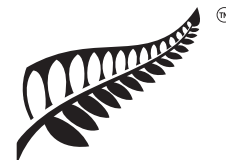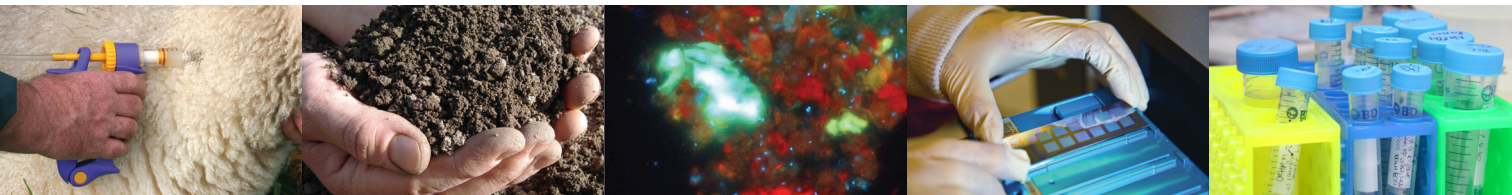**HIGHLIGHTS//**2012

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

Chairman's Report

Through its national and international roles and responsibilities, the NZAGRC continues to build its reputation as an important source of clear and unbiased advice on the science behind agricultural greenhouse gases and their mitigation options.

Professor Warren McNabb

Agriculture is part of a complex and dynamic social, economic and environmental system. With an ever growing world population to feed, it is vital that agricultural production increases, but not its environmental impacts. New Zealand is an integral part of this dynamic. It is a major food exporter and has increasing opportunities to upscale food production to meet a growing international demand. However, it also needs to do this in an environmentally sustainable manner.

The New Zealand Greenhouse Gas Research Centre (NZAGRC) was founded in 2010 in recognition of this challenge. The NZAGRC's key role is to find ways by which New Zealand can meet its international greenhouse gas emission obligations without reducing agricultural output and thus deliver economic, environmental and social benefits to New Zealand, as well as setting an example globally.

During 2011/12 the NZAGRC research programme has continued in earnest in line with the strategic science plan. The governance of the NZAGRC was formally reviewed at the end of 2011 with a very positive outcome. The report praised the Centre Director for excellent leadership and management and the Steering Group for setting and maintaining a very high quality of governance. The Steering Group's mode of operation has ensured that the nine members maintain a clear focus on the needs and goals of the NZAGRC rather than the organisations that they individually represent.

The Global Research Alliance on Agricultural Greenhouse Gases has gained significant momentum during the past year. The NZAGRC team continues to play an important national and international role through its work supporting the Livestock Research Group (LRG) and providing advice on overarching science issues. The first projects to receive Alliance funding from the Ministry for Primary Industries (MPI) are now underway and the NZAGRC's input has helped to ensure that New Zealand's domestic research efforts and global collaborations are well aligned.

Professor Warren McNabb
Chair of NZAGRC Steering Group
August 2012

Director's Report

The 2011/12 financial year has been another busy one for the NZAGRC. I'm pleased to say that the science programmes are progressing well, milestones are being achieved and usable results, outputs and publications are emerging from the research. Attracting and retaining talented researchers into the agricultural greenhouse gas area remains a key goal for the NZAGRC and we have continued to build on the progress made in 2011/12. This year we have provided assistance to 9 additional students, bringing us to a total of 28 young and early career scientists supported to date.

In addition to our Stakeholder and International Science Advisory Groups (SAG and ISAG), this year we established a Māori Advisory Group (MAG). This group is currently evaluating how the NZAGRC can best align with and add value to current Māori scientific, capability building and information provision initiatives. I would like to express my thanks to all of our Advisory Groups, and particularly to the Steering Group, for their dedication to the NZAGRC and the knowledgeable advice that they have provided throughout the last year.

The NZAGRC's input into the Global Research Alliance has grown considerably this year. In addition to co-chairing the Livestock Research Group and representing New Zealand at various Alliance meetings, we have provided MPI with scientific and administrative support for a range of initiatives being funded from the Government's $45m Alliance budget. These are profiled towards the end of this year's Highlights report.

2012/13 is shaping up to be eventful as the science strategy will undergo a formal review by our International Science Advisory Group which will form part of a more comprehensive review of the NZAGRC's progress against its contractual obligations. An exciting development is the move to more closely align the NZAGRC with the Pastoral Greenhouse Gas Research Consortium (PGgRc). A common research strategy and operating model for the two organisations has been developed and we believe that increased coordination will lead to a wide range of future benefits for the NZ agricultural GHG research effort.

Dr Harry Clark
NZAGRC Director
August 2012

I'd like to thank all of the scientists that have openly engaged with the process of informally reviewing our science plan in 2012 and their input into guiding the future goals of the research has been invaluable.

Dr Harry Clark

The New Zealand Agricultural Greenhouse Gas Research Centre

The NZAGRC is a partnership between the leading New Zealand research providers working in the agricultural greenhouse gas area and the Pastoral Greenhouse Gas Research Consortium (PGgRc).

It is 100% government-funded by the Ministry of Primary Industries (MPI) under the Primary Growth Partnership, a government-industry initiative that invests in significant programmes of research and innovation to boost the economic growth and sustainability of New Zealand's primary sectors (agriculture, fisheries/aquaculture and forestry). About NZ$48.5 million is being invested by the NZAGRC into research and development activities over ten years. The NZAGRC is a "virtual" Centre and the research that it funds is carried out by researchers working in their own organisations and collaborating across organisations. The NZAGRC administrative headquarters are in Palmerston North.

*NZAGRC Staff. L-R: **Kate Parlane** - Administrator, **Dr Victoria Hatton** - Operations Manager (International), **Dr Harry Clark** - Director, **Dr Heather Went** - Operations Manager, **Dr Andy Reisinger** - Deputy Director (International)*

The Mission

'To provide knowledge, technologies and practices which grow agriculture's ability to create wealth for New Zealand in a carbon-constrained world'

The NZAGRC is working with its member organisations, particularly the PGgRc as a joint venture of industry and government, to deliver science that is innovative, practical, credible and able to stand up to international peer review. The NZAGRC strives to ensure that its activities are transparent and effectively communicated to its stakeholders.

The Vision

'To be an internationally renowned centre for research and development into agricultural greenhouse gas mitigation solutions'

During 2011/12 the NZAGRC has taken further steps towards realising the vision of the Centre. Scientifically, work is progressing well and, following an informal review by the ISAG, some amendments are planned to the work programme to enhance the future goals and ensure delivery against the vision. The NZAGRC has been communicating its role, research and achievements to a wide audience via a quarterly newsletter (Release) and updated website amongst other vehicles. NZAGRC staff and key NZAGRC-funded researchers have been working alongside MPI to advance the goals of the Global Research Alliance and continue to actively promote New Zealand's expertise and leadership in this area on the international stage.

Leading Partners in Science

The NZAGRC has nine members, who between them represent research, development, education and industry. Each member brings unique strengths to the NZAGRC through the specific capabilities and expertise of their science teams and research facilities, and provides one representative to the NZAGRC Steering Group (SG).

agresearch
Farming, Food and Health. First™
Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi

Lead role in methane and nitrous oxide emission research and contributes to research in increasing soil carbon sinks. AgResearch also hosts the NZAGRC.
SG Chair: Professor Warren McNabb

MASSEY UNIVERSITY

Leads research into biochar and innovative management practices that reduce GHG emissions and facilitates a programme to develop capability and capacity in GHG mitigation research.
SG Rep: Professor Mike Hedley

Dairynz

Lead role in integrating research outcomes for the dairy industry, applying those outcomes in dairy farming systems and in stimulating uptake of new knowledge within the dairy industry.
SG Rep: Dr David Johns

NIWA
Taihoro Nukurangi

Lead role in assessing the effectiveness of mitigation outcomes on climate change impacts in New Zealand, and contributes to emission measurements.
SG Rep: Dr Murray Poulter

Landcare Research
Manaaki Whenua

Coordinates research in emission measurement and soil carbon and contributes to the nitrous oxide research programme.
SG Rep: Dr Peter Millard

PGgRc
PASTORAL GREENHOUSE GAS
RESEARCH CONSORTIUM

A major funder of methane mitigation research and a key conduit for industry guidance to ensure applicability of NZAGRC's research to the agriculture sector, and will be an important pathway for commercialisation and practice change.
SG Rep: Mark Aspin

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND
New Zealand's specialist land-based university

Leads research in nitrous oxide emission mitigation and facilitates a programme to develop new capability and capacity in GHG mitigations research.
SG Rep: Dr Peter John

Plant & Food
RESEARCH
RANGAHAU AHUMARA KAI

Leads research on soil carbon mitigation, stocks and rates of change and nitrous oxide mitigation.
SG Rep: Warrick Nelson

SCION
Next generation biomaterials

Contributes to research on soil carbon.
SG Rep: Dr Trevor Stuthridge

Capability Building

Increasing the pool of researchers with skills in the agricultural greenhouse gas mitigation area is a major objective for the NZAGRC.

To achieve this objective the NZAGRC funds promising students and early career researchers to build capability for the future. Some of this funding is embedded within the funding of the core science programme, with additional funding being available when high quality students are identified. The funding plan has three elements:

1. Short term scholarships to encourage promising undergraduate students to undertake postgraduate studies;

2. Well funded PhD stipends for high quality students; and

3. Fellowships for top post-doctoral and early career scientists on 2-3 year contracts.

In 2011/12 the undergraduate "pipeline" scholarship schemes continued with Massey and Lincoln Universities. These have now completed their second year and will be reviewed following the completion of the third intake of summer/Honours student scholarships. Two core science programmes accommodated short term Masters project students from overseas. These help to build international linkages and may lead to high calibre PhD students who remain in the agricultural greenhouse gas emissions field in the future. Additionally, one new PhD position has been established in the methane area.

The NZAGRC continues to be a major funder of PhD students in scientific research related to nutrition, animal and plant performance and greenhouse gas emissions in New Zealand.

Internationally, the GRASS award scheme allows senior NZ scientists to visit and work with colleagues in other Global Research Alliance member countries for extended periods, and to collaborate with overseas visitors in New Zealand.

Type of Capability Development	# new in 2011/12	Total funded to date
Undergraduate - Summer student	5	9
Undergraduate - Honours student	1	2
Masters Project	2	2
Masters		1
PhD	1	10
Post doctoral fellow		3
Early career scientist		1
	9	28

1: Alice Keir, 2: Peter West, 3: Roshean Fitzgerald, 4: Chelsea Hirst, Calvin Ball & Priya Saini, 5: James Wong, 6: Preeti Raju & Yang Li, 7: Nicolas Puche.
1-3 Lincoln University, 4-7 Massey University.

Stakeholder Engagement

The NZAGRC is advised by an International Science Advisory Group (ISAG) and a Stakeholder Advisory Group (SAG).

The former ensures that research carried out by the NZAGRC is internationally excellent, while the latter aims to ensure that research remains connected with practical realities of farming in New Zealand and that domestic stakeholders can both provide input to, and be informed of, the NZAGRC's research directions. In addition, a Māori Advisory Group was been established in 2012, recognising the special role but also particular challenges that Māori may face in mitigating agricultural greenhouse gases. This group has only started its work but has already signalled its keen intent to contribute to the effective working of the Centre.

A major highlight of the past year was the second annual conference of the NZAGRC in February 2012. This three day meeting brought leading NZAGRC researchers together with stakeholders from policy and industry, including the ISAG and SAG. Plenary presentations and poster displays showcased work to more than 150 delegates, followed by two days of science workshops to promote in-depth discussion of progress and research opportunities.

During 2011/12, the NZAGRC continued its regular profile in the media and with the wider scientific community and general public, including through its regular newsletter 'Release'. The NZAGRC website (www.nzagrc.org.nz) was revised to ensure easy access to the growing amount of information held by the Centre and research activities carried out under the Centre science programme by its partners. To join the NZAGRC's news and information mailing list, email enquiry@nzagrc.org.nz.

Scientists discuss latest research results during the 2012 NZAGRC conference

Andy Reisinger, NZAGRC Deputy Director, opening the 2012 NZAGRC conference

NZAGRC International Science Advisory Group

Science Programme
Methane

Principal Investigators: Dr Graeme Atwood and Dr Peter Janssen

The NZAGRC methane programme aims to reduce emissions by directly targeting methane-producing microbes (methanogens) in the rumen through inhibitors and vaccines, and indirectly through feeding and animal selection and breeding. Work is coordinated with and builds on research funded by PGgRc and/ or MPI. The programme made significant progress this year.

Inhibiting ruminant methane emissions, without compromising the normal digestive functions of the rumen, requires the targeting of methanogen-specific features. These are being identified by a genome sequencing strategy coordinated across the NZAGRC and PGgRc programmes. This year the genome sequence of another rumen methanogen, *Methanobrevibacter* sp. AbM4, has

been completed and its gene sequence information has been added to a growing rumen methanogen gene database. This database allows researchers to confirm targets for inhibitor and vaccine development and identify new targets for further investigation.

One potential consequence of inhibiting methane production in the rumen is likely to be the accumulation of H_2. This H_2 needs to be removed or it will inhibit rumen function. It is thought that homoacetogens (organisms that use H_2 and CO_2 to form acetate) could use this accumulated H_2, but this is currently an unproven assumption. Research is underway to measure homoacetogen activity when methanogens are inhibited, with the aim to isolate and study rumen homoacetogens, so that we can better

understand their role in the rumen and encourage their establishment in the absence of methanogens.

The year 2012/13 will see even closer alignment between the NZAGRC and PGgRc in the methane area, building on a joint research strategy developed during 2011/12 with a strong technology focus. The key strategic targets are the development of four mitigation options: breeding indices; vaccines; inhibitors; and forage systems. The goal is for proof of concept work to be completed by 2015. The longer term aim is to achieve a 1.5% emissions intensity reduction per annum from the four mitigation areas, over and above business as usual improvements, with an ability to have this recognised in the national inventory. Robust underpinning science is vital to achieve these targets.

Animal variation project provides wealth of information

A PGgRc-SLMACC-funded study conducted over the past five years has established that there is statistically significant variation between animals in the quantity of methane sheep emit per kg of food eaten. This variation is both heritable and repeatable, and the PGgRc now has a flock of high and low emitting sheep which is proving valuable to researchers. NZAGRC funding was added in 2010 and is being used to collect animal genomic information from the trial. By June 2012, all 1,000 sheep had been genotyped and the formal analytical process is now underway to see if genetic changes which account for the differences in emissions can be pinpointed and could be exploited for targeted breeding programmes.

First vaccine prototype being evaluated in sheep

Vaccination of ruminants has the potential to be a very cost-effective means of mitigating methane emissions by preventing or reducing the growth of methanogens in the rumen and impairing their ability to produce methane. NZ researchers have established a vaccine development pipeline and during 2011/12 they continued to identify and test prospective vaccine targets. A promising first candidate for a prototype anti-methanogen vaccine is currently being evaluated in sheep. A further seven vaccine targets have been identified, five of which have been used to immunise sheep. The antisera produced against these five new targets will be tested *in vitro* against pure cultures of methanogens to test their ability to inhibit their growth and methane production.

Science Programme
Nitrous Oxide

Principal Investigators: Dr Cecile de Klein and Professor Hong Di

Nitrous oxide (N_2O) is a potent greenhouse gas (GHG). In New Zealand, approximately 15% of total GHG emissions are N_2O.

The NZAGRC N_2O research programme seeks to reduce N_2O emissions from agriculture through novel technologies as well as exploring potential on-farm management options that could reduce emissions. The research team is focussing primarily on two key processes in the nitrogen cycle, nitrification and denitrification, both of which result in N_2O emissions but offer different mitigation options. Other work explores the potential to reduce the nitrogen content in pasture, which could also help reduce N_2O emissions.

Nitrification describes the chemical transformations that turn urea (from urine patches or the application of fertiliser) into nitrate through the complex actions of soil microbes. This gradual break-down generates N_2O as by-product. The team is investigating the genetic makeup of the microbes involved to guide the identification of new molecules that can supplement existing nitrification inhibitors (such as DCD). Additionally, scientists are looking to develop improved protocols for the use of existing nitrification inhibitors. The key to this research is fully understanding the current effectiveness of these products and then ensuring application at their most effective times and forms.

Denitrification describes the natural processes that turn nitrate in soils into nitrogen gas (N_2) but generate N_2O as an intermediate step. N_2 makes up approximately 80% of the earth's atmosphere and has no detrimental environmental impacts. The team are exploring ways in which the production of N_2 can be accelerated and thus N_2O emissions to the atmosphere reduced.

More applied work in this area draws on already extensive scientific information which shows that there is a threshold level of soil moisture above which N_2O emissions increase dramatically. This work aims to develop robust farm management guidelines relating to when and where to apply fertiliser and graze livestock during different times of the year to minimise N_2O losses.
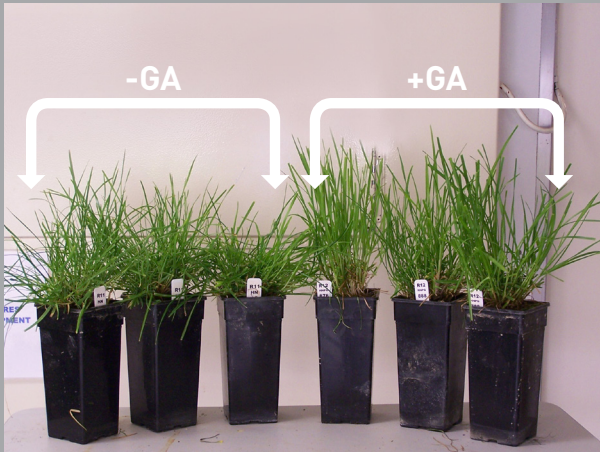
Trial shows significant growth potential in ryegrass under low N conditions

There is a common assumption that grass growth is at all times resource (e.g. N supply) limited and that to increase grass growth, additional N needs to be added, generally by adding fertiliser. The NZAGRC-funded team have conducted studies using a phytohormone, gibberellin, to understand whether common perennial grasses are growing to their full potential at all times given the resources available. Preliminary results clearly demonstrated the potential for stimulating ryegrass growth without adding more N and more broadly suggest that developing new pasture grass species which are able to produce high yielding plants with low N content is possible.

Aiming to manipulate denitrification

Even though denitrification is the primary process of N_2O production in pasture soils, there is still much more to understand about the detailed process. The NZAGRC-funded team's experiments so far have shown that New Zealand dairy-grazed pasture soils vary widely in denitrification enzyme activity (DEA), denitrification rate (DR), amounts of microorganism biomass present and N_2O/N_2 ratio. The key soil factors contributing to the differences in the amount of N_2O produced, DEA and DR and N_2O/N_2 ratio included the amount of available nitrate, phosphorus, soil moisture, soil microorganism biomass and soil carbon status. The next steps of the research will focus on understanding how soil, climatic and/or microorganism parameters affect the key microorganism community functions and whether/how these can be manipulated.

Science Programme
Soil Carbon

Principal Investigators: Professor Frank Kelliher and Dr David Whitehead

Sustainably increasing the quantity of carbon stored in agricultural soils has the potential to offset emissions of other greenhouse gases to the atmosphere. However, realising this potential is challenging, in part because soil carbon stocks are already high in New Zealand, having only recently been converted from forest cover to agriculture.

The NZAGRC programme has three distinct components: (1) assessing the potential to store carbon across the range of physical and climatic conditions found in New Zealand; (2) devising management practises to sustainably increase soil carbon storage; and (3) methods for verifying changes in soil carbon.
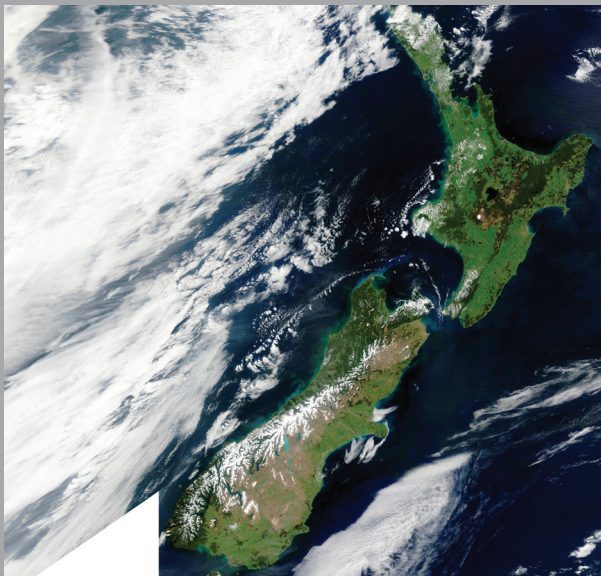
Data mining and modelling approaches have been used to estimate current stocks and upper limits of soil C. Analyses indicate that current stocks of soil C are strongly affected by soil classification, climate and land use, while specific soil properties (e.g. mineral surface area) influence the upper limits of soil C storage.

Experimental approaches to assess the potential of farm management practices for increasing carbon storage in soil are now well established. These comprise re-grassing to convert conventional ryegrass pasture into a high diversity sward (changes carbon input), introduction of exotic earthworms into pastures (carbon incorporation with depth) and addition of biochar to soil (retention of carbon). Different methodologies are being used at experimental sites to address the challenge of measuring small changes in soil carbon storage against a background of high and variable carbon stocks. Considerable progress has also been made in further developing models that can simulate and predict the effects of the experimental treatments. In turn, those models will allow forecasting of the long-term impacts of different farm management options at larger spatial scales.

The final focus area is to develop improved methods to verify temporal changes in soil carbon storage and develop a rule system suitable for a national inventory of agricultural soils. One aspect has been to measure C storage to depth of 1m in soils beneath pasture which for 60 years had been grazed by sheep and received either rainfall or rainfall plus irrigation as required during summer. In an allied SLMACC project, by meta-analysis of 56 pastoral soil profiles from across NZ, we quantified the uncertainty of using data from shallow samples to estimate total C storage to deeper depths.

Using modelling to understand and extend experimental results

The Hurley Pasture Model (HPM) accounts for changes in soil carbon in relation to farm management. It focuses strongly on grazing processes, inputs of carbon and nitrogen from grazing animals and addition of nitrogen fertiliser. This model is being used to explore long-term effects of farm management practices on soil carbon storage and retention. Initial modelling results demonstrate that the off-take of nitrogen in intensive, notably dairy, systems, leads to a reduction in carbon and nitrogen sequestered in soil. Together with results from NZAGRC-funded CenW modelling, these two approaches provide important theoretical support and tools to understand results from experiments, and allow the up-scaling of results from individual field plots to larger regions.

New modelling approach reduces uncertainty in soil carbon stocks

Modelling of current carbon stocks over the New Zealand landscape has produced a soil map of the 0-30 cm layer at a 1km spatial resolution. Due to the relatively short history of agriculture in NZ, dominant predictors of soil carbon were found to be soil type, environmental variables such as rainfall and the type and density of pre-human vegetation cover. The statistical uncertainty in this map is half that present in the current soil carbon model used by the NZ government, thus potentially offering a significant reduction in uncertainty in GHG inventory calculations. In conjunction with improved estimates of maximum soil C storage across New Zealand, this map will allow us to identify how and where soil carbon levels could potentially be increased.

Science Programme
Integrated Systems

Principal Investigators: Mr Dave Clark and Dr Robyn Dynes

This work area aligns closely with a SLMACC funded programme looking at developing profitable, practical low emitting farming systems. The NZAGRC fits within this broader work by developing better predictive mechanistic models for enteric methane emissions and nitrous oxide emissions from soils. These models can then by incorporated into simple farm systems models.

Assessing the impact of farm system changes (ruminant species, feeding level and feed type) on methane production is contingent on accurate rumen sub-models within a whole farm framework. However, existing process models that aim to predict methane yield from fresh forages have poor predictive ability. New equations for predicting molar proportions of volatile fatty acids (VFA) in the rumen of sheep fed fresh forages have been derived by meta-analysis of previous NZ experiments. These equations significantly improve the

predictive capability of existing models. An additional highlight in this area has been the development of a mathematical model of the interactions between H_2 concentrations and methanogen growth. Concentrations of H_2 in the rumen are critical for methanogen growth, methane and VFA production. Having a defensible model will be critical for the future assessment of putative mitigation strategies such as vaccines and chemical inhibitors.

Accurate monitoring of emissions is expensive, so assessment of on–farm nitrogen management strategies requires sound predictive models that take account of soil and climate variation at the farm scale. Two conceptually different models for estimating N_2O emissions, APSIM and DNDC have been compared for their ability to reflect different environmental conditions and to model N_2O emissions from urine patches in various experiments

from Waikato and Southland regions. The results are being compared with other models that predict nitrification, denitrification and N_2O emissions, particularly from urine patches which are likely to remain the major source of N_2O emissions from grazed pasture.

A database of N_2O emissions has been expanded with further emissions data from around NZ. The N_2O emissions from a dairy farm using a whole farm model with the relevant soil and climate data from the database have been estimated based on statistical analysis of measured N_2O emissions. These analyses suggest that in some circumstances, alternative management and the adoption of nitrification inhibitors during critical periods, stand-off pads, and timing of fertiliser and effluent application could reduce farm-scale N_2O emissions by up to 30%.

International Dimensions

GLOBAL
RESEARCH
ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

New Zealand Government

The Global Research Alliance on Agricultural Greenhouse Gases (Alliance) is a major international initiative to increase international collaboration and develop ways to reduce agricultural greenhouse gas emissions intensity while meeting growing food demand.

New Zealand hosts the Secretariat through MPI and co-chairs the Livestock Research Group (LRG) of the Alliance alongside the Netherlands. The NZAGRC is contracted to coordinate the New Zealand science input into the Alliance and the NZAGRC Director is the nominated New Zealand co-chair of the LRG. Since this international dimension provides important context and, in many cases, extension of New Zealand's domestic research efforts, highlights from this work are also covered in this booklet.

In the 2011/12 year, New Zealand launched five major targeted research projects in support of the objectives of the LRG. These projects seek to accelerate research led by New Zealand scientists in collaboration with colleagues from around the world and to develop dedicated research networks in specific interest areas. NZAGRC helped

scope these projects to ensure they are consistent with and build on domestic research activities and capacity, and administers the contracts for these projects on behalf of MPI.

In addition, the past year saw the launch of the New Zealand Fund for International Partnerships in Livestock Emissions Research. This fund, which is administered by MPI directly, seeks to support research initiatives that may be led by New Zealand or international scientists, provided that the results are of benefit to New Zealand and there is significant participation by New Zealand scientists. Four projects were approved for funding, all led by New Zealand, and a second funding round will run in the 2012/13 financial year. NZAGRC provided strategic and scientific expert advice to MPI to the design of the fund and selection of successful projects.

Additional activities related to the Alliance include the design and operation of capacity building workshops and initiatives in Latin America and south-east Asia, which seek to increase consistency in emissions estimates and improve the

Participants at the Livestock Research Group meeting, Amsterdam, November 2011

ability of major livestock-producing world regions to identify and develop regionally appropriate mitigation options. These initiatives are supported by the LEARN/GRASS awards and fellowships scheme and extension of a global network and database of experts in the area of livestock emissions and mitigation research. NZAGRC also maintains communications related to the LRG through regular newsletters and updates to the group's web pages, and ensures strong and consistent science representation from New Zealand in the other Research and Cross-Cutting Groups set up under the Alliance.

International Dimensions
Project Highlights

Sharing best practice in nitrous oxide chamber measurements

A 2011 Alliance workshop identified the need for a technical "best practice guide" on chamber methodologies for measuring nitrous oxide emissions from agricultural soils (arable and grassland), written by leading international experts. The coordination of this project was funded by the New Zealand government and the guide is due to be completed and published shortly. The aim is for this guide to become the accepted international standard reference manual for N_2O measurements using chambers, thereby improving quality and inter-comparability of N_2O emission factor and flux assessments.
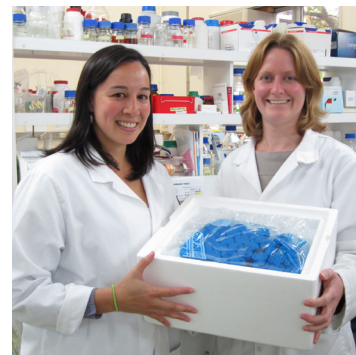
Working together globally to characterise and learn from rumen microbes

Alliance funding has supported the establishment of a number of initiatives to better understand global rumen microbial genomics diversity. The aim is to share knowledge in this area more widely between international research groups, with the overall goal of more rapid development of methane mitigation solutions. During 2011/12, a Rumen Microbial Genomics Network (RMG Network) was established to promote collaboration between international research groups. Three new projects have been funded to characterise the diversity of the rumen microbial community focussing on: (i) a taxonomy of rumen bacteria; (ii) a global census of rumen microbial diversity; and (iii) the Hungate 1000 project to produce a reference set of rumen microbial genomes.

Sharing data and developing joint protocols to identify low emitting animals

Some animals naturally emit less methane than others without affecting their productivity, but reliably identifying such animals and using specific genetic traits for breeding purposes remains difficult. This prompted the formation of the NZ led Animal Selection via Genetics and Genomics network, which aims to better coordinate existing data across Alliance member countries and discuss common protocols for identifying low-emitting animals and discovering genetic markers that could be used in livestock improvement programmes. These objectives are supported by a NZ/Australia led project to combine existing phenotype information across several countries to develop shared measurement protocols and breeding objectives to accelerate reductions in emissions intensity via targeted breeding and selection indices.

Technical manual for the design of livestock respiration chambers

Respiration chambers remain the gold standard for measuring greenhouse gas emissions from individual animals, but they also require significant up-front investment and offer many opportunities for modifications to their design and operation. Exploring options and drawing on experiences of others is therefore a key step for any institution wishing to build its own system. NZ coordinated and led the production of a 'Technical Manual on Respiration Chamber Design', which provides global examples of respiration chambers detailing the designs, operation and cost of existing and new chambers from NZ, Australia, the UK, Belgium, Denmark, Spain and Switzerland. The manual is a living resource to which new and innovative designs can be added.

Evaluation of a novel method for measuring CH_4 emissions from grazing cattle

Selecting low-emitting animals and verifying the effectiveness of novel mitigation methods requires cheap and accurate methods for measuring emissions from individual animals. NZ scientists evaluated a novel method for measuring CH_4 emissions from grazing cattle, called the Greenfeed™ system. This method measures CH_4 emissions from grazing animals by attracting them to a specially designed pellet feeder that includes a gas analyser. NZ tests indicate that the method can give robust herd-wide emissions data but at present cannot reliably rank individual animals in terms of their emissions. Similar tests are being carried out in the UK and Australia, and proposals for further joint work on refinement of the technique are being developed.
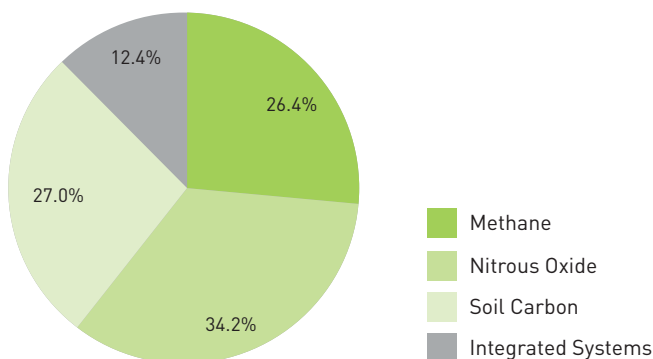
Financial Summary and Outputs

FINANCES[1]

Spending in 2011/12 has been across three key areas: Core Research ($3.87 million); Other Research (including fellowships, policy support and short term projects) ($0.40 million); and Administration ($0.50 million)[1].

Science has been funded across four research areas, in accordance with the NZAGRC's approved domestic science plan: Methane, Nitrous Oxide, Soil Carbon and Integrated Systems.

In addition to the investment made in science, funding was provided for the NZAGRC conference, relevant workshop and conference support and undertaking a stock take exercise with respect to the NZAGRC partners' work related to Māori.
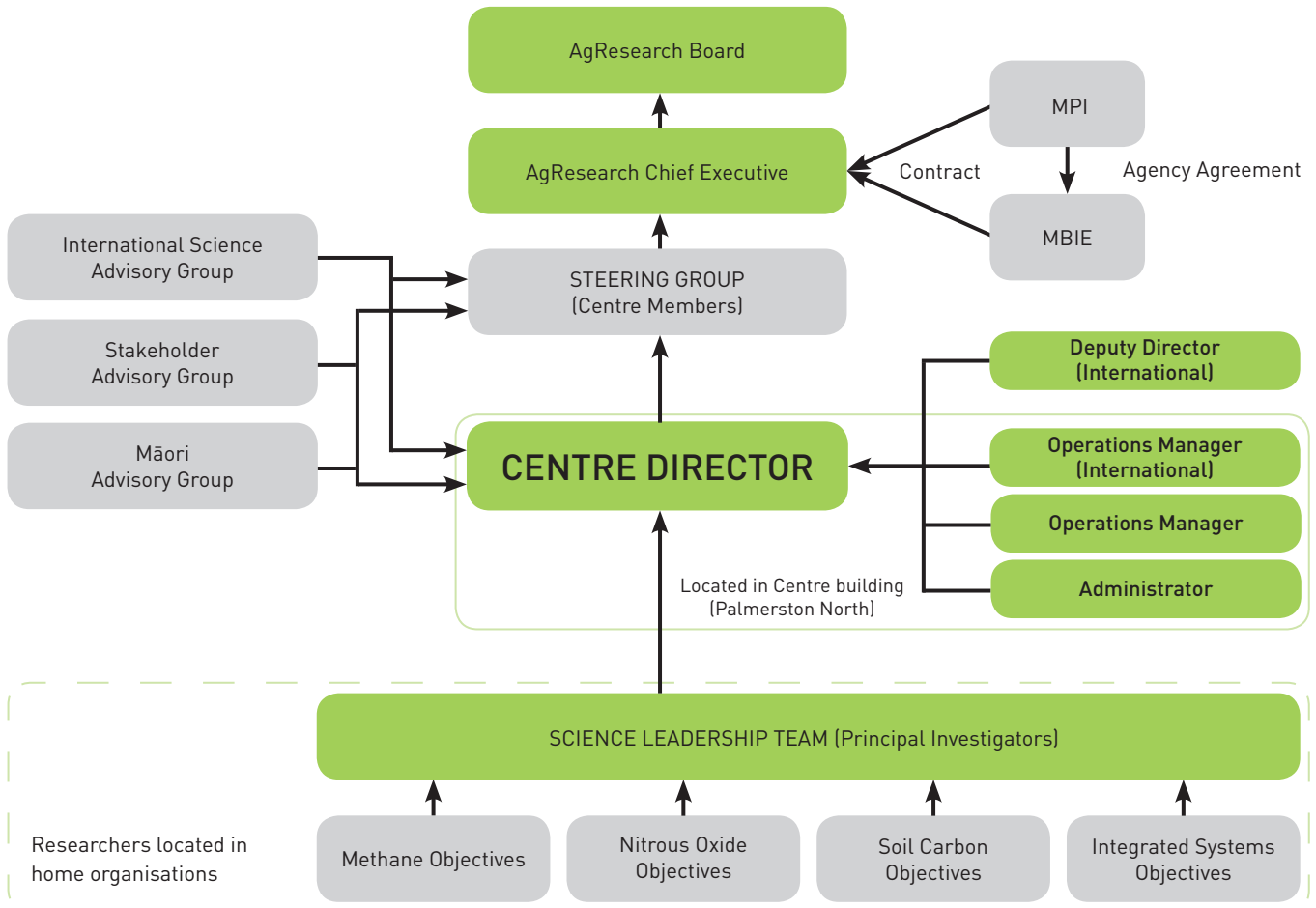
OUTPUTS

During 2011/12 the NZAGRC has both hosted and attended a significant number of meetings and presentations with a diverse group of external parties, both in New Zealand and internationally. The NZAGRC has also actively promoted itself and its role in the media and to a scientific audience via conference papers and peer-reviewed publications.

Type of Interaction/Output	# in 2011/12
Meetings and Presentations (New Zealand)	71
Meetings and Presentations (International)	11
International Visitors and Groups	9
Global Research Alliance related interactions	15
Media interactions	8
Conference presentations	53
Journal articles in press	3
Journal articles published	13
Other interactions/publications	10

NZAGRC Core Research Spending 2011/2012

- Methane
- Nitrous Oxide
- Soil Carbon
- Integrated Systems

26.4%
12.4%
27.0%
34.2%

[1] Research investments and advice to MPI related to the Global Research Alliance are not included in these figures

Governance Structure

AgResearch Board

AgResearch Chief Executive

MPI

Contract

Agency Agreement

MBIE

International Science Advisory Group

Stakeholder Advisory Group

Māori Advisory Group

STEERING GROUP (Centre Members)

Deputy Director (International)

CENTRE DIRECTOR

Operations Manager (International)

Operations Manager

Located in Centre building (Palmerston North)

Administrator

SCIENCE LEADERSHIP TEAM (Principal Investigators)

Researchers located in home organisations

Methane Objectives

Nitrous Oxide Objectives

Soil Carbon Objectives

Integrated Systems Objectives

agresearch

Farming, Food and Health. First ™
Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi

*Dairy*NZ

Landcare Research
Manaaki Whenua

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

New Zealand's specialist land–based university

MASSEY UNIVERSITY

NIWA
Taihoro Nukurangi

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RESEARCH
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