) Soil erosion, water and nutrient use efficiency were assessed in the Nanwang Farm, Pucheng, Shaanxi, China for different integrated cropping livestock systems.
(4) Integrated crop-livestock systems that involved rice and forage crops (a legume and grass) were assessed for crop and livestock production and soil quality India.

(5) Rotation trials were established in Indonesia for assessing yield, nutrient content and soil characteristics in integrated crop-livestock production systems in Bogor, Indonesia.
(6) Field trials established in Machakos County in eastern Kenya to select the best crop rotation for crop livestock integration.
(7) Soil characteristics (pH, Soil Organic Matter, nitrogen, potassium, phosphorous and texture), water quality (pH, DO, EC, Turbidity, True color, Apparent color, Alkalinity, TSS, Turbidity, Ca, Mg, Cl, NO_2^- , NO_3^-) and feed quality assessments were carried out in Uganda.
(8) Agronomic and environmental effects of integrated crop-livestock production systems under different tillage practices were assessed in Uruguay.

The research contracts for all projects have been renewed based on project progress reports and renewal proposals in October 2014. Data on yield, nutrient uptake and soil water have been collected from field studies involving improved crop varieties of rice, wheat, barley, quinoa, potato, amaranthus, soybean, and ground nut. The data is currently being analysed and will be presented by counterparts during the third RCM, which will be held in Mexico from 9 to13 March 2015.

Landscape Salinity and Water Management for Improving Agricultural Productivity (D1.20.13)

Technical Officers: Lee Heng and Karuppan Sakadevan

This project started in July 2013 with the aims to: a) identify ways to improve crop productivity and sustainability through water and salinity management, b) define approaches and technologies to assess and monitor soil water content and salinity at field and area-wide scales, and c) reduce impacts of climate change and variability on the widespread increase in landscape salinity. The first RCM was held from 15 to 19 July 2013 in Vienna, Austria with seven research contract holders (Bangladesh, China (two participants), Iran, Pakistan and Vietnam (two participants), two agreement holders (Spain and USA) and two technical contract holders (Czech Republic and USA) participated in the RCM. The second RCM was held in Beijing, China in September 2014 where results from the first year's findings were presented. In the coming months, the research contracts will be due for evaluation and renewal. Both AquaCrop and HYDRUS-1D models are being used to simulate crop yield response to salinity stress. In Bangladesh, good simulation of rice field studies using AquaCrop model was obtained indicating it can be used for assessing the potential impacts of sea-level rise and the consequent increase in water and soil salinity and other climatic parameters on rice yield in the coastal regions of the country. The third RCM is planned for 2016 in Ho-Chi Minh City in Vietnam.

Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-Based Cropping Systems in Sub-Saharan Africa (D1.50.12)

Technical Officers: Mohammad Zaman and Gerd Dercon

This CRP is already in its third year of implementation. The CRP aims to improve the livelihoods of farmers with low socio-economic development and rural communities in Sub-Saharan Africa through restoration of degraded soils and ecosystems and development of productive and resilient agricultural practices. Fifteen participants, with seven research contract holders from Benin, Kenya, Madagascar, Mauritius, Mozambique, Pakistan and Zimbabwe, three technical contract holders from China, the Czech Republic and the United Kingdom, and five agreement holders from Austria, Belgium, Kenya, New Zealand and United States of America attended the first Research Coordination Meeting (RCM) at the IAEA's headquarters in Vienna, Austria, from 30 January to 3 February 2012. The second RCM was held in Antananarivo, Madagascar, from 14 to 18 October 2013. The third RCM was held on 4 to 8 May, 2015 in Harare, Zimbabwe. Key outputs from the CRP include:

1. Overall the three year results from those field trials in Sub-Saharan Africa showed that mulching must cover 30% of the soil surface area to achieve the benefits of conservation agriculture. However, due to subsistence farming, low soil fertility and acidic soil pH, farmers are not able to produce enough biomass to apply them as mulch. Therefore after the correction of soil pH through liming and application of animal manure, co-application of mulch and N fertilizer under no tillage system led to a significant increase in crop productivity, soil water retention, nutrient use and improved soil microbial activity (soil enzymes) and biomass.
2. In Benin, tillage, inoculation and mulching significantly improved soybean nodulation. However, nitrogen fertilization decreased soybean nodulation.
3. In Zimbabwe, minimum tillage under mulching tends to improve soil organic carbon and soil water retention.
4. In Pakistan, co-application of mulch and fertilizer led to a significant improvement in water use efficiency.

Each project participant will submit one draft manuscript for publication in a refereed scientific journal by September, 2015.

The SWMCN Laboratory team has further followed up research activities to support this CRP. Based on samples collected from several long-term experiments in Austria, Belgium, Kenya, Senegal and China a protocol has been

produced to assess soil organic carbon stability using ^{13}C and ^{15}N stable isotope techniques. The three year intensive research and development also resulted into a paper, which has been accepted for publication in the Soil Biology and Biochemistry Journal.

Approaches to Improvement of Crop Genotypes with High Water and Nutrient Use Efficiency for Water Scarce Environments (D1.50.13)

Technical Officers: Karuppan Sakadevan and Pierre Lagoda

The CRP was started in December 2011 and the first RCM was held in Vienna, Austria from 12 to 16 December 2011 followed by the second RCM held in Malaysia from 24 to 28 June. The overall objective of this CRP is to increase crop productivity and food security by developing improved crop varieties and soil, water, nutrient and crop management technologies and making them available to farmers, and ensure their cropping systems are resilient to biotic and abiotic stresses in water scarce environment. The CRP is in its fourth year of implementation. The third RCM was held in Mexico from 9-13 March 2015 and all participants attended the meeting. Nine research contract holders (China, Kenya, Malaysia (two participants), Mexico, Pakistan, Peru, Uganda and Vietnam) and one technical contract holder (Peru) attended the meeting. The research contract holder from Bangladesh and the agreement holder from South Africa did not attend the meeting. The specific objectives are to:

- Increase the productivity of crop varieties tolerant to environmental stresses under existing soil and climatic conditions, and
- Enhance nitrogen and water use efficiencies of crops tolerant to environmental stresses through best practice soil, water, crop and fertilizer management practices.

Key outputs of the CRP until December 2014 include:

(1) Fertilizer and water management practices for ratooning rice cultivar Jiafuzhan was evaluated for yield and fertilizer use efficiency and has been extended to more than 40,000 ha. Results showed that nitrogen application rate 180 kg N/ha, Jiafuzhan had a high yield of 7,650 kg/ha in the first crop and 6,900 kg/ha in the second crop, with a total yield of 14,550 kg/ha;

(2) Three sorghum mutant varieties namely Pahat (ZH-30 mutant line), Samurai 1 (Patir-1 mutant line) and Samurai 2 (Patir-4 mutant line) were evaluated for water and nutrient use efficiency under the existing soil and climatic conditions in Indonesia under rainfed conditions. Results showed that average grain yield increased by approximately 7% when nitrogen fertilizer application increased from 30 to 60 kg N/ha. However, when fertilizer application increased to 90 kg N/ha there was no further yield increase;

(3) Three successive field trials were carried out to evaluate elite potato varieties in the yield at (a) three levels of manure (3, 6 and 10 tons/ha), (b) 10 tons/ha manure in combinations with 30 kg N/ha, and (c) 10 tons of manure in combination with 50 kg P_2O_5/ha. The evaluations were carried out in four locations across Kenya (Molo, Kabianga, Njoro and Marigat). Results showed that application of manure at 10 tons/ha produced the highest yield of potato at 37 tons/ha compared with lower manure application rates. Further, nitrogen fertilizer application at 30 kg N/ha along with 10 tons/ha manure increased yield by 20-30% across the varieties and locations;

(4) Information on yield, water and nutrient use efficiencies of three varieties and one advanced mutant line of barley, and five improved genotypes of quinoa suitable for high altitude which were evaluated in three different locations was provided for Peru. Among the five mutant varieties of barley, the Centenario showed yield stability and good adaptability to different climate conditions. For quinoa, grain yield increased with increased water application (2300 to 3200 kg/ha for water application from 138 to 275 mm);

(5) A series of field studies have been carried out to evaluate and select two improved rice varieties MR219-4 and MR219-9 which are tolerant to aerobic conditions. Results showed that the improved varietyMR219-9 increased grain N uptake by 10% compared to the parent variety (28 vs 25.5 kg N/ha).

(6) Genotypes of quinoa, Huauzontle and Chia were evaluated for yield performance for drought and salinity tolerance in Mexico. Preliminary results showed that these dry land crops performed better under water stress conditions and salinity affected yield of these gains differently. The results are currently being analyzed to understand yield response and nutrient uptake of these dry land crops.

(7) Three genotypes of wheat were evaluated for water and nutrient use efficiencies in two agro-ecological zones in Pakistan using four different levels of nitrogen fertilizer application labelled with N-15 stable isotope under dry land conditions. Yield performance showed that the genotypes produced greater yield at the agro-ecozones with clay loam soils compared to the zone with sandy loam soil. Increasing fertilizer application increased yield. However, the optimum yield at both locations responded to 45 kg N/ha.

(8) Two improved varieties of wheat tolerant to UG99 were evaluated for grain yield and nutrient uptake in three locations in Eastern Uganda at four levels of nitrogen and three levels of phosphorus fertilizer application. Results showed that the application of 60

kg N/ha and 15 kg P/ha are recommended for maximum yield in eastern Uganda. Water and nutrient use efficiencies are currently being assessed for these improved varieties.

Response to Nuclear Emergencies Affecting Food and Agriculture (D1.50.15)

Technical Officers: Gerd Dercon and Lee Heng

This CRP aims to develop and assess systems of innovative data collection, management and geovisualization platforms that can be used for both routine monitoring and also in emergency response to nuclear and radiological incidents that could affect food and agriculture. Through this CRP network, institutions and governments involved in nuclear emergency response for food and agriculture will be strengthened. The CRP will also assist in compiling Standard Operating Protocols (SOPs) for actions required in case of a nuclear emergency affecting food and agriculture, as well as sampling analytical SOPs for activity measurements.

The objectives of the CRP are:

1. To identify sampling and analytical strategies in nuclear emergencies affecting food and agriculture
2. To determine how online geo-visualization tools can influence emergency response strategies, approaches to learning from nuclear accidents, and end-users ability to generate future short-term and long-term scenarios about the impact of nuclear accidents on food and agriculture
3. To ensure that systems use common or standardized protocols that can be shared across different software platforms
4. To produce low-cost computer-based platforms that are robust and can be used both routinely to monitor everyday sampling as well as in nuclear emergency situations
5. To produce decision support tools that will help rapid analysis of the situation in radionuclide contamination of food stuffs.

Four research contract holders from China, Morocco, the Russian Federation and Ukraine, two technical contract holders from France and Macedonia and five agreement holders from Belgium, European Commission, India and Japan (2) participate in this CRP.

To date, after first testing and validation in 2014, the online information system to support decision-making in food safety in case of a nuclear emergency is currently being further upgraded by two IT consultants. A first advanced prototype of this system has been presented during the 9th International Experts' Meeting on Assessment and Prognosis in Response to a Nuclear or Radiological Emergency, held in April at the IAEA HQ in Vienna. Significant progress has been made as well to link this system with existing data exchange platforms of the IAEA, such as the Unified System for Information Exchange on Incidents and Emergencies (USIE) and International Radiation Monitoring Information System (IRMIS) managed by IEC.

In 2015, specific protocols for supporting sampling and radionuclide concentration analysis of foodstuffs will be prepared. The second RCM is planned to be held from 28 September to 2 October 2015, Japan.

Minimizing Farming Impacts on Climate Change by Enhancing Carbon and Nitrogen Capture and Storage in Agro-Ecosystems (D1.50.16)

Technical Officers: Mohammad Zaman and Lee Heng

The objective of this CRP is to mitigate nitrous oxide emissions (N_2O) and minimize nitrogen (N) losses from agricultural systems whilst enhancing agricultural productivity and sequestering soil carbon (C). The first Research Coordination Meeting (RCM) was held in Vienna, Austria from 3 to 7 November 2014 to review individual experimental plan for research contractors in line with the objectives of the CRP and to provide them suggestions for the next 18 months were discussed. Ten participants, with seven research contract holders from Brazil, Chile, China, Costa Rica, Ethiopia and Pakistan, two agreement holders from Estonia and Spain, and one technical contract holder from Germany attended the RCM. Since the first RCM, all CRP participants have established field trials to assess the effect of nitrogen process inhibitors on N_2O emission and C sequestration under different agro-climatic condition. Measurements of N_2O emissions and collection of soil and plant samples for chemical analyses are underway. The CRP is expected to continue for five years (2014–2019).

Developments at the Soil and Water Management and Crop Nutrition Laboratory

Evaluation of the uncertainty around the mean level of ^{137}Cs fallout at undisturbed reference site: A simple statistical approach

L. Mabit [1], B.C. Gonsalves [1], X. Chen [1], A. Toloza [1], I.G. Darby [2], R. Padilla-Alvarez [2], G. Weltin [1]*

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[2]Nuclear Science and Instrumentation Laboratory (NSIL), Division of Physical and Chemical Sciences

One of the major issues related to the use of ^{137}Cs as a soil erosion/sedimentation tracer is the selection of the reference site which is used to estimate the initial ^{137}Cs fallout input (also termed reference inventory). The initial ^{137}Cs fallout input is a key component of the conversion models used to estimate erosion and sedimentation rates from the ^{137}Cs data set. The selection and evaluation of the validity of reference sites have been explained in detail in the recent IAEA TECDOC 1741 ''*Guidelines for using Fallout radionuclides to assess erosion and effectiveness of soil conservation strategies*''.

An investigation was carried out at the experimental research station of the Austrian Agency for Health and Food Safety (AGES), in Austria, Grabenegg (48°07'40"N, 15°13'16"E). Located at an altitude of 260 m a.s.l, with an annual average temperature of 8.4 °C and annual precipitation of 686 mm, the soil of this area has been classified as Gleyic Cambisol with a silt-loamy texture.

In a flat undisturbed permanent pasture (i.e. a stable reference site), 9 soil cores were collected using a motorized soil column cylinder auger to evaluate the initial ^{137}Cs fallout (Figure 1). One of the soil cores was divided into 5 cm increments to a depth of 40 cm. Taking into account the precise depth distribution of ^{137}Cs provided by this incremental profile, the maximum sampling depth for the other cores was set at 30 cm and were collected as bulk cores (i.e. 0-30 cm).

The soil samples were analysed for ^{137}Cs mass activity using a gamma spectrometry available at the SWMCN Laboratory. Around 65% of the ^{137}Cs areal activity was found in the 0-10 cm soil layer, and the ^{137}Cs content decreased exponentially with soil depth as expected in a typical undisturbed reference site.

Using the information provided by the 9 samples, the initial ^{137}Cs fallout was evaluated at 7890 ± 1510 Bq m^{-2} (mean ± SD) with a coefficient of variation (CV) of 19.2 %. In addition to these descriptive statistics, which already provide useful information about the limited spatial variability of the initial fallout within the selected area (i.e. CV < 30%), a simple statistical test can be performed to establish the minimum number of soil cores required to provide a reliable mean estimate of the reference inventory within a specified level of confidence (see IAEA TECDOC 1741). This statistical function can be used as well to allow assessing the allowable error (AE) at 90% confidence level for the number of samples already collected as following:

$$AE = \frac{t_{(\alpha,\ n-1)} \cdot CV}{\sqrt{n}}$$

where:

AE = the allowable error (decimal fraction)
t = the t value of the Student's t-test at 90% confidence (α = 0.1)
n = the number of soil samples collected
CV = the coefficient of variation (decimal fraction)

Under the experimental conditions (i.e. n=9; CV=19.2%), the evaluated ^{137}Cs mean baseline inventory of 7890 Bq m^{-2} was established with an allowable error (AE) of 11.8% at 90% confidence level.

This simple statistical test could be applied for any other fallout radionuclides (FRN) investigation (e.g. ^{7}Be, ^{210}Pb$_{ex}$, $^{239+240}$Pu) and can provide clear information about the accuracy of the mean value of FRN estimated at any selected reference sites.

In case of fallout release related with nuclear emergencies, this could provide the associated uncertainty of the mean deposition of radionuclides prior to any effective remediation action.

Figure 1. SWMCN Laboratory team collecting soil samples at the ''reference site'' in Grabenegg, Austria

FAO/IAEA training course on "Water management and use of AquaCrop simulation model" 26 May to 12 June 2015, Seibersdorf, Austria

Technical Officers: Ammar Wahbi, Georg Weltin, Gerd Dercon, Lee Heng, Christian Resch, Norbert Jagoditsch, Peter Strauss, Dirk Raes, Andrew Bugg

The FAO/IAEA training course on "Water management and use of AquaCrop simulation model" was held at the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) from 26 May to 12 June 2015 at Seibersdorf, Austria. This training activity was organised by staff from the SWMCN Laboratory and Section. Fifteen professional and technical personnel specialised in irrigation and water management from seven Member States (Bangladesh, Italy, Iraq, Kuwait, Namibia, Palestine and Sri Lanka) participated in the training. The main focus of the training course was on: (i) water management in rainfed and irrigated agriculture, (ii) techniques for measuring soil water, (iii) assessing soil water balance and crop-water relationships, and (iv) AquaCrop simulation model and its use for improving soil water management and irrigation scheduling. The training was funded by the IAEA Technical Cooperation Department through national TC projects. The Technical Cooperation Department also facilitated the participation of an expert from KU Leuven (Belgium) for training in the use of AquaCrop simulation model for crop water use assessment and irrigation scheduling. Besides lectures, laboratory and field work, a guided tour to the Austrian Agency for Health and Food Safety (AGES) in Grabenegg and the BAW research station Petzenkirchen was organized to highlight ongoing research activities in agricultural water management. An end of training test was given to participants to assess the effectiveness of the training course at an individual level. Feedback from the participants showed that practical and field based training using equipment and simulation modelling was highly useful in their home country (Figure 1).

Figure 1. Participants at the group training course

ReNuAL Update

January 2015 - June 2105

The ReNuAL project continues to make progress in 2015. The conceptual designs completed in November last year for the two new laboratory buildings to be constructed — the Flexible Modular Laboratory (FML), which will house the Joint FAO/IAEA Division's ***Food and Environmental Protection Laboratory*** and the ***Soil and Water Management & Crop Nutrition Laboratory*** in addition to the Terrestrial Environment Laboratory, and the new Insect Pest Control Laboratory — were reviewed by a panel of external experts in February this year. The experts concluded that the designs would successfully meet the future needs of the laboratories. The detailed design plans were accordingly initiated in March, with an expected completion date in August, so that the procurement of building construction can begin, pending the availability of funds.

Approximately €7.4 million in extrabudgetary resources have been raised to date. By September, when the IAEA's Programme and Budget for 2016-17 is expected to be approved by the General Conference with an additional €5 million in regular budget resources for ReNuAL, a total of €10.4 million in regular budget funds will have been allocated to the project. This will bring the total funds raised and allocated to nearly €18 million of the €31 million that is targeted to fund ReNuAL, with the remaining approximately €13 million to come from extrabudgetary sources. Additional extrabudgetary contributions are expected during the General Conference in September.

The funds available by September should be sufficient to construct the first of the two buildings and the new site infrastructure necessary to support these buildings. Procurement to begin construction of the infrastructure began in June, with work on site to begin in September. Once the final cost estimates are available in late August, a decision will be made to construct either the FML or IPCL, with the construction contract to start by the end of 2015. In the meantime, fundraising will continue and construction of the second building will begin as soon as the required funds are available.

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Websites and Links

- Soil and Water Management and Crop Nutrition Section:
  http://www-naweb.iaea.org/nafa/swmn/index.html
- Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture:
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- Food and Agriculture Organization of the United Nations (FAO):
  http://www.fao.org/about/en/
- FAO Agriculture and Consumer Protection Department
  http://www.fao.org/ag/portal/ag-home/en/
- FAO/AGL (Land and Water Development Division):
  http://www.fao.org/nr/water/landandwater_what.html
- New communication materials outlining successes in the area of nuclear techniques:
  http://www-naweb.iaea.org/nafa/resources-nafa/IAEAsuccessStories-2014.pdf
  http://www-naweb.iaea.org/nafa/resources-nafa/ProgBrochure-2014.pdf
  http://www-naweb.iaea.org/nafa/resources-nafa/LabBrochure-2014.pdf

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