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Improving soil fertility and integrated soil-plant management are critical for crop production in Cameroon, Africa

To Our Readers

The end of 2013 is fast approaching. I would like to thank you all for your support throughout the year and my colleagues in the Soil and Water Management & Crop Nutrition (SWMCN) Section and Laboratory for the dedication and commitment that you all collectively contributed to the SWMCN Subprogramme.

My statement in "To Our Readers" from December 2012 is still very relevant on this occasion. The challenges and opportunities for the SWMCN Subprogramme are exciting, with the ever greater focus and awareness of policy makers and farming communities around the world on the management of land and agricultural water resources for sustainable agriculture. In addition, there is mounting pressure on the agricultural sector to reduce greenhouse gas (GHG) emissions. Development of land-water management tools and techniques is increasingly required by cropping and livestock farmers to improve soil and water quality, reduce soil erosion-land degradation, minimize GHG from farm lands, improve soil fertility and produce more food per drop in both rainfed and irrigated lands without compromising water quality and quantity.

The SWMCN Subprogramme has launched two new Coordinated Research Projects (CRPs) in 2013 which aim to address major soil, water and nutrient management issues for climate smart agriculture, and integrated cropping livestock agriculture.

Conservation of natural resources for food security is an important consideration in climate smart agriculture. There is increasing attention to land resource management for food security throughout the world. The Global Soil Week entitled "Losing Ground?" convened in Berlin, Germany, from 27–31 October 2013, with more than 450 participants (scientists, policy makers and land managers) from over 70 countries has raised major concerns about land degradation which affects soil fertility, crop nutrition, food productivity, water quantity and quality. It has highlighted the importance of climate-soil-water nexus in food security.

Besides CRPs, the SWMCN Subprogramme also provided technical support to 52 Technical Cooperation Projects (TCPs) in 2013 and about 30 new TCPs will be implemented in 2014–2015. The SWMCN Laboratory of the SWMCN Subprogramme has also provided support to CRPs through research and development in soil carbon sequestration, GHG emissions and agricultural water management. In addition, 70 fellows were trained in the SWMCN Laboratory in 2013.

We are excited by the ReNuAL project (i.e., **Re**novation of the IAEA **Nu**clear **A**pplications **L**aboratories). This project will be implemented from 2014–2017 to support the renovation and modernization of the FAO/IAEA Agriculture & Biotechnology Laboratories (ABL) to ensure they are fit-for-purpose and appropriately positioned to meet the evolving needs and demands of Member States with adequate infrastructure in place for the next 20–25 years. This ReNuAL project will certainly enable the SWMCN Subprogramme to make a major impact in our effort to support Member States in the application of isotopic and nuclear techniques to develop improved land and water management practices for sustainable climate smart agriculture, resilient to the impacts of climate change and variability and at the same time contribute no or insignificant GHG emissions to the environment.

As you will see in this Soils Newsletter, all vacant positions in both the Section and the Laboratory (Ms Kyoko Makovicky and Mr Mohammad Zaman for the Section and Mr Georg Weltin, Mr Lionel Mabit and Mr Ammar Wahbi for the Laboratory) have been filled. I am extremely pleased with the enthusiasm and commitment of these new team members, all of whom have readily integrated into the life and activities of the SWMCN Subprogramme. I would also like to mention the contributions from consultants (Ms Yanling Mao and Mr Basil Gonsalves) who are making great inputs to Research and Development in the SWMCN Laboratory. We are now a full team, ready to face new challenges in 2014 and the years beyond.

May I also take this opportunity to extend our deepest sympathy to the families of two excellent colleagues from Poland and Bolivia, Mr Wojciech Froehlich and Mr Isaac Luna Lauracia, who have passed away this year. Their contributions to the work of our Subprogramme have been greatly appreciated and they will be sadly missed by us all.

Looking back at the workload and accomplishments that the SWMCN Subprogramme have achieved in 2013, I would like to thank you all again for your help and understanding. I wish you and your families all the best for 2014 and I look forward to receiving your continuing support.

With greetings and best wishes,

Minh-Long Nguyen
Head
Soil and Water Management and
Crop Nutrition Section

STAFF

Soil and Water Management and Crop Nutrition Subprogramme

M. L. Nguyen

L. Heng

K. Sakadevan

M. Zaman

F. Yusuf

K. Ajvazi

K. Makovicky

L. Mayr

G. Dercon

L. Mabit

A. Wahbi

A. Toloza

M. Aigner

M. Heiling

G. Weltin

J. M. Mletzko

C. Resch

N. Jagoditsch

Y. Mao

Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture

Vienna International Centre, P.O. Box 100, 1400 Vienna, Austria
Telephone (+43 1) 2600 + ext.; Fax: (+43 1) 2600 7
Email: Official.Mail@iaea.org

Name	Title	Email	Extension
Qu LIANG	Director	Q.Liang@iaea.org	21610

Soil and Water Management and Crop Nutrition (SWMCN) Section

Name	Title	Email	Extension
Minh-Long NGUYEN	Section Head	M.Nguyen@iaea.org	21648
Lee Kheng HENG	Soil Scientist	L.Heng@iaea.org	26847
Karuppan SAKADEVAN	Soil-Water Ecophysiologist	K.Sakadevan@iaea.org	21613
Mohammad ZAMAN	Soil Scientist / Plant Nutritionist	M.Zaman@iaea.org	21645
Fauzia YUSUF	Consultant	F.Hafeez@iaea.org	21693
Ksenija AJVAZI	Team Assistant	K.Ajvazi@iaea.org	21646
Kyoko MAKOVICKY	Team Assistant	K.Makovicky@iaea.org	21647

Soil and Water Management and Crop Nutrition Laboratory (SWMCNL) A-2444 Seibersdorf, Austria

Name	Title	Email	Extension
Gerd DERCON	Laboratory Head	G.Dercon@iaea.org	28277
Lionel MABIT	Soil Scientist	L.Mabit@iaea.org	28271
Ammar WAHBI	Technical Officer	A.Wahbi@iaea.org	28726
Leopold MAYR	Senior Laboratory Technician	L.Mayr@iaea.org	28305
Martina AIGNER	Senior Laboratory Technician	M.Aigner@iaea.org	28212
Maria HEILING	Senior Laboratory Technician	M.Heiling@iaea.org	28272
Georg WELTIN	Senior Laboratory Technician	G.Weltin@iaea.orgt	28258
Arsenio TOLOZA	Laboratory Technician	A.Toloza@iaea.org	28403
Christian RESCH	Laboratory Technician	C.Resch@iaea.org	28399
Norbert JAGODITSCH	Laboratory Attendant	N.Jagoditsch@iaea.org	28422
Yanling MAO	Consultant	Y.Mao@iaea.org	28271
Joanna Malgorzata MLETZKO	Team Assistant	J.Mletzko@iaea.org	28362

Staff News

Basil Gonsalves joined the Soil and Water Management and Crop Nutrition Laboratory (SWMCNL) in September 2012 as a consultant. He worked on the use of gamma-ray spectrometry techniques in fallout radionuclide (FRN) investigations, participating in soil campaigns carried out by the Laboratory, and comparing in-situ and laboratory approaches for FRN measurements using gamma ray spectrometry. The studies undertaken were also part of Basil's research and he has now earned his MSc degree from the University of Birmingham, United Kingdom. Basil has made a presentation to SWMCNL Fellows on in-situ and laboratory methods for FRN measurements during the Hands-on Training on the Use of Isotopic Techniques in Soil and Water Management & Crop Nutrition in October 2013 and he prepared a report on his research at the Laboratory. Basil completed his assignment with SWMCNL in November 2013. We congratulate Basil on his work and wish him every success in his future endeavours.

Franz Augustin, laboratory assistant, (March 2012–October 2013), left the Laboratory after completing his temporary assignment with the SWMCN Subprogramme. Franz helped with the preparation, installation and maintenance of field and greenhouse experiments, and worked as well on plant harvest and sample preparation for routine analysis. We thank Franz for his contribution to the Subprogramme activities and wish him all the best for the future.

Georg Weltin joined the Soil and Water Management & Crop Nutrition Laboratory on 1 July 2013 as a Senior Laboratory Technician. He is responsible for (i) assisting in the development and adaptation of research protocols for coordinated research and technical cooperation projects, in the field of agricultural water management; (ii) carrying out routine and special training for fellows; (iii) collecting and interpreting data on soil physical, moisture and chemical properties, obtained by isotopic, nuclear and related conventional techniques; (iv) database management for dissemination and online exchange of information collected in the Soil and Water Management & Crop Nutrition Laboratory and Section; and (v) maintenance and trouble-shooting of field and laboratory equipment, in particular in the field of agricultural water management.

Yanling Mao joined the Soil and Water Management & Crop Nutrition Laboratory on 12 July 2013 as a consultant for 12 months. She is focusing on the development and validation of innovative carbon-13 and nitrogen-15 isotope techniques to assess soil organic carbon (SOC) dynamics and determine SOC sequestration mechanisms. Her research is related to CRP D1.50.12 on Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-Based Cropping Systems in Sub-Saharan Africa. She is working at the Department of Resources and Environmental Sciences, Fujian Agriculture and Forestry University, China.

Lionel Mabit joined the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) on 9 September 2013 as a Soil Scientist. Lionel is not new to the Laboratory and the SWMCN Subprogramme. He worked with us from 2005–2012 as a Soil Scientist. Since leaving the SWMCNL in February 2012, Lionel has been working as a Senior Nuclear Environmental Scientist at Environmental Geosciences, University of Basel, Switzerland. We are pleased to welcome Lionel back and look forward to his continuing inputs to the SWMCN Subprogramme.

Ammar Wahbi joined the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) on 1 October 2013 as a Technical Officer (Soil and Water). Previously Ammar worked with the Farming Systems Program, International Center for Agricultural Research in the Dry Areas (ICARDA, 1979–82), as a Research Officer in the Soil Science Department. University of Reading, England (1982–86) and ICARDA again as a Post-Doctoral Fellow (1987–90). Since 1994 he was a member of the permanent staff of the Soil

Science Department, Faculty of Agriculture, University of Aleppo, Syria. Ammar has been involved in two IAEA funded coordinated research projects and has collaborated with research institutions in Australia on the use of simulation models for water use efficiency assessment. A Syrian National, Ammar is married with three daughters. We welcome Ammar and look forward to his contributions to the activities of the SWMCN Subprogramme.

Joanna Malgorzata Mletzko joined the Soil and Water Management & Crop Nutrition Laboratory in August 2013 as a Team Assistant. Besides the SWMCN Laboratory, Joanna assists as well the Plant Breeding and Genetics Laboratory and Animal Production and Health Laboratory. She contributes to the efficient operation of the office by providing assistance and advice on administrative practices and procedures. We welcome Joanna, and look forward to work together.

Mohammad Zaman joined the SWMCN Section as a Soil Scientist/Plant Nutritionist on 4 November 2013. Zaman is originally from Pakistan and holds both Pakistan and New Zealand nationalities. Prior to joining the SWMCN Section, Zaman worked for 19 years in the area of soil fertility and quality, soil plant and water interaction, greenhouse gas emissions, nutrient use efficiency, soil salinity and integrated nutrient management at different research, academic, commercial and international organizations in both developed and developing countries.

Zaman received his PhD degree from Lincoln University, New Zealand. After completing his PhD, Zaman continued his post-doctoral research at Lincoln University in the areas of soil fertility and water quality, using both conventional and stable isotopic techniques. He then moved to Chiba University, Japan, to work on N dynamics and greenhouse gas emissions.

After two years in Japan, Zaman returned to Pakistan and worked as a research officer at the Agricultural Research Institute, Tarnab. He then returned to New Zealand to take up a position as a researcher with the National Institute of Water & Atmospheric Research (NIWA). Zaman then moved to a farmer owned cooperative fertilizer Industry where he established an international network of academic researchers from New Zealand, Australia, Canada, China, Japan, Pakistan and the USA. His work focused on increasing the adaptive capabilities of soil/plant systems to climate change and enhancing on-farm nutrient use efficiency through novel product development, decision support systems and tools.

Zaman is married and his wife (Shazia) and three children (Haider, Mamuna and Sikander) will join him by the end of January 2014. Zaman is looking forward to being actively involved in the life of the SWMCN Subprogramme.

Fauzia Yusuf Hafeez joined the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) on 18 November 2013 as a consultant (plant-microbe interaction) for a period of three months. Fauzia is a professor at the Department of Biosciences, COMSATS Institute of Information Technology, Islamabad, Pakistan. Her research expertise includes the development of bio fertilizers and biological nitrogen fixation. Her research group at the National Institute for Biotechnology and Genetic Engineering (NIBGE) has released the first commercial product of biofertilizer "BioPower" through a public-private partnership in Pakistan. We welcome Fauzia and look forward to her contributions to the activities of the SWMCN Subprogramme.

Kyoko Makovicky joined the SWMCN Section as a Team Assistant on 1 August 2013. She is bringing to the Section her experience with the IAEA, including 4 years (2009–2013) with the Department of the Nuclear Safety & Security and nearly 2 years (September 2007–June 2009) with the Joint FAO/IAEA Agriculture & Biotechnology Laboratories in Seibersdorf. We welcome Kyoko to the Section and look forward to receiving her inputs into the Team.

Feature Articles

A New Soil Water and Bulk Electrical Conductivity Sensor Technology for Irrigation and Salinity Management

Steve Evett[1], Robert Schwartz[1], Joaquin Casanova[1] and Scott Anderson[2]

[1]Soil and Water Management Research Unit, Conservation & Production Research Laboratory, USDA-ARS, Bushland, Texas, USA (http://www.cprl.ars.usda.gov/)

[2]Acclima, Inc., 2260 East Commercial Street, Meridian, Idaho 83642 USA (www.acclima.com)

Existing soil water content sensing systems based on electromagnetic (EM) properties of soils often over estimate and sometimes underestimate water content in saline and salt-affected soils due to severe interference from the soil bulk electrical conductivity (BEC), which varies strongly with temperature and which can vary greatly throughout an irrigation season and across a field. Many soil water sensors, especially those based on capacitance measurements, have been shown to be unsuitable in salt-affected or clayey soils (Evett et al., 2012a). The ability to measure both soil water content and BEC can be helpful for the management of irrigation and leaching regimes. Neutron probe is capable of accurately sensing water content in salt-affected soils but has the disadvantages of being: (1) labour-intensive, (2) not able to be left unattended in the field, (3) subject to onerous regulations, and (4) not able to sense salinity.

The Waveguide-On-Access-Tube (WOAT) system based on time domain reflectometry (TDR) principles, recently developed by Evett et al. (2012) is a new promising technology. This system can be installed at below 3 m in 20-cm sensor segments to cover as much of the crop root zone as needed for irrigation management (Fig.1, Casanova et al., 2012). It can also be installed to measure the complete soil profile from the surface to below the root zone, allowing the measurement of crop water use and water use efficiency – knowledge of which is key for irrigation and farm management, and for the development of new drought tolerant and water efficient crop varieties and hybrids, as well as watershed and environmental management.

The TDR method measures the travel time of an electronic pulse along waveguides inserted in the soil. The travel time increases with soil water content, allowing calibration of TDR systems for soil water content. Calibrations in sand and clay loam over a range of water contents, showed that travel time was not significantly influenced by sensor design (tube diameter, length and electrode spacing) and exhibited quadratic responses ($P<0.001$ and $r^2>0.99$ for both soils) to increasing water content (Fig.2). A linear response between travel time and water content is predicted in sand for regular TDR probes. For the WOAT system, a quadratic response is expected as a result of the contributions of the plastic WOAT body volume fraction to the sensed bulk permittivity and its dependency on water content, which a mixing model approach shows to be nonlinear. Calibrations for these widely different soils could be modelled with a common intercept coefficient of 1.67 nanoseconds (ns), making it clear that a family of similar quadratic curves will define calibrations for the majority of soils. The characteristics of the quadratic curve for a particular soil may be determine by measurement of travel time and volumetric water content in a saturated sample, opening the way for a simple calibration procedure for end users.

Fig.1. Installation of a stack of 20 cm long WOAT sensors into undisturbed soil by augering from within between alternative pushes with a hydraulic coring machine (Giddings).

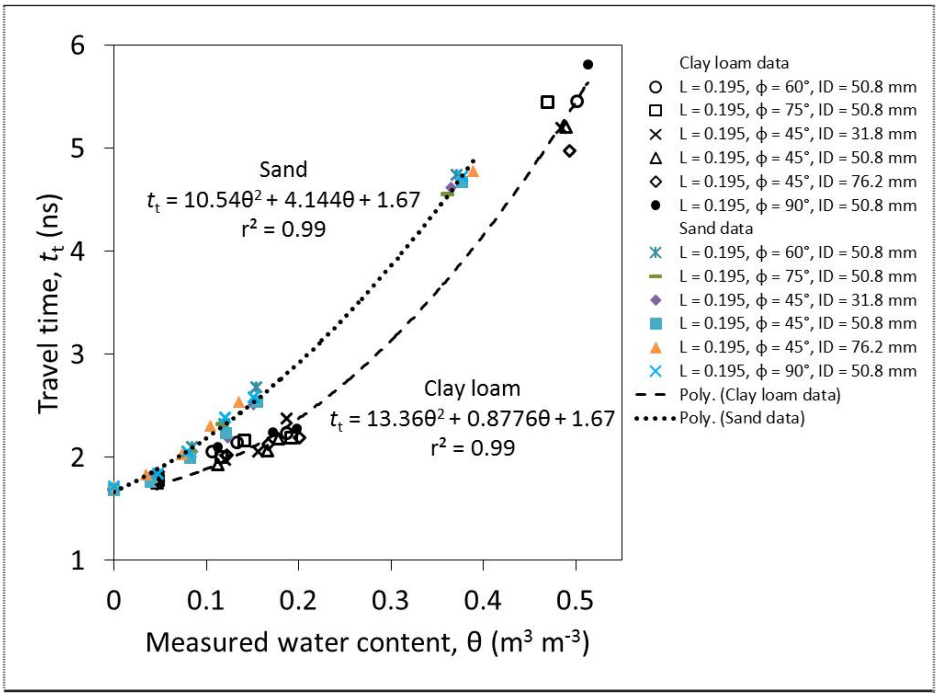

Fig.2. Calibration equations in terms of travel time (t, ns) and soil water content (ϑ, $m^3\ m^{-3}$) for sand and clay loam, for six prototype waveguide-on-access-tube sensor segments with different tube diameters (ID), electrode lengths (L) and electrode separation angles (φ).

Sensor probe constants for BEC determinations were found by acquiring waveforms in KCl solutions of measured conductivity. The probe constant increased with increasing electrode separation and correlated closely (r^2=0.94) with an analytical derivation for three-rod probe constants. This result means that BEC can be easily measured using the WOAT design. The ability to measure soil BEC also enables better management of salt affected soils and monitoring of environmental contamination. This system is less sensitive to interference from soil BEC than conventional TDR systems. The WOAT sensor platform includes wireless communication that enables remote access to data. It will be a practical, multi-segment down-hole access-tube-based system that uses new, relatively inexpensive TDR technology to accurately and automatically determine soil water content and BEC in 20-cm thick soil layers in undisturbed soil. Such a device would be useful for irrigation and salinity management, determination of crop water use and water use efficiency, and in watershed and environmental management.

References

Casanova, J.J., Evett, S.R., Schwartz, R.C., Design and Field Tests of an Access-tube Soil Water Sensor. Appl. Eng. Agric. 28(4) (2012) 603–610.

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Evett, S.R., S.K. Anderson, J.J. Casanova, R.C. Schwartz, Patent application serial No. 13/404,491, Entitled "Soil Water and Conductivity Sensing System", filed 24 February 2012 with claims priority to Provisional Serial No. 61/515,381–Filed August 5, 2011 (2012b).

Review and Discussion on the Key Assumptions and Challenges Surrounding the Use of ^{7}Be as a Soil and Sediment Tracer

L. Mabit[1], A. Taylor [2], W.H. Blake [2], H.G. Smith [3], and M.J. Keith-Roach[4]

[1] Soil and Water Management & Crop Nutrition Laboratory, IAEA, Austria
[2] School of Geography, Earth and Environmental Sciences, Plymouth University, UK
[3] School of Environmental Sciences, University of Liverpool, UK
[4] Kemakta Konsult, Stockholm, Sweden

The assumptions and challenges surrounding the use of ^{7}Be to investigate soil and sediment in river basins have recently been reviewed (Taylor et al., 2013) to support the Coordinated Research Project D1.20.11 on Integrated Isotopic Approaches for an Area Wide Precision Conservation to Control the Impacts of Agricultural Practices on Land Degradation and Soil Erosion. This paper analyses the assumptions made in the context of hillslope erosion studies and additional implications for the use of ^{7}Be as a tracer at a catchment-scale.

A key assumption in hillslope erosion studies is that ^{7}Be fallout is spatially uniform for a typical field or location. It is also important to assume that rainfall received prior to a study event is non-eroding to maintain a uniform inventory and enable estimates of soil redistribution to be attributed to a particular event. This requirement is well recognised by researchers in this field and these conditions have been met in studies shown in the literature. Little attention, however, has been given to the effects of other factors (e.g. atmospheric processes affecting the rainfall field across a site, topographic factors including the influence of vegetation cover), which could influence the uniformity of fallout and therefore the spatial variability of the ^{7}Be inventory.

Assumptions of spatially uniform fallout at the microscale has not been adequately supported by previous research. Studies demonstrated for example the variability in raindrop size distribution across short distances (i.e. 250 m). These factors are, however, likely to translate into minimal gradients in ^{7}Be inventories and it is more likely that factors affecting the direct transfer of ^{7}Be to soil, such as rain shadowing (by e.g. vegetation and topography) and interception by vegetation, will have a greater influence on spatial uniformity. These factors could present a fundamental challenge to the application of ^{7}Be as a hillslope soil erosion tracer unless suitable studies are undertaken to demonstrate otherwise. Plant interception and potential uptake are likely to contribute to significant heterogeneity. Therefore it is vital that a suitable period of radioactive decay separate pre-harvest inventory and pre-harvest sampling.

The second key assumption is rapid sorption of the tracer to soil particles. Rapid sorption of ^{7}Be to soil particles upon fallout is assumed to be at shallow soil depth distributions and laboratory batch studies have been reported on this sorption. Applications of ^{7}Be as a tracer have overlooked the potential for high rates of infiltration through preferential flow pathways to increase sorption time, thus, influencing depth distributions, which has implications for erosion modelling using current conversion models. Furthermore, there is potential for ^{7}Be to be transported in the dissolved phase in overland flow and this remains a key area for research to determine the influence of this upon redistribution estimates.

As a tracer at the catchment scale, ^{7}Be offers a unique opportunity to provide an indication of recent sedimentation and the transport of surface material, which could make a significant contribution to catchment management schemes. Successful use at this scale does, however, rest upon support for the third assumption of irreversible sorption to soil particles in a range of environments and such support is currently lacking. Knowledge of ^{7}Be behaviour with changing physico-chemical parameters in fluvial environments is conflicting and there is evidence to suggest that ^{7}Be may be mobilised under reducing, saline or low pH conditions. Impact upon sorption behaviour is likely to be highly site specific and it is a priority that future laboratory studies are coupled with in situ monitoring of parameters to determine the likelihood for increased tracer mobility under representative conditions and timescales.

A detailed appraisal of current knowledge surrounding each assumption is provided together with discussion regarding the potential influence upon tracer estimates and recommendations for further research. Further information can be found in the recently published article of Taylor et al (2013).

References

Taylor, A., Blake, W.H., Smith, H.G., Mabit, L., Keith-Roach, M.J., Assumptions and Challenges in the Use of Fallout Beryllium-7 as a Soil and Sediment Tracer in River Basins, Earth-Science Reviews, 126 (2013) 85–95.

Technical Cooperation Projects

Operational Projects and Technical Officers Responsible for Implementation

Project Number	Title	Technical Officer(s)
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 and L. Heng in collaboration with Plant Breeding and Genetics Section
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 M. Lionel
ANG5011	Monitoring Soil Fertility in Pasture Areas for Their Improvement and Maintenance	L. Heng
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
BGD5028	Assessing Crop Mutant Varieties in Saline and Drought Prone Areas Using Nuclear Techniques	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
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
BKF5010	Enhancing Crop Productivity through Small Scale Irrigation Technologies for Peri-Urban Agriculture to Improve the Income and Livelihood of Farmers	L. Heng
BOT5007	Using Isotopic, Nuclear and Other Conventional Techniques to Support the Development of Improved Soil and Water Management Techniques to Increase Crop Production	K. Sakadevan and M.L. Nguyen
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
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
ECU5026	Improving the Efficiency of Irrigation in the Rio Chota Sub-Basin	K. Sakadevan
GUA5018	Evaluating the Impact of Anthropogenic Contamination on Aquatic Ecosystems	K. Sakadevan in collaboration with Isotope Hydrology Section

Project Number	Title	Technical Officer(s)
HAI5003	Enhancing Crop Productivity through the Application of Isotope Nuclear Techniques	K. Sakadevan
HON5007	Evaluating Nutrient Pollution and Heavy Metals in Lake Yojoa to Determine the Impact on the Environment and Human Health	K. Sakadevan in collaboration with Isotope Hydrology Section
INS5039	Enhancing Food Crop Production Using Induced Mutation, Improved Soil and Water Management and Climate Change Adaptation	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
IRQ5018	Using Fallout Radionuclides and Stable Isotope Techniques to Assess Soil Quality and Dust Production for Enhanced Agricultural Land Productivity	G. Dercon
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 and M.L.Nguyen
KAM5001	Improving Soil Fertility and Crop Management Strategies in Diversified Rice Based Farming Systems	M.L. Nguyen and L. Heng
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
KEN5031	Improving Agricultural Productivity in Mixed Cropping Systems through Application of Knowledge Based Technologies Generated with the Aid of Nuclear Techniques	L. Heng and K. Sakadevan
MAG5019	Improving the Use of Agricultural Resources and Combating Soil Erosion by Optimizing Conservation Agriculture and Developing Strategies for Its Dissemination	M. Lionel and M. Zaman
MLI5024	Enhancing Sustainable Intensification and Diversification of Sorghum Production Systems in the Southern Zone by an Integrated and Participatory Approach, Phase 2	L. Heng
MLI7003	Assessing Erosion, Sedimentation and Water Resources in River Basins by Using Isotope Techniques	M. Lionel
MOZ5003	Sustaining the Management of Soil Fertility	G. Dercon
MOZ5004	Improving Nitrogen and Water Use Efficiency of Maize Varieties in Conservation Agriculture under Smallholder Farming Systems	G. Dercon and M. Zaman
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
NER5015	Improving Productivity of the Millet Cowpea Cropping System through Development and Dissemination of Improved Varieties and New Water and Fertilizer Management Techniques	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
NIC8012	Applying Nuclear Techniques for the Development of a Management Plan for the Watershed of the Great Lakes	G. Dercon

Project Number	Title	Technical Officer(s)
OMA5001	Producing Forage Crops Tolerant to Salinity and Drought	K. Sakadevan
QAT5003	Improving Agricultural Productivity in Saline Land/Areas	K. Sakadevan
RAF5058	Enhancing the Productivity of High Value Crops and Income Generation with Small Scale Irrigation Technologies	L. Heng
RAF5063	Supporting Innovative Conservation Agriculture Practices to Combat Land Degradation and Enhance Soil Productivity for Improved Food Security	G. Dercon
RAS5055	Improving Soil Fertility, Land Productivity and Land Degradation Mitigation	M. Zaman
RAS5056	Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change	K. Sakadevan in collaboration with Plant Breeding and Genetics Section
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
RAS5065	Climate Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications	L. Heng in collaboration with Plant Breeding and Genetics Section
RLA5051	Using Environmental Radionuclides as Indicators of Land Degradation in Latin American, Caribbean and Antarctic Ecosystems (ARCAL C)	G. Dercon
RLA5052	Improving Soil Fertility and Crop Management for Sustainable Food Security and Enhanced Income of Resource Poor Farmers (ARCAL CI)	K. Sakadevan
RLA5053	Implementing a Diagnosis System to Assess the Impact of Pesticide Contamination in Food and Environmental Compartments at a Catchment Scale in the Latin American and Caribbean (LAC) Region (ARCAL CII)	G. Dercon in collaboration with Food and Environmental Protection Section
RLA5062	Applying Stable Isotopes to Assess the Impacts of Natural Zeolite to Increase Nitrogenous Fertilizer Use Efficiency, to Improve Soil Fertility and to Reduce Soil Degradation (ARCAL CXXV)	K. Sakadevan
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
SEY5006	Implementing Nutrient and Water Management Practices Using Nuclear and Related Techniques to Enhance National Vegetable Production through Sustainable Agricultural Management	L. Heng
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

Project Number	Title	Technical Officer(s)
TAD5005	Developing Soil Conservation Strategies for Improved Soil Health	G. Dercon
URT5027	Improving Livestock Production and Productivity through Sustainable Application of Nuclear and Related Techniques	L. Heng in collaboration with APH and IPC Sections
URT5028	Improving Crop Production and Productivity through the Use of Nuclear and Nuclear Related Techniques	L. Heng in collaboration with IPC Section
VEN7004	Use of Agro-environmental Radioactive Soil Tracers (i.e. 137Cs and 2010Pb) for Assessing and Managing Sedimentation Processes Impacting Reservoirs	M.L. Nguyen
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	G. Dercon
ZAM5027	Developing Maize Genotypes for Drought and Low Soil Fertility Tolerance	L. Heng in collaboration with Plant Breeding and Genetics Section
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
ZIM5018	Optimizing Water Use and Soil Productivity for Increased Food Security in Drylands through Farmer Participation in Sustainable Technologies	L. Heng

Forthcoming Events

FAO/IAEA Events

Training Courses

(1) Integrated Nutrient-water Manage-ment at Field and Area-wide Scale, 19 May–27 June 2014, Seibersdorf, Austria

(2) Using Fallout Radionuclide and Compound Specific-stable Isotope Techniques for Precision Soil Conservation, 6–31 October 2014, Seibersdorf, Austria

Both training courses will be held at Seibersdorf, Austria, and target scientists and technicians from TC projects funded by the IAEA, in the area of soil, water and crop management. For each training course approximately twenty fellows can be accepted. If professional and technical staff from Member States are interested in participating in these courses, please contact Gerd Dercon, Head of the Soil and Water Management & Crop Nutrition Laboratory for further information.

Non-FAO/IAEA Events

International Conference-Exhibition on Soils, Sediments, and Water, 18–24 March 2014, Lille, France
http://www.intersol.fr

EGU General Assembly, 27 April–02 May 2014, Vienna, Austria
http://www.intersol.fr

20th World Congress of Soil Science, 8–13 June 2014, Seoul, Republic of Korea
http://www.20wcss.org/

World Conference on Natural Resource Modeling, 08–11 July 2014, Vilnius, Lithuania
http://www.resourcemodellingconference2014.com/

9th International Soil Science Congress on the Soul of Soil and Civilization, 14–16 October 2014, Side, Antalya, Turkey
http://www.soil2014.com/invitation.aspx

Past Events

Meetings at the IAEA

Interregional Project Design Meeting on Climate Change and Its Impact on Glacier Retreat and Land-water-ecosystem Quality in Polar and Mountain Regions across the World: From Assessment to Action, 17–20 June 2013, Vienna, Austria

Technical Officer: Gerd Dercon

Climate change is a significant global challenge and it is becoming an important area of focus for the IAEA's Technical Cooperation (TC) Department. Through TC projects, IAEA Member States are learning to use nuclear techniques to contribute to international efforts to combat climate change. For example, naturally occurring stable and radioactive isotopes can provide useful information for assessing the impact of climate change on communities and the environment around the world, and thus help develop climate change mitigation and adaptation strategies.

A meeting was held on 17–21 June 2013 at the IAEA's headquarters in Vienna to develop a new interregional TC project on Climate Change and Its Impact on Glacier Retreat and Land-water-ecosystem Quality in Polar and Mountain Regions across the World: From Assessment to Action. The proposed TC project builds on earlier pilot TC projects 'Using Environmental Radionuclides as Indicators of Land Degradation in Latin American, Caribbean and Antarctic Ecosystems' and 'Developing Soil Conservation Strategies for Improved Soil Health'. These projects validated the potential of nuclear techniques to improve the understanding of the impact of climate change in polar and mountainous regions with the support of the SWMCN Subprogramme, The meeting was attended by 16 participants representing a number of research institutions and UN organizations including FAO/IAEA, UNEP and UNU to discuss an action plan necessary to identify the impact of climate change on fragile polar and mountainous ecosystems and to improve policies relating to their conservation and management. A comprehensive work plan was also developed for the proposed project.

The proposed project will focus on the impact of rising temperatures caused by climate change on seasonal snow cover, glacial retreat, permafrost decline and related soil degradation, sediment redistribution and increasing greenhouse gas emissions.

IAEA will provide technical support to the participants from developing and developed countries for this project. Human resource capacity building on the use of isotopic, nuclear and complementary techniques will be provided to participating countries using integrated and multidisciplinary approaches. These techniques will assist them to better understand the impact of climate change on the frozen parts of the Earth's surface and the land-water-ecosystem quality in polar and mountainous regions. "The aim is to improve their management and conservation", says G. Dercon, the lead IAEA scientist for this project.

First RCM of the CRP D1.20.13 on Landscape Salinity and Water Management for Improving Agricultural Productivity, 15–19 July 2013, Vienna, Austria

Technical Officers: Lee Heng and Karuppan Sakadevan

The purpose of this First Research Coordination Meeting (RCM) was to review the objectives and experimental plans of the national research projects in line with the objectives and work plan of the CRP and to provide common guidelines for implementing projects for the next 18 months. Participants from nine countries (six research contract holders from Bangladesh, China, India, Pakistan and Vietnam (two participants) and four agreement holders from Australia, Germany, Spain and the USA) attended the meeting. The research contract holder from Iran was not able to attend the meeting. National work plans from the participants were reviewed and revised. The specific aims of the CRP are to: (i) address the problems of salinization in agricultural landscapes, to optimize the use of salt affected soils and saline water through improved soil, water and crop management practices, and to understand how salinity responds to land and water management at the field and landscape scale, and (ii) evaluate the potential impact of on-farm practices on regional crop productivity, water and salt stores and fluxes under current and future climate scenarios using numerical modelling tools .

A field trip was made to Petzenkirchen, 100 km west of Vienna, where cooperative studies on soil water monitoring are being established between IAEA, the Vienna University of Technology (TU) and the Austrian Federal Agency for Water Management and where the cosmic ray soil moisture observation system (CosMOS) will be compared with eddy covariance, scintillometry, the soil moisture monitoring network and TDR sensors.

The potential use of the following nuclear and isotopic techniques to unravel the relative importance of processes involving soil-plant-water interactions in salt affected soils was also discussed:

- soil moisture neutron probe (SMNP), to measure plot scale changes in soil water in combination with the cosmic ray soil moisture observation system (CosMOS) for changes in soil water in the upper soil layer;
- the use of $\delta^{18}O$ and $\delta^{2}H$ to quantify the proportion of soil evaporation at the field scale, as part of the field and regional water balances;
- the use of ^{13}C in plant tissues as an indicator of drought and salinity tolerance; and
- HYDRUS-1D or 2D tools for modelling landscape salinity and water management.

A newly developed soil water and bulk electrical conductivity sensor, known as the Waveguide-On-Access-Tube (WOAT) system based on TDR principles and developed by USDA-Bushland, Texas, will be tested in some participating countries.

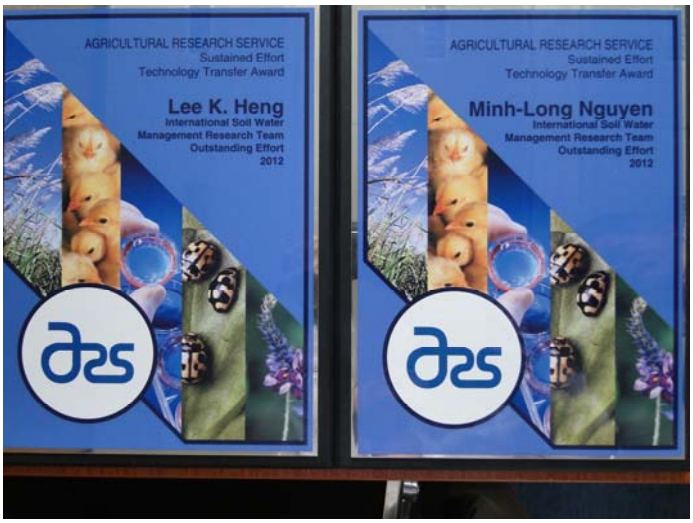
Duty Travels

USA: 2013 Annual Award Recognition Ceremony, 10–12 June 2013, Beltsville, USA

Technical Officer: Lee Heng

L. Heng and M.L. Nguyen (SWMCN Section) were recipients of the 2012 Outstanding Sustained Effort Technology Transfer Awards from the Agricultural Research Service (ARS), United States Department of Agriculture (USDA). The Awards recognize the contribution made by the SWMCN Subprogramme to the transfer of technologies and knowledge to end users on the use of nuclear and isotopic techniques to improve agricultural water use efficiency. The SWMCN Subprogramme has been working with Mr S. Evett and his colleagues of the USDA ARS Soil and Water Management Research Unit in Bushland, Texas in land and water management for sustainable agriculture and food production for many years.

This travel was to attend the USDA-organized Award Ceremony which was held on 11 June in Beltsville, Maryland. The ceremony was held at the Henry A. Wallace Auditorium, Beltsville Agricultural Research Center (BARC). Before the award ceremony, I had the opportunity to visit the ARS Office of International Research Programs (OIRP) at the George Washington Carver Center in Beltsville, where I presented an overview of the works of the SWMCN Subprogramme and discussed with Mr S. Evett the upcoming CRP on Landscape Salinity and Water Management for Improving Agricultural Productivity.



Bangladesh: IAEA/RCA Meeting on the Use of Participatory Tools (WOCAT-LADA) to Address the Assessment of the Efficiency of Soil Conservation Measures, 17–21 June 2013, Dhaka, Bangladesh

Technical Officer: Minh-Long Nguyen

The main purpose of this travel to Dhaka, Bangladesh was to conduct the IAEA/RCA Meeting on the Use of Participatory Tools (WOCAT-LADA) to address the assessment of the efficiency of soil conservation measures. The meeting involved participants from IAEA Member States in Asia and the Pacific region, that are participating in the IAEA/RCA Project RAS5055 entitled: Improving Soil Fertility, Land Productivity and Land Degradation Mitigation.

The focus of the meeting was to discuss the use of WOCAT (World Overview of Conservation Approaches and Technologies)-LADA (Land Degradation Assessment in Drylands) tools to assess land degradation and soil erosion and to highlight the potential linkage between these tools and the use of isotopic and nuclear techniques to address sustainable land management (SLM).

The meeting was attended by 22 participants, including two experts, one from FAO (LADA) and one from WOCAT (WOCAT, Switzerland) and representatives from 10 countries. Potential actions for linkages between WOCAT-LADA tools and isotopic-nuclear techniques to assess the efficiency of soil conservation measures were discussed.

Participants at the IAEA/RCA meeting on the use of WOCAT-LADA tools

Participants at the second RCM

Malaysia: Second Research Coordination Meeting (RCM) of the CRP on Approaches to Improvement of Crop Genotypes with High Water and Nutrient Use Efficiency for Water Scarce Environments (D1.50.13), 24–28 June 2013, Kuala Lumpur, Malaysia

Technical Officer: Karuppan Sakadevan

The Technical Officer travelled to Kuala Lumpur, Malaysia from 24–28 June 2013 to organize the second RCM in collaboration with the Malaysian Nuclear Agency. The meeting was attended by research contract holders from Bangladesh, China, Indonesia, Kenya, Malaysia (two participants), Mexico, Pakistan, Peru (two participants), Uganda and Vietnam and an agreement holder from South Africa. Mr R. Ibrahim and Mr K. A. Rahim from the Malaysian Nuclear Agency, Ministry of Science, Technology and Innovation, Malaysia, were the local coordinators.

The Technical Officer provided an introduction on Sustainable Intensification of Crop Production Systems through Crop Improvement and Soil, Water and Crop Management. He reiterated the general and specific objectives of the CRP and the work plan developed during the first RCM. The Technical Officer also presented the first year progress report and highlighted the gaps between project objectives and achievements made during the first year. During the first two days of the meeting, all participants presented their results on crop improvement and soil and water management, obtained during last 18 months.

As part of the activities related to the RCM, a one day visit was organized on the third day of the RCM to the Malaysian Agricultural Research and Development Institute (MARDI). The objectives of the visit were to brief the participants on the activities of MARDI related crop improvement and soil and water management practices.

Pakistan: To facilitate final agreement on new Country Programme Framework for 2014–2019, 2–6 July 2013, Islamabad-Faisalabad-Lahore-Peshawar, Pakistan

The main purpose of this four day travel to Pakistan was to accompany Mr A. Boussaha, Director of the Asia and Pacific Technical Cooperation Division (DIR-TCAP) to hold consultations with national authorities on key issues, particularly food and agriculture relating to the TC programme and to facilitate final agreement on new Pakistan Country Programme Framework (CPF) for 2014–2019 period. This visit highlights the following points:

(1) Pakistan Atomic Energy Commission, Islamabad (PAEC) provides a very comprehensive CPF for the use of isotopic and nuclear techniques in food and agriculture, including the conservation of natural and agricultural resources for sustainable food productivity and the environment. Institutes such as PINSTECH (Pakistan Institute of Nuclear Science and Technology, Islamabad), NIAB (Nuclear Institute for Agriculture and Biology, Faisalabad), NIBGE (National Institute for Biotechnology and Genetic Engineering, Faisalabad), and NIFA (Nuclear Institute for Food and Agriculture, Peshawar) with their well-developed expertise and experience in nuclear applications in soil and water management can provide technical support and training to IAEA's Member States in the Region, in the areas relating to food and agriculture.

(2) Pakistan Institute of Engineering & Applied Sciences (PIEAS), together with NIAB, NIBGE, and NIFA can be tertiary training providers for young scientists in neighboring countries to acquire knowledge on the

use of isotopic and nuclear techniques in food and agriculture.

(3) The successful deployment and up scaling of technologies relating to biological nitrogen fixation and biofertilizers by NIBGE and NIAB can help IAEA's Member States to reduce the farmers' reliance on chemical (synthetic) N fertilizers.

At the Pakistan Institute of Nuclear Science and Technology (PINSTECH) in Islamabad

Spain: XXX National Conference on Energy and Education, 14 September 2014, Madrid, Spain

Technical Officer: Gerd Dercon

On behalf of the Joint FAO/IAEA Division, G. Dercon travelled to Madrid on 14 September 2013 to participate in the conference and give a keynote lecture on the use of nuclear techniques in food and agriculture during the XXX National Conference on Energy and Education. This is an annual conference organized by the Nuclear Industry Forum of Spain. The main objective of this Conference is the training of teachers in the broad field of nuclear energy.

This year, the Conference (13–14 September 2013) focused on the applications of nuclear techniques and their importance to the scientific world. Over 250 teachers from schools throughout Spain and at all educational levels attended the Conference.

Radiation and its effects, the uses of nuclear technology in agriculture, medicine, industry and environmental management, and the management of radioactive waste in Spain and in the European Union were some of the issues that were discussed in this two day Conference.

More information can be found at:
http://www.foronuclear.org/es/noticias/ultimas-noticias/inauguracion-de-las-xxx-jornadas-nacionales-sobre-energia-y-educacion

Italy: Joint ICTP-IAEA Workshop on Advancing Modelling of Climate, Land-Use, Energy and Water (CLEW) Interactions, 7–8 October 2013, Trieste, Italy

Technical Officer: Minh-Long Nguyen

The main purpose of this duty travel was to attend the workshop that was jointly organized by the IAEA and the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, where ICTP is located. (http://cdsagenda5.ictp.trieste.it/full_display.php?smr=0&ida=a12212). This Joint ICTP-IAEA Workshop is entitled: Advancing Modelling of Climate, Land-use, Energy and Water (CLEW) Interactions. As one of the course directors, the technical officer also presented a lecture entitled: The Use of Nuclear Techniques in Land and Water Management.

The focus of the workshop was to advance the knowledge of CLEW and to highlight the tools and methodologies used including nuclear techniques, to elucidate the linkage between different CLEW components.

Twenty eight participants from different countries attended the workshop. Workshop topics included: (i) a review of recent advances and the current state of CLEW methodology frameworks, (ii) a review of case studies from Australia, Cuba, Germany, Lithuania, Mauritius, India and South Africa, (iii) an assessment of gaps and shortcomings in the current methodologies, and (iv) an assessment of the relevance and applicability of CLEW methodologies to planning and policy formulation in developing countries.

The workshop highlighted the need for further refinement in the integration of the LEAP (Long-range Energy Alternative Planning Tool), WEAP (Water Evaluation and Planning Tool) and the AEZ (Agro Ecological Zone model) models into the CLEW framework to enhance the development of a coherent practical package of tools which would allow decision-makers and practitioners from both the government and private sectors, to develop a comprehensive and integrated approach to energy, water and food production development through a nexus perspective.

Madagascar: Second Research Coordination Meeting (RCM) of the CRP on Soil Quality and Nutrient Management for Sustainable Food Production in Mulch-based Cropping Systems in Sub-Saharan Africa (D1.50.12), 14–18 October 2013, Antananarivo, Madagascar

Technical Officer: Minh-Long Nguyen

The technical officer travelled to Antananarivo, Madagascar to organize the second RCM in collaboration with Ms L. Rabeharisoa, Professor, Radioisotopic Laboratory, the University of Antananarivo, Madagascar.

This second RCM identified key issues that need to be corrected such as the liming and fertilizer applications to correct soil acidity and remove soil fertility constraints on crop production. All the participants agreed that these issues should be addressed in the second year to ensure that the CRP objectives will be accomplished. Two technical contract holders (the Czech Republic and the United Kingdom) and one agreement holder (New Zealand) were unable to attend and present their project results.

Both FAO Representative (Mr P. T. Takoukam) and participating members of the National Task Force of Conservation Agriculture (NTFCA) have highlighted the importance of conservation agriculture and the relationship between mulch retention, resource use efficiency, soil organic carbon sequestration, environmental quality and crop productivity.

Participants of the CRP D1.50.12 in front of the Radioisotope Laboratory, University of Antananarivo

Japan: Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-site the Fukushima Daiichi NPP, 14–21 October 2013, Japan

The incident at TEPCO's Fukushima Daiichi Nuclear Power Plant (NPP) led to the radioactive contamination of large areas in and around Fukushima. The Government of Japan formulated a programme for the remediation of these areas and as part of this remediation programme a series of activities aimed at improving the living conditions of the people affected by the accident have been initiated.

In response to a request made by the Government of Japan, the IAEA organized a fact finding mission to provide assistance to manage the remediation of contaminated areas, to review remediation related strategies, plans and works, and to share findings and lessons learned with the international community. The mission was carried out from 7 to 15 October 2011. The final report of this mission is available on the IAEA webpage: http://www.iaea.org/newscenter/focus/fukushima/ /final_report151111.pdf.

Since then, various remediation activities have been put in place through the joint efforts of the Government of Japan and the local municipalities. However, challenges still remain, for example in remediating the highly contaminated forest areas, implementing radiation protection measures, and securing temporary sites for the establishment of interim storage facilities.

In response to these challenges, the Government of Japan requested the IAEA to carry out a follow-up mission on remediation of large contaminated off-site areas with the main purpose of evaluating the progress of on-going remediation works and providing advice to address remediation challenges.

The mission had the following three main objectives:

(a) To provide assistance to Japan in assessing the progress made with the remediation of the Special Decontamination Area and Intensive Contamination Survey Areas;
(b) To review remediation strategies, plans and works, initiated as a result of advice provided by the previous IAEA mission on remediation of large contaminated off-site areas; and
(c) To share its findings and lessons learned with the international community.

Germany: Global Soil Week 2013: Losing Ground? 27–31 October 2013, Berlin, Germany

Technical Officer: Minh-Long Nguyen

The Technical Officer attended the first two days of the Global Soil Week (GSW) and presented a paper in the Session entitled: Responsible Land Governance–Integrated Governance for Energy Security and Sustainable Land Use. In this session, the application of nuclear techniques for quantitative assessment of the impacts of land uses, farming practices and climate change and variability on soil quality and soil-water-energy interactions was presented and discussed. This GSW which is an initiative of the Global Soil Forum was established by the Institute for Advanced Sustainability Studies (IASS) in 2011 and the GSW 2013 highlights its importance as a forum for interactive exchange and dialogue among stakeholders from science, government, business and civil society regarding the importance of land-water-energy-nutrient nexus in sustainable land/soil management and governance. Further information on this GSW 2013 can be accessed at: http://globalsoilweek.org/gsw-2013/.

Malaysia: First Technical Meeting of the regional TC project RAS5065 on Supporting Climate-Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications, 12–15 November 2013, Penang, Malaysia

Technical Officer: Lee Heng

Lee Heng travelled to Penang, Malaysia to conduct the first technical meeting for the RAS5065 project on Supporting Climate-Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications. The meeting was attended by national counterparts from Bangladesh, Cambodia, China, Indonesia, Lao PDR, Malaysia, Mongolia, Myanmar, the Philippines and Thailand. The counterpart from Vietnam was unable to attend the meeting. The meeting was hosted by the Malaysian Agricultural Research and Development Institute (MARDI) and the Malaysian Nuclear Agency. The objective of the project is to develop sustainable rice production systems for food security and climate change adaptation. The purpose of the meeting was to present individual country progress reports for 2013 and also to discuss and finalize details of future activities, including implementation strategies and training of project counterparts and their junior staff.

An expert from the Technical University in Vienna, Mr M. Enenkel also participated in the meeting. He presented information on the application of drought forecasting using the Combined Drought Index in South-East Asia, with soil moisture data obtained from Remote Sensing. A local company specializing in weather stations also gave a presentation on the use of weather data for climate-smart agriculture. A field trip was organized to the experimental site of MARDI in Seberang Perai, where integrated best-fit soil, water and nutrient management practices using improved rice varieties are being carried out. The field trip also included a visit to the MUDA Irrigation Scheme for rice production and the Rice Museum in Kedah State.

Counterparts of RAS5065 and participants of the technical meeting in Penang, Malaysia

Training Courses

Regional Training Course on the Use of Nuclear and Isotopic Techniques in Assessment of Fertilizer and Water Use Efficiency, 23–27 September 2013, Manila, Philippines

Technical Officer: Karuppan Sakadevan

This regional training course was held in collaboration with the Philippines Nuclear Research Institute (PNRI). The objectives of the training course were to improve the skills, knowledge and technical competency of scientific and technical personnel from participating countries in Asia on the application of isotopic techniques to study soil, water and crop management practices on nutrient and water use by different crops under different agro-eco systems.

The training involved: (i) a general introduction to soil, water, crop and nutrient management, (ii) factors affecting nutrient and water use efficiencies in agriculture, (iii) soil and plant testing to determine the nutrient requirements of crops, (iv) farming practices that improve soil fertility and reduce nutrient losses, (v) laboratory and field experimental techniques related to nutrient and water management, (vi) water quality, managing salt affected soils and saline waters for crop production, and (vii) isotopic techniques for quantifying water and nutrient use efficiency and evaluating crops tolerant to drought and salinity.

Twenty five professional staff from 13 participating countries (Bangladesh, China, India, Indonesia, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand and Vietnam) attended the training. Lectures were provided by Mr Y. Li, Institute of Environment and Sustainable Development in Agriculture (IEDA), Chinese Academy of Agricultural Sciences (CAAS), China and Mr K. Mahmood, Nuclear Institute for Agriculture and Biology (NIAB), Pakistan.

The local coordinator for the training was R. Rallos from PNRI.

Regional Training Course on the Use of Fallout Radionuclide Based Techniques for Soil Erosion Assessment (Part II), under the Regional TC Project RAF5063 on Supporting Innovative Conservation Agriculture Practices to Combat Land Degradation and Enhance Soil Productivity for Improved Food Security, 18–29 November 2013, Antananarivo, Madagascar

Technical Officer: Lionel Mabit

The main objective of this Regional Training Course was to provide basic information on the use of fallout radionuclide (FRN) conversion models. The training course covered an introduction to spatial applications and mapping tools (i.e. Geostatistics and Geographic

Information Systems) for extrapolating soil erosion from field to area wide scales, and practical training on FRN data analysis and interpretation of results. Twenty two participants from Africa (i.e. Algeria, Benin, Ivory Coast, Madagascar, Mali, Morocco, Senegal, Tunisia, Uganda and Zimbabwe) attended this training course. The training was provided by the IAEA Technical Officer, two international experts (i.e. L. Gaspar, M. Benmansour) and the Course Director (N. Rabesiranana). The Institut National des Sciences et Techniques Nucléaires (INSTN), Antananarivo, Madagascar was the local organizer for this training.

Latin America–A new CSSI Technique is on its way

Claudio Bravo-Linares[1], Roberto Meigikos Dos Anjos[2], Sergio de Los Santos Villalobos[3], Max Gibbs[4] and Gerd Dercon[5]

[1]Universidad Austral de Chile, Chile
[2]Universidade Federal Fluminense, Brazil
[3]Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, Mexico
[4]National Institute of Water and Atmospheric Research, New Zealand
[5]Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria

Under the Regional TC Project RLA5051 on Using Environmental Radionuclides as Indicators of Land Degradation in Latin American, Caribbean and Antarctic Ecosystems, three fellows from Brazil, Chile and Mexico received on-the-job training in 2013 for two months on the use of compound-specific stable isotope (CSSI) techniques for precision soil conservation at the National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand.

As a result of this training, CSSI techniques have now been introduced to Latin America for the first time to assess soil redistribution in agricultural landscapes and commercial forest plantations and to identify hotspots of soil erosion. This will help improve the cost-effectiveness of soil conservation measures at the catchment level by implementing control measures. CSSI techniques are based on the measurement of carbon-13 natural abundance signatures of specific organic compounds (e.g. fatty acids of plant and animal origins) in the soil profile. By linking fingerprints of land use to the sediment in deposition zones, CSSI techniques have been successful in determining the sources of eroded soil or transported sediment and thereby identifying areas sensitive to land degradation/erosion.

The fellows have learned all of the necessary components of CSSI techniques, including sampling design, sample preparation and analysis, which help to determine the stable isotope signatures of different land uses. Further emphasis was also placed on how to use the data obtained from chemical analysis using software such as Isosource and SIAR, which were created to model and interpret the data.

In order to be able to apply all of their newly acquired knowledge, the fellows worked with samples taken from case study sites in their respective countries and even samples from Antarctic soils, taken during an IAEA expedition within the framework of the regional project RLA5051.

The training also led to a new regional TC project, which is planned to start in 2014, linking the use of CSSI and other techniques to improve soil conservation enabling the participants to further expand this technique in Latin-American and Caribbean region. The fellows will become trainers under this new regional initiative.

However even before this new regional project begins, two postgraduate students have already been trained by one of the fellows. So the first step has been taken to disseminate the CSSI technique in the region. In addition, although the CSSI techniques have only recently been introduced to Latin America, interest from private forestry companies has also already emerged in Chile. The forestry company ARAUCO and the Universidad Austral de Chile have started to work together to improve the management of their forest plantations through erosion hot spots identification and control.

In the meantime, the fellows also assisted the host in New Zealand to upgrade the existing software for CSSI data analysis which will enable the analysis of larger sets of data and give more detailed and statistical information about the proportion of sediment contribution from different land uses in a catchment. An excellent example of how both trainers and trainees can benefit from this interaction. During the training they also enjoyed playing Rugby with the host country.

Three fellows enjoying rugby in New Zealand.

Status of Coordinated Research Projects (CRPs)

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 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 quickly making them available to farmers, making their cropping systems resilient to biotic and abiotic stresses in water scarce environment. The specific objectives are to:

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

Water and nutrient use experiments in Pakistan

Ten research contract holders (Bangladesh, China, Kenya, Malaysia (two participants), Mexico, Pakistan, Peru, Uganda and Vietnam), one technical contract holder (Peru) and one agreement holder (South Africa) participated in the meeting.

The second RCM was held in Malaysia from 24–28 June 2013 and all participants attended the meeting. During the second RCM all participants presented results from their first field experiments and the constraints they face in this research. The country work plans were revised to ensure that they align with the objectives of the project.

The following activities were carried out by the counterparts to evaluate the performance of improved varieties of a number of crops under existing soil and climate conditions:

(1) Field studies evaluating improved varieties of rice, ground nut, mung bean and sesame under saline conditions in Bangladesh.
(2) Yield, fertilizer use and economic benefits of ratooning rice cultivar Jiafuzhan evaluated in Fujian Province, China.
(3) Field studies established to evaluate the tolerance of sorghum varieties to acidity and drought stress in two locations in Indonesia. Soil and plant data have been collected for further analyses.
(4) In Kenya, four pre released varieties of English Potato were evaluated in four different locations for their response to different rates of manure application.
(5) 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 in Peru.
(6) Plant morphological characteristics and water and nutrient use for two improved mutant lines of rice adapted to aerobic conditions which were evaluated in three locations in Malaysia.
(7) Preliminary soil characteristics completed for two different agro-eco systems in Mexico. Thirty two improved genotypes of Amaranthus were evaluated for assessing plant morphological characteristics from which varieties have been selected for evaluation of water and nutrient use efficiencies.
(8) Preliminary field studies at two agro-ecological regions in Pakistan for quantifying wheat yield, nitrogen uptake and nitrogen use efficiency of improved wheat varieties
(9) Screening for mutant lines tolerant to UG99 and drought which have been carried out for wheat in South Africa.
(10) Five different genotypes of wheat which were evaluated for yield response to different rates of fertilizer application in five locations in Uganda.

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

Technical Officers: Minh-Long Nguyen and Gerd Dercon

This Co-ordinated Research Project (CRP) is now in its second year with the second research coordination meeting (RCM) held in Antananarivo, Madagascar, from 14–18 October 2013 to review each participant's project work plan and research progress to ensure the accomplishment of the CRP objective. Mr Mohamad Zaman, a newly appointed Technical Officer (TO) in the SWMCN Section, will replace Mr Dercon as a principal TO for this CRP since he is busy with his new role as Head of the SWMCN Laboratory.

The overall objective of this CRP is to improve the livelihoods of farmers with low socio-economic development and rural communities in a region that is dominated by a savannah ecosystem in its natural state. The CRP aims to address the following four key issues relating to soil quality and nutrient management for sustainable food production in mulch-based cropping systems in Sub-Saharan Africa: (1) improve soil fertility and soil health by promoting carbon (C) sequestration and applying the principles of conservation agriculture, (2) increase productivity in integrated crop-livestock systems across different spatial scales in the moist and dry savannahs of Sub- Saharan Africa, (3) enhance on-farm and area wide ecosystem service efficiency (e.g. nutrients, water, labor and energy use efficiency), and (4) assess economic feasibility and conduct socioeconomic and environmental impact assessments of mulch based farming systems.

The CRP was formulated on the recommendations of a consultants' meeting held at IAEA, Vienna, 5–8 July 2010. The first Research Coordination Meeting (RCM) was held in Vienna, 30 January–3 February 2012. 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 RCM.

The SWMCN Laboratory team initiated a series of research activities to support this CRP. A long term field experiment of over 15 years at Gross Enzersdorf (BOKU Research Station, 8 km east of Vienna) is selected to assess carbon sequestration and the stability of organic carbon using ^{13}C and ^{15}N techniques. Two additional experiments have also been initiated to validate ^{13}C and ^{15}N techniques for assessing sequestration in: (i) a long term field experiment in Grabenegg, at the experimental research station of the Austrian Agency for Health and Food Safety (AGES), west of Vienna, and (ii) a greenhouse column experiment within the SWMCN Laboratory. Soil samples collected from three long-term field trials in Belgium, Kenya and China have been analyzed for ^{13}C and ^{15}N in the SWMCN Laboratory. The SWMCN Laboratory team in Seibersdorf is also currently working on to develop real-time soil moisture measurement protocols to better understand the role of applying mulch on soil water dynamics in various cropping systems (Grabenegg). Testing of low-cost methods for ^{13}C-labelling of organic materials has also been initiated by the SWMCN Laboratory team to provide ^{13}C labelled materials for local research on soil organic carbon dynamics to the CRP D1.50.12 participants.

Integrated Isotopic Approaches for an Area-wide Precision Conservation to Control the Impacts of Agricultural Practices on Land Degradation and Soil Erosion (D1.20.11)

Technical Officers: Gerd Dercon and Minh-Long Nguyen

The overall objective of this CRP is to develop integrated isotopic approaches to identify hotspots or critical source areas of land degradation in agricultural catchments and apply effective soil conservation measures (precision conservation) to them. The specific objectives of this CRP are to: (i) establish soil redistribution patterns and rates over several temporal scales on an area-wide (catchment) basis using a combination of fallout radionuclide (FRN) and conventional techniques with spatial analysis (ii) develop and validate protocols for the application of compound specific stable isotope (CSSI) techniques to identify and apportion the amount of source soils (degraded land areas) from main land uses or management (cropland, grassland and forestland) in the catchment, (iii) integrate nuclear based approaches with other non-nuclear techniques through modelling and other tools to establish comprehensive soil redistribution studies on an area-wide basis, and (iv) create a basis for developing decision support tool (s) (DST) to implement precision conservation and contribute to sustainable land management.

This CRP, which was formulated on the recommendations of a consultants' meeting held at the IAEA, Vienna, 5–7 November 2007, is in its final year. The first research coordinated meeting (RCM) was held at the IAEA in Vienna from 8–12 June 2009. The second RCM was held at the National Centre for Atomic Energy, Nuclear Sciences and Applications [(Centre National de l'Energie, des Sciences et des Techniques Nucleaires (CNESTEN)] in Rabat, Morocco, from 27 September–

1 October 2010. A mid-term review of the CRP was successfully carried out in November 2011. The third RCM was held in Vienna from 23–27 July 2012 in conjunction with the FAO/IAEA International Symposium on Managing Soils for Food Security and Climate Change Adaptation and Mitigation.

In 2012-2013 the protocol for the application of CSSI techniques to identify critical areas of land degradation at the catchment scale was validated under different agro-ecological conditions and land use systems (i.e. Chile, China, Morocco, Poland, the Russian Federation, Syrian Arab Republic and Vietnam). A staff member from the Soil and Water Management & Crop Nutrition Laboratory (C. Resch) was trained in the use of the CSSI technique at the University of Hohenheim, Stuttgart (3–14 December 2012). This training enabled Mr C. Resch, to "train the trainers" so that he can now provide expertise and training in this technology to other SWMCNL staff, allowing them to start the next step of disseminating this novel analytical technique to Member States through group or individual fellowship training to be conducted at the Seibersdorf laboratories.

The fourth and final RCM was held in Vienna from 4–8 November 2013. The purpose of the final RCM is: (i) to review and discuss the final research results obtained since the last RCM in 2012, (ii) to evaluate main achievements in accordance with the project objectives and agreed work plan, and (iii) to plan the dissemination of the research results. Seven research contract holders from Chile, China, Morocco, Poland, the Russian Federation and the Syrian Arab Republic, four technical contract holders from Belgium (University of Ghent), China (Chinese Academy of Agricultural Sciences) and Germany (University of Hohenheim) and five agreement holders from Australia (CSIRO), Canada (University of Manitoba), New Zealand (National Institute of Water & Atmospheric Research) and the United Kingdom (University of Exeter and University of Plymouth) attended the fourth RCM.

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

Technical Officers: Lee Heng and Karuppan Sakadevan

The overall objective of this CRP is to address soil and water salinity in agricultural landscapes and to optimize the use of salt affected soils and saline water through improved soil, water and crop management practices, and to understand how salinity responds to land and water management at the field and landscape scale. The potential impact of on-farm practices on regional crop productivity, water and salt stores and fluxes under current and future climatic conditions will be studied using numerical modelling approaches.

This CRP was formulated on the basis of the recommendations of a consultants' meeting held at IAEA headquarters, Vienna from 1–4 October 2012. The first Research Coordination Meeting was held in Vienna, Austria from 15–19 July 2013. Eleven participants, with seven research contract holders from Bangladesh, China, India, Iran, Pakistan and Vietnam (two participants) and four agreement holders from Australia, Germany, Spain and the USA attended the meeting. Work plans were presented, discussed and revised during the meeting. The CRP is expected to run for five years (2013- 2018).

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

Technical Officers: Gerd Dercon and Lee Heng

The release of radionuclides into the environment as a result of nuclear and/or radiological emergencies may result in contamination of land, water and atmosphere. The release of radionuclides to the atmosphere and their transfer into the food chain is a dynamic process and concentrations of radionuclides will vary over time and space across a landscape(s). To respond to and manage a nuclear and/or radiological emergency in "real-time", up-to-date information on the spatial and temporal distributions of radionuclides in a particular landscape is necessary for decision-makers and end-users. The challenge is to collect, monitor and make available information through efficient data collection, data management and spatial and temporal mapping of radionuclide concentrations in soil, water, plants and animals. Ensuring a comprehensive and well-managed information system is fundamental for routine monitoring, and especially for and effective emergency response. Such strategies should put in place soon after a major accident occurs.

This CRP will assist Member States to establish food safety controls immediately after a crisis or incident in order to protect people from the harmful effects of radioactive contaminations and help establish protocols for sampling and remediation after nuclear incidents. This CRP aims to develop strategies through data collection, management and geospatial analysis and visualization to provide a rapid response immediately after a nuclear incident.

The first RCM was held from 16–20 December in Vienna. Four research contract holders from China, Morocco (contract to be approved yet), the Russian Federation and Ukraine, two technical contract holders from France and Macedonia and three agreement holders from Japan and India will attend the fourth RCM.

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

Technical Officers: Karuppan Sakadevan and Minh-Long Nguyen

The overall objective of this CRP is to enhance food security and rural livelihoods through improving resource use efficiency and the sustainability of integrated crop-livestock systems under a changing climate. The specific objectives are to: (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 greenhouse gas (GHG) emissions, soil carbon sequestration and water quality, (4) assess the socio-economic and environmental benefits of crop-livestock systems, and (5) develop soil, water and nutrient management options in integrated crop-livestock systems for potential adoption by farmers.

Nine research contract holders (Argentina, Brazil (two participants), China, India, Indonesia, Kenya, Uganda and Uruguay) and three agreement holders (France, International Institute for Tropical Agriculture in Nigeria and the United States of America) are participating in this project.

The first RCM was held in Vienna, Austria from 22–26 July 2013 and seven research contract and two agreement holders participated in the meeting. During the first RCM, all participants provided an overview of the current research and development activities in integrated – cropping livestock in their respective countries. These include: (1) soil, water and nutrient management, (2) greenhouse gas emission, and (3) carbon sequestration. The national project objectives were revised to align with the overall objective of the project and work plans were revised to meet the national project objectives.

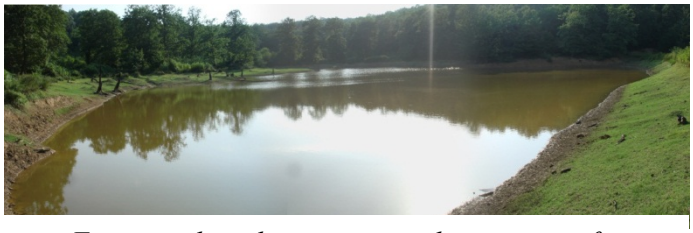
Participants at the first RCM

Strategic Placement and Area-wide Evaluation of Water Conservation Zones in Agricultural Catchments for Biomass Production, Water Quality and Food Security (D1.20.10)

Technical Officers: Karuppan Sakadevan and Lee Heng

The overall objective of this CRP is to assess and enhance services provided by water conservation zones (farm ponds, wetlands and riparian buffer zones) for optimizing water storage, nutrients biomass production and food security within agricultural catchments. The specific objectives of the project are: (1) to optimize water storage in water conservation zones for downstream irrigation use, (2) to regulate nutrient cycling in water conservation zones to improve bio-fuel crops and fuel wood production, and (3) to optimize the use of water conservation zones for crop production.

Eight research contract holders from China, Estonia, Iran, Lesotho, Nigeria, Romania, Tunisia and Uganda, four agreement holders with two each from France (University of Renne and Institute de recherché pour le Development) and the USA (University of Florida and University of Rhode Island) are participating in this project. The first RCM was held in Vienna from 15–19 December 2008. The national project objectives were refined and work plans developed for participating countries. The second RCM was held in Estonia, from 10–14 May 2010. All participants presented progress reports on their research covering the period 2008–2009 and constraints to project progress were discussed. The project work plan was revised and additional activities were proposed. The third RCM was held in Vienna from 23–26 July 2012. Information collected from 2010–2012 was discussed and the participants also attended and presented papers at the International Symposium on Managing Soils for Food Security and Climate Change Adaptation and Mitigation. The final RCM was held in Vienna from 26–30 August 2013. All participants presented their results and major findings for the project. In addition to their presentations, all participants have worked towards developing the TECDOC publications. The draft TECDOC is expected to be completed by the third quarter 2014.



Farm pond used to capture and store water for irrigating rice crops in Iran

Activities of the Soil and Water Management and Crop Nutrition Laboratory, Seibersdorf

FAO/IAEA Training Course on Agricultural Water Management: The Use of Isotope, Nuclear and Conventional Techniques, 24 June–4 August 2013, Seibersdorf, Austria

Gerd Dercon[1], Lee Heng[2], Jose Arrillaga[1], Georg Weltin[1], Peter Cepuder[3], Leo Mayr[1], Christian Resch[1], Karuppan Sakadevan[2], Martina Aigner[1], Norbert Jagoditsch[1], Franz Augustin[1], Minh-Long Nguyen[2]

[1]Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria
[2]Soil and Water Management & Crop Nutrition Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria
[3]University of Natural Resources and Applied Life Sciences (BOKU), Austria

The FAO/IAEA Training Course on Agricultural Water Management: The Use of Isotope, Nuclear and Conventional Techniques was held at the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) from 24 June to 4 August 2013. This was the second training course organized this year by scientists and technicians from the SWMCN Laboratory and Section in close collaboration with BOKU.

Twenty-two fellows from 16 Member States (Algeria, Bangladesh, Indonesia, Iraq, Ivory Coast, Madagascar, Malaysia, Mali, Mozambique, Oman, Palestinian Territories, Seychelles, Senegal, Tanzania, Zambia and Zimbabwe) with various backgrounds (students, trainers, researchers and irrigation managers) participated in the training.

The main focus of the training was to: (i) discuss the principles of water management in rainfed and irrigated agriculture, (ii) demonstrate monitoring techniques for estimating soil moisture at plot level, (iii) show the use of isotope, nuclear and conventional techniques for estimating soil water balance and assessing crop water relations, and (iv) model crop water requirements and irrigation scheduling using AquaCrop and related software.

The training was funded by the IAEA Technical Cooperation Department through national TC projects.

Besides lectures and laboratory demonstrations, a guided tour to the Marchfeldkanal Water Distribution System close to Vienna was organized to give a practical example of large-scale irrigation management.

In addition, experts from companies such as LI-COR Biosciences, Pessl Instruments and Eijkelkamp Agrisearch Equipment demonstrated equipment used to assess crop water use and monitor soil water quality and quantity. This partnership with companies improved the impact of the training course, as it gave the fellows an excellent insight into the latest technologies available for improving agricultural water management.

A self-assessment at the end of the training course gave the participants the opportunity to validate the effectiveness of the training at an individual level.

Feedback from the participants showed that hands-on training with equipment was highly appreciated and led to improved confidence in the handling of instruments and trouble-shooting (Sadeq J.H. Dwenee). Visits to field sites, where the application of knowledge gained in theory can be experienced (Raed Alary), were programme highlights.

This training is useful for Member States as they prepare to meet the challenges that climate change will bring to farming communities and develop climate-smart agriculture, particularly on water management practices.

More information about this training course can be found on the UN Radio:
http://www.unmultimedia.org/radio/english/2013/09/tanzania-benefits-from-un-agencies-workshop-on-water/index.html

FAO/IAEA Training Course on agricultural soil and water management to support crop production in Asia and the Pacific, 7 October–5 November 2013, Seibersdorf, Austria

Gerd Dercon[1], Karuppan Sakadevan[2], Lee Heng[2], Peter Cepuder[3], Ammar Wabbi[1], Georg Weltin[1], Leo Mayr[1], Christian Resch[1], Martina Aigner[1], Adriana Gomez[4], Norbert Jagoditsch[1], Franz Augustin[1], Long Nguyen[2]

[1]*Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria*
[2]*Soil and Water Management & Crop Nutrition Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria*
[3]*Universität für Bodenkultur BOKU, Universität für Bodenkultur (BOKU), Institut für Hydraulik und landeskulturelle Wasserwirtschaft (IHLW)*
[4]*GIS Consultant*

The FAO/IAEA Training Course on Agricultural Soil and Water Management to Support Crop Production in Asia and the Pacific was held at the Soil and Water Management & Crop Nutrition Laboratory (SWMCNL) from 7 October to 5 November 2013. This was the third group training organized by the SWMCN Subprogramme in 2013.

The training brought together 26 fellows from 21 countries within the Asia and Pacific region. They spent one month at the IAEA's Seibersdorf Laboratory, working with the IAEA experts, to gain hands-on experience in the application of nuclear techniques to improve farming practices. Over the course of four weeks, the fellows received a comprehensive overview of soil and water management in agriculture, including the use of nuclear techniques for water use efficiency, fertilizer use efficiency and soil salinity. The training specifically focused on nutrient cycling and soil organic matter dynamics, soil erosion and conservation agriculture practices, direct measurements of soil water content, crop transpiration and soil evaporation, salinization of soil and water and managing salt affected soils and saline waters for crop production.

Fellows from Afghanistan, Indonesia, Iran, Iraq, Jordan, Laos, Malaysia, Mongolia, Myanmar, Nepal, Oman, Pakistan, Palestine, the Philippines, Qatar, Sri Lanka, Syria, Thailand, Vietnam and Yemen participated in the training programme.

Self-assessment at the end of the training period provided each fellow with the opportunity to validate the effectiveness of the training.

Feedback from the participants showed a very positive response, as most fellows were not previously aware of the use of any nuclear techniques in soil-water management before, and they learnt and benefited a lot from this training. One of the fellows, D. Suriyaarunroj, from Thailand elaborated that though the training lasted for only one month, they learnt a lot from the IAEA experts as well as from group discussion and working together.

The training also facilitated a discussion on the development of potential new regional TC projects.

More information about this training course can be found on the following link:

http://www.iaea.org/technicalcooperation/Home/Highlights-Archive/Archive-2013/11122013-TCAP_Group_Fellowship.html

The video URL is:
http://www.youtube.com/watch?feature=player_embedded&v=cOSItWQgy5A

Accessing Area Wide Soil Water Content using the Cosmic Ray Neutrons Approach

The SWMCN Laboratory recently acquired a cosmic ray soil moisture observation system (CosMOS, the CRS 1000/B model) to test its suitability for measuring area wide soil water content. While CosMOS has been shown to be able to measure soil water content in dryland systems (Franz et al., 2013), its suitability and usefulness for irrigation management has not been tested. The CosMOS technique is a non-invasive intermediate-scale soil water monitoring system that has a water footprint of an area equal to 40 ha (Desilets et al. 2010). Besides the large area covered by a single device, the measurement is not affected by variations in soil temperature, salinity, bulk texture and density (Desilets et al. 2010), of remote data accessibility and requires no more than one calibration of the system.

The CRS 1000/B model cosmic ray neutron probe

A meeting was recently held between staff from the SWMCN programme (L. Heng, G. Dercon and G. Weltin), the Centre for Water Resource Systems, Vienna University of Technology (TU, Prof Blöschl, Director of the Centre; Dipl. Ing M. Oismueller and Ms M. Vreugdenhil, PhD student) and Dr Peter Strauss from the Austrian Federal Agency for Water Management. It was agreed in the meeting to install the CosMOS system in a field site near Petzenkirchen in Lower Austria, 100 km west of Vienna, where collaborative studies on soil water monitoring have been carried out with TU and the

Austrian Federal Agency for Water Management. At this field site, nearly 40 soil water sensors (SPADE sensors) covering an area of 60 ha have recently been installed. Other devices already operating in the same site are: TDR, eddy covariance, scintillometry and a weather station. In addition, ground water research has been conducted over the last 60 years, making this location ideal for testing the device and cross-referencing data obtained from cosmic ray neutrons with measurements by conventional techniques.

References

Franz, T. E., Zreda M., King, E.G., Application of Cosmic-ray Neutron Probes to Long-term Monitoring of Soil Moisture in African Drylands, Joint IAEA and FAO Proceedings, 23-27 July 2012, Vienna, Austria, IAEA-CN-191 (2013).

Desilets, D., Zreda M., and Ferre, T.P.A., Nature's neutron probe: Land surface hydrology at an Elusive Scale with Cosmic Rays. Water Resour. Res., 46, W11505, doi:10.1029/2009WR008726 (2010).

Scientific Visitors

- Mr J. Simunek, University of California, Riverside, 14 July 2013 to discuss the use of HYDRUS and UnsatChem models for salinity management.
- Mr E. G. Videgla, Benin Ministry of Agriculture, 16-20 September 2013. Scientific visit to the Section and Lab.
- Mr S. A. Rashid Alrasbi, Directorate General of Agricultural and Livestock Research, Ministry of Agriculture, 30 September–4 October 2013.
- Mr M. M. Karim Khan, Bangladesh Institute of Nuclear Agriculture (BINA), 4–8 November 2013.

ReNuAL

Renovation of the FAO's and IAEA's Nuclear Sciences and Applications Laboratories in Seibersdorf

Objective

As part of the IAEA's Nuclear Sciences and Applications (NA) Laboratories in Seibersdorf, to ensure that the FAO/IAEA Agriculture & Biotechnology Laboratories (ABL) are fit-for-purpose and appropriately positioned to meet the evolving needs and demands of Member States with adequate infrastructure in place for the next 20–25 years. The goals are to:

- Redesign and expand the current infrastructure to ensure the efficiency and effectiveness of laboratory operations and services to better meet the current and future requirements of Member States;
- Ensure that the laboratories remain a vibrant research and training institution that continues to attract highly qualified scientists and other staff committed to advancing applied nuclear sciences to serve the needs and interests of Member States.

The Current Situation

The NA Laboratories in Seibersdorf comprise eight laboratory groups, five of which are co-operatively supported by the FAO and the IAEA through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. The laboratories support the delivery of nuclear sciences and applications through regular budget-supported activities, such as coordinated research projects (CRPs), through extra-budgetary mechanisms and through the IAEA's Technical Cooperation Programme. Currently 87 staff work in Seibersdorf, including 58 staff at the FAO/IAEA Agriculture & Biotechnology Laboratories, supported by consultants, cost-free experts, visiting scientists and interns. The laboratories maintain a balance among applied/adaptive research and development, education and training, and scientific and technical services. Key activities in the laboratories include:

- ***Applied/Adaptive Research and Development:*** All laboratories are instrumental in developing and adapting proven methodologies and technologies for transfer to Member States. Research is demand driven and leads to new possibilities in the provision of services that in turn support research in Member State laboratories. Currently, over 50 CRPs are directly supported by the NA laboratories in Seibersdorf.
- ***Education and Training:*** The NA laboratories provide trainees and fellows from Member States with hands-on training in nuclear techniques through the TC programme and via extra-budgetary funding. The number of fellows, scientific visitors, training course and workshop participants is currently reaching 350 Member State experts per year. Most training courses are oversubscribed and there is currently little capacity to receive more.
- ***Scientific and Technical Services:*** The laboratories provide quality assured technical services, such as calibration and dosimetry audits, reference materials, proficiency testing and other analytical support services the demand for which continues to grow. The laboratories' services include supporting the research of Member States' scientific institutions by establishing and sharing best practices worldwide and building collaborative global scientific networks.
- ***Support for the Delivery of Technical Cooperation Projects:*** The NA laboratories currently provide support to almost 300 TC projects through education and training activities, scientific and technical services and technical advice.

The Need for ReNuAL

Established in 1962, more than 50 years ago, demands on the NA Laboratories in Seibersdorf have continually increased in order to meet the evolving needs and demands of Member States; as the numbers of Member States grow; and as more have recognized the value of the laboratories and sought their support. These demands are expected to further increase in the future as the issues that the laboratories are expected to address continue to evolve.

While the laboratories have seen individual upgrades and extensions during the past 51 years, these were implemented sporadically and in response to individual needs but without an overall and comprehensive concept. No concerted renovation or significant new construction has taken place during this period. Whereas technologies and techniques used in the laboratories have changed dramatically over time, the facilities have not evolved to match the requirements for operations, training and compliance with current safety and security regulations and relevant quality management requirements.

The NA laboratories in Seibersdorf need both a quantitative and a qualitative enhancement. New investments in space and equipment is essential to secure the future of the laboratories for the benefit of Member States and to ensure that individual laboratories and support operations are fully compliant with the latest safety and security standards for laboratory research facilities.

At the 2012 IAEA General Conference, Director General Amano expressed his intention to launch a new initiative for to the modernization of the IAEA's Nuclear Sciences and Applications Laboratories at Seibersdorf, of which the FAO/IAEA Agriculture & Biotechnology Laboratories are the largest single component. This initiative was supported through the adoption of Resolution GC(56)/RES/12. In August, this year, FAO Director General da Silva warmly welcomed the invitation of Mr Amano to support this initiative and to assist in mobilising the necessary resources among Member Countries. As part of this endeavour, the current document outlines this initiative, targeted to ensure the availability of fit-for-purpose laboratories appropriately positioned to meet the needs and demands of Member States for the next 15-20 years.

Major Elements of ReNuAL

The ***ReNuAL*** project aims to ensure adequate infrastructure and equipment and a forward-looking approach for the FAO/IAEA Agriculture & Biotechnology Laboratories to carry out their mandate proficiently. Current projections, taking into account specific laboratory needs, space norms and training forecasts, foresee an increase in overall space of 59% compared to the current situation. Acquiring a balanced mix of key programmatic priorities and the necessary laboratory, office and training space, along with the highest priority equipment, will be crucial to the success of this project.

The current ***ReNuAL*** project, with strict adherence to programmatic prioritization, incorporates the following:

- The comprehensive renovation of the current laboratory facilities to ensure adherence to applicable safety regulations and to guidelines on barrier-free access for the disabled;
- Scientific equipment and instrumentation that ensure methodological alignment with the majority of external stakeholders;
- Design, planning, contingency and project management costs commensurate with the volume of the projected construction and renovation plan.

Budgetary Target and Timeline

The ***ReNuAL*** concept anticipates a tentative preliminary budget of around €31 million over the next four years, and envisages completion by 2017. It foresees financing through a combination of regular budget and extrabudgetary funding. To this end, the IAEA has allocated approximately €2.6 million of Regular Budget funds each year over the next four years, i.e. a total of around €11 million, while the remaining investments will be generated from a variety of extrabudgetary sources. Efforts will also be made to attract private sector support.

Fit-for-Purpose Laboratories

The ***ReNuAL*** project will ensure that the laboratories will:

- Serve as a hub for growing networks of Member State laboratories in the respective thematic areas as a means to enhance their sustainability;
- Address emerging issues, for example, the impact of and adaption to climate change, new transboundary animal diseases, rapidly growing issues in the field of cancer;
- Foster the development of new nuclear applications, products and services;
- Increase capacity-building activities by providing hands-on training in both conversant and new areas;
- Institutionalize a systematic approach to quality assurance through modern facilities capable of accreditation to international standards, where relevant, and contribute to improving the quality of Member States' laboratories within the framework of respective agricultural, food, environmental, health and safety standards.

From Labs to Member States

The Joint FAO/IAEA Agriculture & Biotechnology Laboratories (ABL) in Seibersdorf support and implement programmatic activities in response to Member State needs in the areas of food and agriculture. Their mandate is to assist Member States in the development and adaptation of new and existing technologies, involving isotopes, radiation and complementary techniques, to suit local requirements and environmental conditions, and to provide relevant training and analytical services.

Applied research and development are linked to coordinated research activities and technical cooperation projects, two of the IAEA's main delivery mechanisms in transferring nuclear technologies to Member States. The laboratories research and develop new and adapt existing technologies to suit local needs in Member States. This creates extraordinary opportunities for the laboratories' scientists and technicians to work with external stakeholders and Member States in meeting the often very specific challenges of both developing and developed countries. During the subsequent technology transfer process, laboratory outputs are disseminated and tested in the field and results are fed back for further improvement and validation — providing the unique feedback loop that makes this approach so effective.

Training and capacity building are crucial components of technology transfer. While most training activities are carried out and supported locally in Member States or in regional laboratories, numerous train-the-trainer workshops, courses and seminars are held at the FAO/IAEA Agriculture & Biotechnology Laboratories, involving several hundred trainees annually, with the overall goal of building sustainable capacity in Member States. While the key impetus may be the technology, thorough emphasis is placed also on the wider aspects of the problems to be studied or solved. Thus, trainees return home with comprehensive knowledge and with an extensive scientific and technical network ready to assist.

Technical and analytical support are provided to Member States through evaluation, standardization and selection of appropriate equipment and processes for each specific project and need, taking into account local conditions and infrastructure. FAO and IAEA technical staff responsible for implementing field projects has extensive experience in routine operations, maintenance and repair of the necessary processes and equipment.

The NA Laboratories in Seibersdorf

The NA laboratories in Seibersdorf — eight in total — are a unique feature in the United Nations system. Five of these laboratories are co-operatively managed by the FAO and the IAEA through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. These are:

- The **Animal Production and Health Laboratory** supports Member States in the use of radioisotopes and related technologies to map superior genes for increased animal productivity, and develops and transfers molecular and immunoassay methods for diagnosis and control of transboundary animal diseases.
- The **Food and Environmental Protection Laboratory** uses nuclear technologies to trace and authenticate food products and to detect and monitor contaminants in foods and the environment, improving Member State laboratory practices in food safety and quality to safeguard health and facilitate international trade.
- The **Insect Pest Control Laboratory** develops environmentally friendly methods of pest control for area-wide control of key insect pests, such as fruit flies, tsetse flies, moths and disease transmitting mosquitoes. It is renowned worldwide for its work on the sterile insect technique.
- The **Plant Breeding and Genetics Laboratory** focuses on mutation breeding to increase biodiversity for desired traits of crop plants and hence to accelerate the breeding of varieties with higher yield, yield stability, nutrition and improved resistance to environmental stresses such as disease, drought and salinity.
- The **Soil and Water Management and Crop Nutrition Laboratory** uses isotopic and radiation methods to measure and monitor soil, water and nutrients in cropping systems as a basis for developing strategies that ensure judicious and efficient use of resources and that minimize environmental degradation.

The three NA laboratories at Seibersdorf operated exclusively by the IAEA are:

- The **Dosimetry Laboratory**, part of the IAEA's human health programme, oversees the quality assurance aspects of the use of radiation in medicine in Member States. It provides dosimetry calibrations for national standards laboratories and conducts audits of the dose in radiotherapy and radiation protection.
- The **Nuclear Spectrometry and Applications Laboratory**, part of the IAEA's nuclear science programme, works with laboratories in Member States to enhance their use of nuclear instrumentation and analytical techniques, for example in promoting the use of various types of accelerator for materials testing and historical artefact preservation.
- The **Terrestrial Environment Laboratory**, part of the IAEA's environment programme, helps Member States to better understand and protect the terrestrial environment. To this end, the laboratory develops environmental assessment strategies and ensures the quality of analytical results by recommending methods, providing reference materials and organizing proficiency tests.

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  http://www-naweb.iaea.org/nafa/swmn/index.html

- Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture:
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