



# UK Agri-Science & Innovation

Supporting international  
actions to mitigate  
agricultural GHG emissions

Issue 2

Autumn 2013

## Welcome

to the second newsletter communicating information on UK activities supporting the Global Research Alliance (GRA) on Agricultural Greenhouse Gases. UK technical and scientific participation in the GRA builds upon the current UK Government investment in the [Agricultural Greenhouse Gas \(GHG\) Research Platform](#) and aims to promote and enhance UK research into GHG mitigation. UK scientists are actively participating in the GRA Croplands and Livestock Research Groups and the Inventory & Measurement Cross-Cutting Group.

The aim of the newsletter is to update UK and international readers on UK-led GRA actions, recent UK contributions at international meetings and events, and participation in GRA research networks and in capability building.

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## About the Global Research Alliance

The GRA was established in 2009 to help reduce the emissions intensity of agricultural production and increase its potential for soil carbon sequestration. Minimising GHG emissions from agriculture while increasing food security is a global issue and many countries have research underway to measure and mitigate losses from cropland and livestock systems.

The GRA aims to link up these research efforts to achieve faster progress towards the solutions needed for improving agricultural productivity and reducing its contribution to climate change. It aims to help improve the ways that agricultural GHG research is conducted and to enhance participating countries' scientific capacity via active exchange of data and research, development and extension of technologies and practices, and identifying research gaps and potential opportunities for new cross-national research collaborations.

Activities are progressed within three research groups (Livestock, Croplands and Paddy Rice) and two cross-cutting groups (Inventory & Measurement and Soil Carbon & Nitrogen Cycling) and there are now 40 member countries including the UK. For further information visit [www.globalresearchalliance.org](http://www.globalresearchalliance.org).

## GRA ACTIVITIES LED BY THE UK

### Global Research Alliance Modelling Platform (GRAMP): An open web platform for modelling GHG emissions

**The UK is leading the GRA action to create a generic modelling network.**

Computer models are often used to understand how systems respond to change, and in agriculture are used for many purposes, including understanding and predicting GHG emissions. Although there are many models available, most are developed and tested in similar ways. Measurements and observations are used to construct the models, data is used to drive them and independent data is used to test their performance. The process of model development, testing and application is therefore similar across many models.

Traditionally, modelling teams collect their own data and use their own methods and metrics for model evaluation. In the GRAMP project we are developing a generic modelling platform to allow model developers and users to share data, tools and methodologies to accelerate model development, to better test and improve our models, and to build better confidence in model predictions with quantified uncertainty.

The proposal for the GRAMP network was developed through discussions between the UK Government Department for Environment, Food and Rural Affairs (Defra) and scientists at the University of Aberdeen, SRUC, Rothamsted Research and ADAS, and work began in December 2012.

The web-based modelling platform is designed to link researchers with appropriate datasets, models and training material. The platform will eventually support a variety of models, but to trial the platform and test the architecture and functionality, GRAMP started piloting of the work with variants of the DNDC model, building on the excellent work already done through the Global DNDC Network coordinated in New Zealand. >>



## Objectives and scope of GRAMP

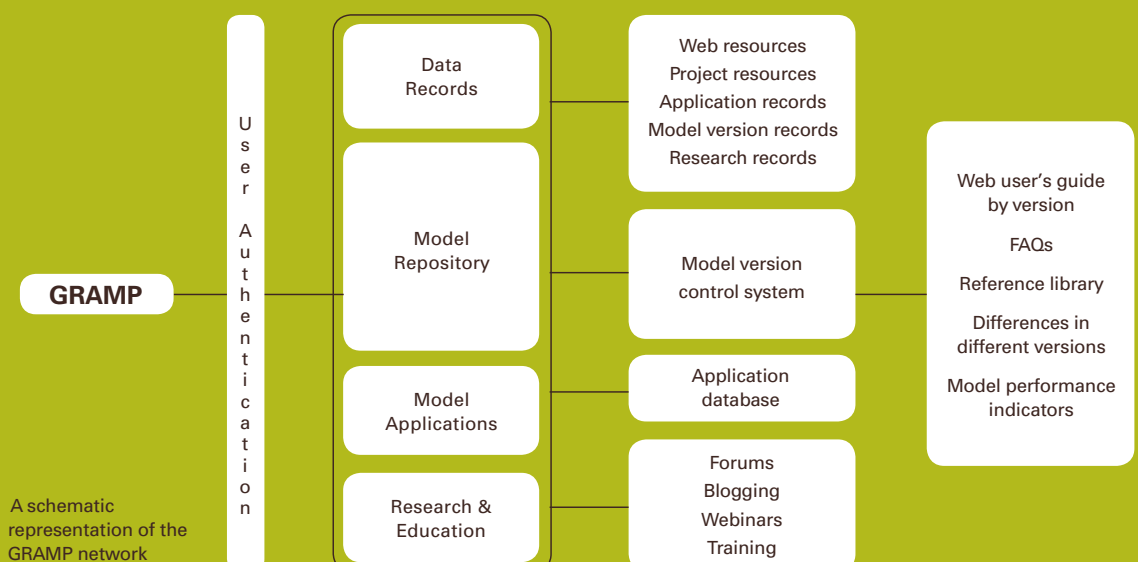
- 1) To create an open web-platform with existing data and prior knowledge, in consort with end-users, with every stage open to critical review and revision to improve the predictions of soil carbon & nitrogen cycling in agro-ecosystems in the context of climate change.
- 2) To establish a vibrant network of specialist researchers, model developers and users who can work together, to examine strategically what the various models on the market can deliver in accounting for the effect of ecosystem management on GHG emissions, identify promising mitigation options and assess the effect of future climate on emissions.
- 3) To link up a network of experimental sites across the world for testing, tuning and validating models and their derivatives across different crops, management strategies, soil types and climates. This will involve classifying the various models according to their capabilities and specificities.
- 4) To allow network members to exchange information, experiences and data and provide a forum for model development for future needs.

## GRAMP functionality and output

GRAMP will host a set of links to global databases with associated metadata. It also contains a web-GIS-linked mapping system with a reference library, a database system and training materials (case studies, demos, videos). GRAMP hosts the existing ecosystem models with a version control system. This allows users and model developers to create version-specific documentation. GRAMP documents the performance of different model versions, which allows users to identify changes and the implications of those changes for output variables of interest. GRAMP also provides training manuals, videos and tutorials for new users and provides FAQs.

Users are able to interact in the forums, raise questions and get help from worldwide colleagues to solve questions. Tools are provided for blogging, which allow experienced users, developers and eminent scientists in this field to communicate with the audience. GRAMP also has the capabilities to organise Webinars, which allow scientists across the world to attend web-based seminars. An RSS-type feed will provide updates to users on new versions, papers and workshops etc.

The GRAMP website was launched at the Croplands Research Group meeting in Tampa, Florida on 7th November 2013.





## Animal Health & GHG Emissions Intensity Network

### **The formation of a dedicated research network on animal health and GHG emissions intensity is now underway.**

The network, established under the Livestock Research Group, is bringing together practitioners from animal health, veterinary and GHG research communities across the world to investigate links and synergies between efforts to reduce the burden of disease on livestock and reducing GHG emissions intensity.

Whilst there is good recognition of the effects of climate change on animal health it is less well recognised that animal health status can have an effect on climate change because diseased animals are less productive, resulting in higher intensity of GHG emissions per unit of product (meat, wool, milk or drafting power). An important task of the network is to raise awareness of these links and potential mitigation options.

The network offers researchers a unique opportunity to develop international links, pool resources and data, and build upon existing research projects and therefore maintain and enhance capacity in this cross-cutting field of research. The network will encourage sharing of information on current and planned activities in different countries and organisations so as to avoid duplication

of effort, identify research gaps and help focus and prioritise research efforts.

The UK Government is committed to leading the network for three years which should be sufficient to nurture productive relationships between the relevant research communities. As part of the UK Government commitment, Defra is providing a discretionary Travel & Subsistence (T&S) budget for UK scientists to attend network meetings and workshops. Experts from GRA member countries are invited and encouraged to participate in the network as are other international organisations with an interest. The network will engage with development aid organisations as this area of work has the potential to offer real benefits to farmer livelihoods and food security.

Over the next few years a series of network meetings and workshops will be held in the margins of suitable conferences. The first will be held alongside the Society for Veterinary Epidemiology and Preventative Medicine (SVEPM) conference in March 2014.

For further information and to register as a participant, please e-mail:

[animalhealthnetwork@adas.co.uk](mailto:animalhealthnetwork@adas.co.uk)



## Global GHG abatement potential from health interventions in the agricultural livestock sector

**To support the Animal Health Network, Defra has funded ADAS to prepare a paper to review the scale of the opportunity that animal health actions offer in terms of climate change abatement on a global scale.**

This builds on a research project commissioned by Defra and led by ADAS to model the impact of controlling endemic cattle diseases on national cattle productivity, agricultural performance and GHG emissions, which will report at the end of 2013.



» The paper reviews the literature on the contribution of livestock to GHGs globally and prospects for future emissions in response to an increase in global population and increased demand for livestock products. While on a per capita basis the developed world consumes nearly three times the level of meat and four times the level of milk in the developing world, population increases in less developed regions mean that total consumption of meat and milk in these areas is expected to double during 2015-2030. Given the livestock sector is already estimated to be contributing 18% (FAO, 2006) towards global carbon dioxide equivalent (CO<sub>2</sub>e) emissions, there clearly exists the potential for substantial GHG increases from future expansion of this sector.

Based on global populations of different categories of livestock and emissions intensity data, it is evident that ruminants provide the highest contribution to global GHG emissions of all meat sectors, in part due to methane production. The most promising approach for methane reduction is through productivity and efficiency improvements in livestock production where such improvements enable a larger proportion of feed inputs to be directed towards the production of useful products, thus reducing emissions intensity (FAO, 2006). Disease and parasites are amongst the most severe factors to impact on livestock productivity (Lamy et al., 2012) although very few studies have been conducted on the potential impact of animal health on GHG emissions (Stott et al., 2010).

The Defra research project that the paper builds upon focused on 10 common endemic cattle diseases in the UK to provide estimates of abatement available from a range of control measures and their cost effectiveness per unit of CO<sub>2</sub>e. An interdisciplinary team of researchers including veterinary experts and practitioners, climate scientists and economists have worked together to produce marginal abatement cost curves for these measures. The analysis indicates that there are available opportunities for cost-effective reductions in GHG emissions although the work has highlighted a number of issues over the availability and reliability of data on disease impacts and control which require further investigation.

Nevertheless this UK-focused research provides a basis for wider work to better scope the global opportunities for disease control as a mechanism for climate control.

#### References

Stott, A., MacLeod, M. and Moran, D. Reducing greenhouse gas emissions through better animal health. (Edinburgh, UK: SAC, 2010). Available at: [www.knowledgescotland.org/images\\_db/reducinggreenhousegas.pdf](http://www.knowledgescotland.org/images_db/reducinggreenhousegas.pdf). Accessed May 2013.

Lamy, E., van Harten, S., Sales-Baptista, E., Manuela, M., Guerra, M. and de Almeida, A. 'Factors influencing livestock productivity', in: V. Sejian (eds.), Environmental Stress and Amelioration in Livestock Production (Berlin: Springer-Verlag, 2012, pp. 19-51).

FAO. Livestock's Long Shadow – Environmental Issues and Options. (Rome: FAO, 2006). Available at: [www.fao.org/docrep/010/a0701e/a0701e00.htm](http://www.fao.org/docrep/010/a0701e/a0701e00.htm).



## Scoping the extent to which Earth Observation (EO) data can cost effectively provide agricultural activity information

### Defra is funding a project on using EO to provide activity data for inventory compilation to support the GRA Inventory & Measurement Cross-Cutting Group.

Data sets and statistics on agricultural activity, traditionally collected via surveys, are required for compilation of national inventories of GHGs from agriculture and land management. Such inventories rely on surveys for information on land use, crop areas, livestock numbers and fertiliser use, however internationally some challenges are faced. For countries at an early stage in inventory development, lack of infrastructure and resource can act as a barrier to on the ground survey techniques. For countries with more developed inventories, the complexity of activity data requirements may make survey approaches prohibitively expensive, or introduce unacceptable levels of



Image source: Chelys

» burden for farmers to complete them. Furthermore as an inventory becomes more complex, the data required to generate operational estimates of GHG emissions increases.

There is therefore a need to collect enhanced land management data cost effectively and without disproportionately increasing the load on farmers. One potential source of information to supplement, or to some extent replace surveys, is EO data, either from aircraft or satellite platforms. Although EO data is limited to information on surface properties (e.g. colour, temperature, roughness, elevation etc) appropriately designed models combined with supplementary information may be able to generate proxies or indicators for variables of interest.

This project aims to:

- 1) Critically evaluate the ability of existing or near launch EO sensors to fulfil the data requirements of developing Agriculture, Forestry and Other Land Use inventories, either through existing products or novel algorithms; and
- 2) Collect evidence on the most pressing data requirements for inventory compilation via an international stock take.

Once the data requirements have been identified the project will assess the extent to which EO data can fulfil them, with reference to case studies on existing international experience of such approaches. The project will consider whether such approaches represent a cost saving against existing survey methods. The international stocktake will be collected via a structured questionnaire circulated to inventory practitioners in participating GRA countries. This will provide international context on both activity data requirements and existing uses of EO technologies for inventory compilation (including successful and unsuccessful attempts to make use of EO data).

The findings of the work will be presented at an international GRA workshop providing a knowledge exchange opportunity for inventory practitioners, policy makers and EO specialists.



## The UK is hosting the next Inventory & Measurement Cross-Cutting Group meeting in Edinburgh, Scotland

**The third meeting of the Inventory & Measurement Cross-Cutting Group will be held alongside the annual meeting of the UK GHG Platform in Edinburgh in December 2013.**

The UK GHG Platform is a five-year research programme funded primarily by Defra, with additional support from the devolved administrations of Scotland, Wales and Northern Ireland to generate new country-specific measured and modelled emissions factors for methane and nitrous oxide from agriculture.

The main objective of the research is the development of an improved Agricultural GHG Inventory, that uses appropriate country and practice specific emission factors and that will reflect the adoption of mitigation practices by the agricultural industry, enabling forecasting and monitoring of performance against the wider UK target emissions reductions set by the UK Climate Change Act 2008.



» The Platform consists of three projects (Methane ResearCH<sub>4</sub>, Nitrous Oxide InveN<sub>2</sub>Ory and Data Synthesis, Modelling and Management) and aims to interact with the global research community mainly through the GRA. A cross-platform technical meeting is held annually to encourage interaction across the projects, to provide an opportunity to share expertise and experiences and to present results to stakeholders. This year's meeting is being hosted by SRUC in Edinburgh on the 17th December 2013.

Alongside this event, the UK is hosting the third GRA Inventory & Measurement Cross-Cutting Group meeting from the 17th-20th December 2013. This meeting brings together representatives from GRA member countries with the goal of work planning and information sharing to improve GHG quantification and measurement to add value to the related activities of individual members and partners.

The delegates are invited to attend the UK GHG Platform meeting to get a better understanding of UK agricultural inventories and the UK GHG research programme. A one day field tour of SRUC's GreenCow facility is also planned on the 20th December. This is a world class livestock GHG emissions research facility for measuring methane emissions and feed intake. For more information click [here](#).

A summary of both meetings will be provided in the next publication of the UK Agri-Science & Innovation newsletter.



## UK PARTICIPATION IN GRA NETWORKS

### SRUC and New Zealand researchers cooperate on dairy cow GHG emissions

**Researcher Dr Natalie Pickering from New Zealand's AgResearch organisation recently visited Edinburgh, working with animal science researchers at SRUC.**

Natalie was based at the Roslin Institute building during July as part of a project funded by the New Zealand Government in support of the GRA. Natalie worked with SRUC's Dr Eileen Wall, Professor Georgios Banos, Dr Mizeck Chagunda and others over the summer, helping to research the genetics and genomics of GHG emissions from dairy cows.

Using the extensively phenotyped database on the Langhill selection lines of dairy cows, Natalie calculated a predicted methane emission (PME) trait, based on energy requirements, feed intake and milk production of the cows. Point methane measurements, via laser methane detector, were available from Dr Mizeck Chagunda and were used for comparison and adjustment of PME estimates. Estimated breeding values and genetic parameters were calculated for PME and the next step involves combining this data with genomic information (Bovine 50K SNP chip) to perform a genome wide association study (GWAS).

This project is an extension of work already performed in New Zealand on sheep. Under the same programme, Natalie has performed a GWAS using sheep measured in respiration chambers. It is hoped that the results from both studies can be combined/compared.

The main aim of Natalie's project task is to help pull together information from research groups around the world who are studying ways to reduce GHG emissions from ruminant livestock using animal selection, genetics and genomics techniques. All these groups are members of the Animal Selection, Genetics and Genomics Network ([ASGGN](#)) of the Livestock Research Group. Their aim is to develop shared measurement guidelines and breeding objectives that will provide breeding and selection information that can be used to accelerate a reduction in the intensity of emissions from livestock.



Dr Natalie Pickering from New Zealand (right) with Dr Eileen Wall from the UK (left) during her visit to Scotland.





## GHG mitigation methods for manure management

**Professor Dave Chadwick (Bangor University), Professor Brian Chambers (ADAS) and John Williams (ADAS) have produced a draft “Directory of GHG Mitigation Methods for Manure Management” as an activity of the Manure Management Network (MMN) of the Livestock Research Group.**

The purpose of the document is to provide succinct information on a range of mitigation methods for GHG emissions from manure management whilst also addressing their wider impacts on other diffuse pollutant losses and agricultural productivity. The directory had been identified as a priority action of the MMN and

was prepared in the lead up to their second meeting held in the margins of the Greenhouse Gases and Animal Agriculture (GGAA) conference in Dublin, June 2013.

The document provides a list of mitigation options and assesses potential impacts on direct nitrous oxide and methane emissions as well as the effects on phosphorus (total and soluble), nitrogen (nitrate, nitrite, ammonium), biological oxygen demand, sediment and faecal indicator organism losses to water, and ammonia emissions to air (indirect nitrous oxide losses are accounted for by including nitrate leaching and ammonia emissions). The mitigation options are categorised into livestock housing, manure storage, manure treatment, manure application, livestock grazing and ‘the entire manure management continuum’ and include methods such as increased slurry storage capacity to allow better timing of slurry application, integrated manure and fertiliser application, and use of nitrification inhibitors. The directory aims to help users in developing policies and selecting suitable mitigation methods to reduce GHG emissions.

At the recent MMN meeting in Dublin, Professor Dave Chadwick introduced the directory and the approach used to participants attending from twelve different countries. Participants believed that this was a useful approach to take. The next steps will be to generate a spreadsheet version of the directory for MMN members to comment on the relevance of different technologies to their country specific conditions, farming systems and farmers’ capabilities.



## UK PARTICIPATION IN GRA CAPABILITY BUILDING ACTIVITIES

### International technicians training course on methods for the measurement of methane emissions from forage-fed ruminants

**In January 2013 Francis Lively (Agri-Food and Biosciences Institute, Northern Ireland) visited New Zealand to teach on an international technician training course.**

The aim of the course was to provide hands on training to participants from South America and South East Asia to develop skills that will improve the measurement and understanding of GHG emissions from agriculture in their home countries. Francis Lively was invited to provide expert teaching on SF<sub>6</sub> tracer technologies.

The course was funded by the New Zealand Government to support the GRA objectives to reduce global methane

emissions from enteric fermentation and to develop a collaborative approach to reducing GHG emissions attributed to pastoral farming.



Participants in the technicians training course in New Zealand.







## UK REPRESENTATION AT GRA MEETINGS

**International technician training course (January 2013, New Zealand)**

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**GRA meetings in the margins GGAA, Dublin, Ireland**

Sustainable Agriculture Initiative (SAI) (21st June 2013)

Animal Selection Genetics and Genomics Network meeting (27th June 2013)

Manure Management Network meeting (27th June 2013)

Network on Feed and Nutrition in relation to methane emissions (27th June 2013)

Grasslands Network Scoping workshop (27th June 2013)

Joint RuminOmics\* / Rumen Microbial Genomics Network (27th June 2013)

Livestock Research Group meeting (28th – 29th June 2013)

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**Cropland Research Group meeting (7th November 2013 in Tampa, Florida)**

\*RuminOmics is an EU financed project connecting the animal genome, gastrointestinal microbiome and nutrition to improve digestion efficiency and the environmental impacts of ruminant livestock production.

## FURTHER INFORMATION

UK scientists are participating in a wide range of GRA activities and there are many opportunities for further involvement.

In addition to the activities captured in this newsletter, UK scientists are now participating in the development of methodological guidelines for measurement of soil organic carbon stocks of agricultural land, an activity of the Inventory & Measurement Cross-Cutting Group. The best practice guide to using chambers to measure nitrous oxide emissions from soils for distribution to all GRA members is now complete and can be downloaded [here](#).

The UK has continued its involvement in the Livestock Research Group Networks on Feed and Nutrition in relation to GHGs and on Rumen Microbial Genomics.

Please contact ADAS for further information on UK participation in the GRA and other international initiatives such as the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI).

Send your email address to ADAS using the contact details below if you would like to receive regular updates on GRA activities, meeting reports, funding opportunities, publications and events.

### Contact details:

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