August 2011

RELEASE

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

The newsletter of the New Zealand Agricultural Greenhouse Gas Research Centre

Director's Update

Welcome to issue 3 of the NZAGRC Newsletter. I am not sure where the time is going, the last few months have flown by.

We celebrate the first full year of the science programme by collecting the first tranche of annual reports. I am pleased to say that the science programmes are progressing well, milestones are being achieved and publications are emerging from the work.

The profile of the Centre overseas seems to be growing judging by the number of visitors that are coming to the Centre. I have spent time with Andy, Victoria and our scientists hosting visitors from China, Thailand, Uruguay, Chile, the Netherlands, UK and USA. This is in addition to attending meetings and conferences (recently in Korea, Australia) at the request of international research organisations.

The Centre has recently been appointed by MAF to administer the LEARN fellowship programme and the GRASS Awards; two capability building funds worth NZ$0.8M that facilitate research exchanges for emerging researchers, technicians and senior scientists to and from New Zealand. This is in addition to our role co-chairing and supporting the Livestock Research Group and assisting MAF with general science input to the Alliance.

Enjoy reading

Dr Harry Clark

Staff News

Harry's Angels From left to right: Victoria Bradley, Kate Parlane and Heather Went

The NZAGRC are pleased to welcome **Dr Heather Went** back from maternity leave to work part time. Heather has been tirelessly crocheting winter bonnets for son Joshua born in February, but is excited to be resuming her role as Centre Operations Manager. Heather will be available at the Centre on Monday and Tuesday and will be responsible for the operational activity of the Centre and the Centre's Science Programme.

Dr Victoria Bradley has been appointed to the position of Operations Manager (International) working with Dr Andy Reisinger Deputy Director (International). In this new position Victoria will work with Andy in leading New Zealand's science contribution to the Global Research Alliance and its Livestock Research Group, and supporting the Centre Director Dr Harry Clark in his role as co-chair of the Livestock Research Group. Victoria joined the Centre in September 2010 from her previous role of Manager, Research Strategy and Policy at Massey University. Her new role includes overseeing the administration of the LEARN Fellowships and GRASS awards and the development of collaborative research opportunities with member countries of the Livestock Research Group and stock-take of research activities across the Alliance.

Kate Parlane is the NZAGRC Administrator and continues to do a wonderful job keeping everything together.

Hon Tim Groser, (NZ's Minister for Trade and for International Climate Change Negotiations) sitting with Hayden Montgomery (NZ Alliance Secretariat) (L-R) and opening the Summit

Global Research Alliance takes its next step

The inaugural Ministerial Summit of the Global Research Alliance on Agricultural Greenhouse Gases took place on Friday 24 June 2011 in Rome, Italy.

The Summit was an opportunity to bring together Ministers and other representatives from Alliance countries to formally launch the Alliance's working phase. This was marked by the signing of the Alliance Charter which acknowledges the frontline role of farmers in addressing the challenges of food security and climate change, and strives to deliver outcomes in this regard. It sets up a framework for country membership and a structure for partners to participate in the Alliance's work.

Thirty three countries were represented at the Summit: Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Finland, France, Germany, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Peru, the Philippines, Republic of Korea, Russia, Spain, Sweden, Switzerland, Thailand, UK, USA, Uruguay and Vietnam. The Alliance now has 32 member countries.

Representatives from the countries chairing the Research and Cross-Cutting Groups presented a high-level summary of their work to date and their plans for the future, which were very well received by Ministers and Senior Officials.

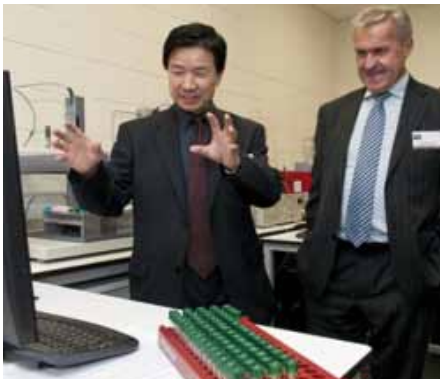
The summit was followed by the inaugural meeting of the Alliance Council, the formal decision-making body of the Alliance. During the meeting, the Council confirmed the Chairs of the Research and Cross-Cutting Groups as follows:

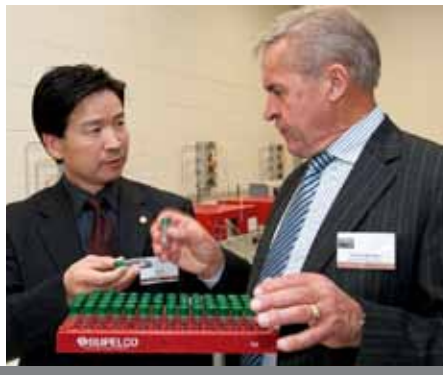
Research Group	Chair	Country
Croplands Research Group	Steve Shafer, US Department of Agriculture	USA
Livestock Research Group	Martin Scholten, Wageningen University and Harry Clark, NZ Agricultural Greenhouse Gas Research Centre	Netherlands and New Zealand
Paddy Rice Research Group	Kaz Yagi, National Institute for Agro-Environmental Sciences and Alvaro Roel, INIA	Japan and Uruguay
Soil Carbon & Nitrogen Cycling Cross-Cutting Group	Bill Slattery, Department of Climate Change and Energy Efficiency and Jean-Francois Soussana, INRA	Australia and France
Inventory/Measurement Issues Cross-Cutting Group	Ian Campbell, Agriculture & Agri-Food Canada and Jan Verhagen, Wageningen University	Canada and the Netherlands

The Council confirmed Canada as the host of the next Council meeting (2012). Dates for the next Research Group meetings were confirmed as follows:

- **20 OCTOBER 2011:** Croplands Research Group meeting – San Antonio, Texas, USA (in the margins of the annual Soil Science Society international meetings)
- **5-6 NOVEMBER 2011:** Livestock Research Group meeting – Amsterdam, the Netherlands (in the margins of the 6th Int. Symposium on Non-CO2 Greenhouse Gases)
- **18 NOVEMBER 2011:** Paddy Rice Group meeting – Tsukuba, Japan
- **MID-NOVEMBER 2011 (TBC):** Inventory & Measurement Cross-Cutting Group workshop proposed in Canada

New Zealand hosted the Summit meeting at the FAO headquarters in Rome, Italy





Hon. David Carter opens the National Centre for Nitrous Oxide Measurement at Lincoln University aided by Professor Hong J. Di, Professor Roger Field and Professor Keith Cameron.

New centre at Lincoln University gets the measure of greenhouse gas emissions:

the Minister of Agriculture opens the National Centre for Nitrous Oxide Measurement

Minister of Agriculture, the Hon. David Carter formally opened the National Centre for Nitrous Oxide Measurement at Lincoln University on April 1st, which will see a tripling in New Zealand's capacity to measure nitrous oxide greenhouse gas emissions.

The new Centre has a capacity to process more than 1000 nitrous oxide samples a day, making it one of the best specialist facilities of its type in the world.

Funding of $0.5m for the new facility was provided by the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) in response to an urgent need to increase New Zealand's nitrous oxide measurement capacity. This funding enabled the upgrading and extension of an existing laboratory to provide a single facility, purpose designed to house nitrous oxide measurement equipment previously distributed across multiple sites.

The National Centre for Nitrous Oxide Measurement has seven gas chromatographs for measuring nitrous oxide, each equipped with an auto-sampler and a computer enabling the rapid processing of large numbers of gas samples. Three technical officers are funded to support the Centre. Lincoln University's Vice-Chancellor, Professor Roger Field, says the University is "delighted to host this important Centre to enhance our research capacity and to work together with our partners in reducing the environmental impact of pastoral farming".

Nitrous oxide makes up around one-third of all greenhouse gas emissions from New Zealand agriculture. Professor Hong J. Di, Professor of Soil and Environmental Science at Lincoln University and Principal Investigator of the nitrous oxide mitigation research programme within the NZAGRC says "investment in the National Centre for Nitrous Oxide Measurement confirms New Zealand's commitment to reducing nitrous emissions from pastoral agriculture and reinforces our leadership in agricultural greenhouse gas research. Our work in the Centre will also complement Lincoln University's long-standing parallel involvement with the processes and mitigation of nitrate leaching in agricultural soils".

NZAGRC Director, Dr Harry Clark, says "Our goal is to develop technologies and practices that reduce agricultural emissions and the National Centre for Nitrous Oxide Measurement will enhance New Zealand's capacity in the nitrous oxide measurement area and facilitate the forging of the national and international partnerships that are necessary to achieve this goal".

Laboratory Technicians Manjula Premaratne, Tom Simpson and Angela Reid with the Hon David Carter during the opening of the National Centre for Nitrous Oxide Measurement

New laboratory's technical team keen to 'stay ahead of the game'

It's teamwork and collaboration all the way in the daily running of the National Centre for Nitrous Oxide Measurement at Lincoln University.

Technical staff Manjula Premaratne, Tom Simpson and Angela Reid (pictured above), representing a mix of Lincoln University and AgResearch affiliations, have established themselves as a smooth running team since the Centre was launched on 1 April this year. The three work with determination and cooperation towards meeting the Centre's capacity to process more than 1000 nitrous oxide samples a day.

"Since we opened we have processed some 30,000 samples," says Manjula, "and I believe that we have the greatest capacity of any laboratory of this type in the world".

However, while the team is proud of the speed of their through-put in the laboratory, quality is the real criterion for judging the Centre.

"Monitoring and maintaining the quality of our analyses and data recording processes absorbs our attention very much. Every single run has its own set of standards per day, and we watch very carefully to ensure our measurements stay inside the expected parameters."

Although Manjula, Tom and Angela are on duty the length of a normal working day, the Centre's equipment runs around the clock. Samples typically arrive by courier first thing in the morning - anything up to 600 at a time - and they are prepared and loaded into the gas chromatographs. The samples come from throughout the country, for example the AgResearch ones come from Invermay, Ruakura and Palmerston North. Angela and Tom generally look after these ones, but it's all teamwork according to the workload.

Manjula usually works on the samples from Lincoln University's own research, particularly the nitrification inhibitor work of Professors Hong Di and Keith Cameron and their postgraduate students.

Emissions inventories work by Professor Frank Kelliher provides another stream of samples for the Centre.

Technical problems, when they arise, are usually resolved in-house as far as possible. Manjula, who has been at Lincoln University for five years, is very familiar with the equipment and generally able to fix anything.

"The technical maintenance issue is an important one," says Tom. "It is vital to keep one step ahead of any possible hitches and be proactive, rather than reactive. Our service has a heavy weight of expectation attached to it. We strive to ensure that samples are processed with maximum efficiency and with the greatest accuracy possible."

When Agriculture Minister David Carter opened the Centre he mentioned the 'international respect' New Zealand enjoyed for the responsible acceptance of its Kyoto liabilities. "We believe we are adding to that respect through the smooth operation of one of the best specialist facilities of its type in the world and we want to keep it that way by staying ahead of the game."

Is biochar a possible solution for the mitigation of pastoral GHG emissions?

Article by Surinder Saggar, Marta Camps and Mike Hedley

The biochar pyrolisis machine which was built by scientists is based at Massey University

Biochar being tested under different soil/ pasture types

Prof Marta Camps with PhD student Saman Herath testing different varieties of Biochar

Biochar is charcoal created by the pyrolysis of biomass under carefully controlled conditions. It differs from ordinary charcoal because its primary use is not for fuel but for soil amendment for carbon sequestration. Research funded by MAF, SLMACC, and NZAGRC and undertaken at Massey University, Landcare Research, Lincoln University and AgResearch is trying to understand the full potential of biochar for the mitigation of pastoral greenhouse gases (GHG's).

Image 1: A sample of Biochar

There is a growing interest in the use of biochar to store carbon in soils, reduce emissions of the agricultural GHG's - nitrous oxide (N_2O) and methane (CH_4), and enhance agricultural productivity. Biochar is intended to be added to soils to improve soil functions and to reduce emissions from the organic material that would otherwise naturally degrade to carbon dioxide. Adding biochar to soil generally raises the pH, increases total nitrogen (N) and potassium, improves cation-exchange capacity, and enhances root development.

Biochar is produced through the pyrolysis of feedstock at a temperature of 300–600°C, under partial or complete exclusion of oxygen (Image 1).

The effect of biochar amendments on soil processes is regulated in part by the biochar properties which can be highly variable as they depend upon the type of feedstock and the pyrolysis conditions. It is also affected by the depth of incorporation of the biochar, drainage conditions in the soil, and the amount of biochar applied. The multiplicity of factors involved may explain why to date no clear picture has emerged as to the efficacy of biochar in reducing GHG emissions and increasing soil carbon.

Not all the biochar created is equal and the contradictory findings on the effect of biochar in reducing N_2O emissions is limiting the development of strategies and technologies to recommend the use of biochar to mitigate N_2O emissions and increase the consumption of CH_4 in soils. There are substantial knowledge gaps that require both laboratory and field research to determine the right type, optimal rate and timing and the method of incorporation of biochar that could influence the nitrification and denitrification and result in reducing N_2O emissions and conserving carbon. Professors Surinder Saggar (Landcare Research), Marta Camps, Jim Jones and Mike Hedley (Massey University), Tim Clough and Leo Condron (Lincoln University) lead research programmes to prepare and compare biochars, and to develop technologies on how best to apply them to soil to increase soil C, reduce N_2O emissions, and increase the consumption of CH_4 in soils.

Current research funded by the NZAGRC is focused on the use of biochar in pasture soils to promote deep root growth and on the development of a robust methodology for the monitoring of root density, black carbon and stabilised natural organic matter in soils. The ultimate aim of this research is to provide the farming community with a technology and tool that will improve their soil carbon storage and reduce N_2O emissions.

From tiny bottles to grazing sheep and cows...

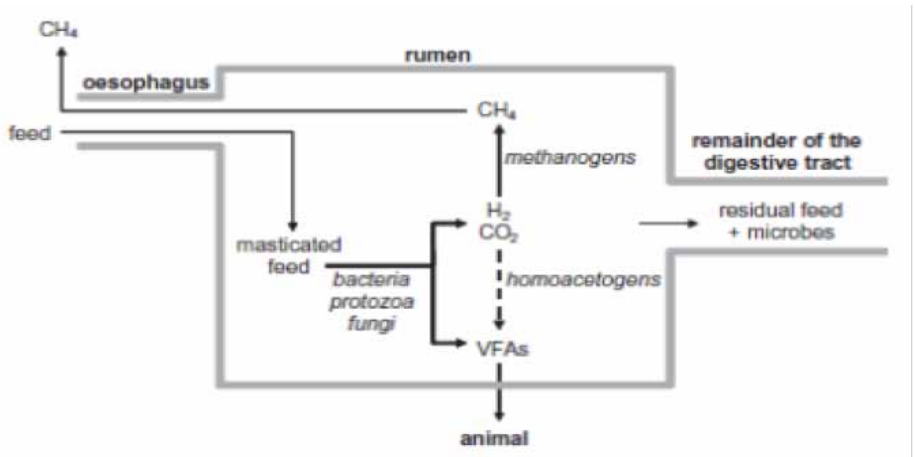
Rumen samples from sheep and cattle.

A tool for screening and validating strategies to lower methane from ruminants

Cesar Pinares and Stefan Muetzel

When feed is fermented in the digestive tract (chiefly rumen) to produce Volatile Fatty Acids (VFAs are the main source of energy for the animal), there is a large surplus of hydrogen (H_2), which if not removed will impair rumen function. Methane (CH_4) is the principle route by which H_2 is removed (Figure 1). This task is performed by a special group of microbes that derive their energy from the conversion of carbon dioxide (CO_2) and H_2 to CH_4. Finding ways to stop methane production, while at the same time ensuring that feed is fermented efficiently, is a complex task and it is being approached from a number of angles. A common element in all attempts to reduce CH_4 production by ruminants is the need to measure whether an approach is successfully inhibiting CH_4. In the long run these approaches have to be tested in animals, (but for a number of reasons (for example; cost, practicality and animal welfare considerations) laboratory methods which can 'simulate' what is happening in the rumen of an animal are needed as a first level of the process of research.

Figure 1.



Rumen fermentation processes leading to the production of H_2 and carbon dioxide (CO_2), which are used at the last step of the process to produce CH_4 by methanogens. Methane is mainly eructated. Homoacetogens form acetate from H_2 and CO_2, but this pathway is postulated to be of minor importance in the rumen (from Buddle et al. 2011). 'Strategies to reduce methane emissions from farmed ruminants grazing on pasture'; The Veterinary Journal Issue 1 April 2011.

Scientists working for AgResearch at the Grasslands Campus in Palmerston North, with funding support from MAF, the PGgRc and the NZAGRC, have developed and tested a suite of in-vitro and in-vivo research facilities that allow them to rapidly and cost-effectively evaluate strategies for their potential to lower CH_4 emissions from ruminants. The facilities include two separate in vitro incubation systems,

respiration chambers (24 for sheep and 4 for cattle) for the accurate measurement of emissions from animals indoors and a field based technique that relies on the use of an inert tracer (SF_6). In principle, CH_4 emissions from ruminants can either be decreased by eliminating methanogens in the rumen (inhibition) or by finding alternative ways of getting rid of their energy source, H_2; essentially starving them into submission. Both strategies are being investigated at AgResearch using a three-stage protocol which starts with a test tube and, for promising approaches, it finishes with an animal trial in the field.

The first stage of the protocol is a rumen simulation in a bottle called a batch culture technique. Here a sample is incubated with buffered rumen fluid in a small bottle connected to a pressure sensor and a gas chromatograph. The total gas production and the concentration of CH_4 and H_2 are measured continuously over a 24 hour period using the gas chromatograph. With this system, samples that show a specific decrease in CH_4 emissions can be separated from those that decrease methane by a general decrease in total gas production which would indicate reduced fermentation and hence loss of productivity. The measurement of CH_4 and H_2 also allows the differentiation between a CH_4 inhibitor and a H_2 sink. The in-vitro batch culture can measure 14 duplicate samples at a time.

If a sample has shown the potential to decrease CH_4 in the batch culture system it goes through to the second stage, testing in a continuous culture system. The principle of this system is the same as the batch culture, but both feed and buffer are supplied continuously into the bottles over a period of 7 to 14 days. This system gives an indication of the longer term effects; does the rumen microbial community change over time and inactivate the approach? This is not uncommon since rumen microorganisms are a diverse consortium of species that can utilise a vast range of feed substrates and rapidly accumulate in sufficient numbers to degrade variety of compounds. The continuous culture system has capability for evaluating 6 samples at a time.

Once it has been established that a substance reduces CH_4 in the continuous culture system the material may then progress to the third stage of testing – the animals. In indoor trials, the animals (sheep or cattle) are placed in a respiration chamber, which is a clear box through which a constant stream of air is passed. Measurements of the CH_4 concentration of the air entering the chamber and the air leaving the chamber allow the calculation of the amount of methane being produced by the animal. Animal welfare is of paramount concern and the animals are provided with feed twice a day and environmental parameters (i.e. humidity, CO_2 concentration, and temperature) are controlled and monitored continuously. This method is the most precise measurement of CH_4 emission from an animal that can be made.

Finally, once a substance of interest has shown mitigation effects when emissions of CH_4 were measured in respiration chambers, the mitigation effects and benefits should be tested in field. The New Zealand livestock farming system is based on the use of pastures. For these conditions, the SF_6 tracer technique is the technique of choice. It involves the dosing into the rumen of a small brass capsule containing a small amount of the SF_6 gas. Then, breath samples from individual animals are collected using a container which had been evacuated. CH_4 emissions are estimated from the concentration of gases CH_4 and SF_6 in the breath samples and the known release of SF_6 from the brass permeation tubes. The SF_6 tracer technique capability allows simultaneous measurements of emissions from up to 100 sheep and cattle at grazing.

This strategy for testing feeds or additives for their effects on CH_4 emission has been tested in the past years and offers an opportunity for accurate screening of various CH_4 reducing treatments or strategies and a final validation in the field.

Sheep in the respiration chamber at the New Zealand Ruminant Methane Measurement Centre, Palmerston North

The SF_6 tracer being used in the field on cattle

New Zealand Agricultural Greenhouse Gas Research Centre **Capability Development Fund**

During the last 12 months, the NZAGRC has provided funding through its Capability Fund for three summer studentships, an Honour's project, and a Master's student and through its core science programmes has sponsored three PhD students, an early career intern and a Post Doctoral Fellow.

The NZAGRC will continue to support young talented scientists through the 2011/2012 year, and is proud to introduce the latest talent to you. Helen Walker and Sam McNally both start doctoral research in soil science funded through NZAGRC pipeline scholarships.

Helen Walker

Helen Walker (neé Free) is building on her honours research involving biochar, soil biology and nutrient management. Her doctoral work is now aimed at addressing fundamental gaps in the understanding of how soils respond to changes in management (e.g., grazing intensity and/or fertiliser inputs) and how changes in the supply and form of carbon brought about by management or by different plant species (or functions/traits) can affect the fate of C and N by altering the balance of different classes of micro-organism or organism function (e.g., autotrophs vs heterotrophs). Modelling by Dr John Thornley (NZAGRC Fellow) and Professor Tony Parsons (Massey University) is addressing the key drivers of change in soil C sequestration versus loss. Helen's work will provide data to enable the model to be tested. By investigating how fluxes of carbon and nitrogen affect the balance of expression of key process genes in soil, Helen's work will leverage technical developments and expertise from an MSI programme led by Professor Parsons and Dr Susanne Rasmussen (AgResearch).

Helen's PhD supervisors are Jacqueline Rowarth, Tony Parsons and Professor Mike Hedley (Massey University). Advisors are Associate Professor Louis Schipper (Waikato University), and Drs Susanne Rasmussen and Paul Newton (AgResearch).

Sam McNally

Sam will investigate the conversion of carbon derived from shoots and roots of different pasture species to stable soil organic matter. The goal of Sam's study will be to identify which pasture species might result in an accumulation of carbon in soil.

Sam completed a BSc and MSc through the Chemistry Department at University of Waikato along with courses in soil science. His MSc thesis focused on the status of selenium and iodine in Waikato Soils and was in collaboration Waikato Regional Council. He comes from an agricultural background growing up on a sheep and beef farm and more recently on a kiwifruit orchard which helped him gain an understanding of the role that soil plays in agricultural and horticultural production. In 2006, Sam received a sporting Blue from University of Waikato for representing New Zealand at the World Junior Orienteering competition.

Sam will be supervised by Louis Schipper at the University of Waikato who is leading a team investigating ways in which soil carbon can be accumulated in pasture soils. Other members of the supervisory team include Mike Dodd (AgResearch) and Johan Six (University of California Davis).

The New Zealand Fund for Global Partnerships in Livestock Emissions Research

New Zealand has established a contestible, international fund worth NZ$25 million to support research on mitigating greenhouse gas emissions from pastoral farming.

New Zealand Agriculture Minister David Carter announced the New Zealand Fund for Global Partnerships in Livestock Emissions Research at the inaugural ministerial meeting of the Global Research Alliance in Rome on June 24, 2011.

The fund draws on the $45 million New Zealand committed to the Alliance in 2009, and it will be allocated over four years.

The fund is open to international scientists, and it is hoped that multi-stakeholder/country consortia bids will be put forward. Projects can be led by New Zealand or international participants, but must include a New Zealand partner. Co-funding from international participants will be encouraged.

The project proposals need to demonstrate a balance between innovative science and the achievement of cost-effective and sustainable solutions for livestock farmers in New Zealand and around the world.

There will be a two-step process for assessing proposals. First an international Expression of Interest will be called and successful applicants will then be invited to submit full proposals.

Updated information will be provided as the fund processes are developed. A call for Expressions of Interest will be made in late September.

Learn
Livestock Emissions & Abatement Research Network

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

Global Research Alliance Senior Scientist (GRASS) Award

Supporting research in Agricultural Greenhouse Gases

The New Zealand Government has announced funding for senior scientists to participate in an exchange programme to enhance collaboration and the building of mutually beneficial research partnerships between New Zealand and other Global Research Alliance countries.

Focus areas

- Methane emissions from livestock and livestock wastes
- Nitrous oxide emissions from livestock wastes
- Enhancement of pastoral soil carbon sinks
- Integrated whole farming systems impacts at all scales as they relate to livestock emissions.
- National inventory development as it relates to livestock emissions

Eligibility

To be eligible, you must:

- Have a PhD or be a scientist with at least 5 years experience participating in/leading major projects that align to the priorities of LEARN, the Alliance or other relevant national strategies
- Demonstrate impact and leadership in your professional field
- Be able to contribute to scientific research and its application in your home region and the larger Alliance network, based on your networking record
- Work in collaboration with a New Zealand research organisation
- Be resident and normally employed on a permanent contract by a research organisation in an Alliance member country
- Be fluent in English

Funding

The exchange must be between 6 weeks and 6 months duration.

- Up to $30,000 for 6 months (pro rata for less than 6 months) will be provided to recipients to cover actual and reasonable living expenses
- Up to $5,000 will be provided for economy airfares and travel/medical insurance
- Up to $5,000 will be awarded for associated research costs

For more details refer to the LEARN website: http://www.livestockemissions.net or email the New Zealand Agricultural Greenhouse Gas Research Centre: LRG-Enquiries@nzagrc.org.nz

New Zealand Greenhouse Gas Research Centre to provide technical support for a new international collaboration

As part of its commitment to improve global understanding of agricultural GHG emissions and mitigation options, the New Zealand Government, in support of the goals of the Global Research Alliance is sponsoring a major regional research project in South America.

In the field: GHG emissions mitigation research in Latin America

The project, led by Regional Fund for Agricultural Technology (FONTAGRO) and supported by the Inter-American Development Bank, aims to improve national inventories of greenhouse gas emissions and testing of mitigation options for pastoral livestock in Latin America and the Caribbean. Participating countries include Argentina, Chile, Colombia, the Dominican Republic and Uruguay. The project receives substantial co-funding from New Zealand. In addition, NZAGRC will provide technical support to help build much needed capacity for livestock mitigation research in the region.

The project will be led by Dr. Veronica Ciganda of the National Institute of Industry and Agriculture (INIA) of Uruguay. Veronica was the first recipient of a New Zealand LEARN Fellowship and spent time at AgResearch in New Zealand during 2008, which allowed her to foster links with New Zealand institutions and leading researchers. Veronica is also working as co-leader of the Ruminant sub-group of the Livestock Group of the Global Research Alliance.

Dr Veronica Ciganda

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