



# UK Agri-Science & Innovation

Supporting international  
actions to mitigate  
agricultural GHG emissions

Issue 3

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## Welcome

to the third newsletter on United Kingdom (UK) activities which support the Global Research Alliance (GRA) on Agricultural Greenhouse Gases. UK technical and scientific participation in the GRA builds upon the UK Government investment in the [UK Agricultural Greenhouse Gas \(GHG\) Research Platform](#) and aims to promote and enhance UK research into agricultural GHG monitoring and mitigation.

The aim of the newsletter is to update UK and international readers on UK-led GRA actions, recent UK contributions at international meetings and capability building activities, and participation in GRA networks. The newsletter also covers information on UK participation in the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) and features topical UK projects of international interest. This publication includes the UK research on Increasing Efficiency of Dietary Nitrogen Use in Dairy Systems.

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## About the Global Research Alliance



The GRA brings countries together to find ways to grow more food without increasing GHG emissions. It was established in 2009 to address the global challenge of mitigating GHG emissions and increasing soil carbon sequestration without impacting on agricultural productivity, and therefore the focus is on decreasing GHG emissions intensity (emissions per unit of output). The GRA aims to help improve the way 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 & Monitoring and Soil Carbon & Nitrogen Cycling). There are currently 42 member countries including the UK.

For further information visit [www.globalresearchalliance.org](http://www.globalresearchalliance.org).



## GRA ACTIVITIES LED BY THE UK

### Animal Health and GHG Emissions Intensity Network

The Animal Health and GHG Emissions Intensity Network is a UK-led initiative of the GRA Livestock Research Group. The aim of the Network is to bring together researchers from across the world to investigate links and synergies between efforts to reduce livestock disease and GHG emissions intensity reductions.

#### Introducing the Network Co-ordinators



**Ilias Kyriazakis** is the Professor of Animal Health and Nutrition at the School of Agriculture, Food and Rural Development at Newcastle University in England. He has previously held Professorships in Scotland and Greece and is currently Visiting and Adjunct Professor in a number of leading European and North American Universities. He was presented recently with the Leroy Award by the European Animal Sciences Federation (EAAP) for his internationally recognised reputation and work in the field of animal sciences.

A veterinarian by training, Ilias specialises in the consequences of management on animal responses, including their responses to pathogens and their environmental impact. Ilias has addressed these issues on several species ranging from mice to cows, and from the whole animal to molecular levels, as he is interested in the development of quantitative frameworks, rather than in addressing specific mechanisms. His particular interest is in the development of strategies that mitigate the environmental impact of livestock, and he has been involved in simulation models that enable the development of such strategies. The interactions between animal management, health and environmental impact have been a focus of his research for more than 15 years. He has stood on the Food and Agriculture Organisation of the United Nations (FAO) Technical Advisory Group of the Partnership on the Environmental Benchmarking of Livestock Supply Chains. As such he is very well suited to lead the Animal Health and GHG Emissions Intensity Network.





Ilias hopes to develop and use the Network as a forum for discussion on the interrelationship between livestock health and environmental impact amongst scientists from research communities relevant to this field (e.g. animal science, veterinary medicine, GHG research, systems analysis, economics and food security). He is interested in the development of research agendas on the consequences of different disease control strategies on the GHG emissions of livestock systems, and the dissemination of relevant research findings to a variety of Stakeholders. He expects that through the development of such research agendas the Network will be able to influence funders for directing effort in this field. The Network relies on the input of researchers who are addressing these issues in a variety of livestock systems and in a variety of countries. Ilias hopes that the Network will lead to real benefits to farmer livelihoods, food security and environmental sustainability.



**Timothy Robinson** is a principal scientist at the International Livestock Research Institute (ILRI) which aims to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. Timothy joined the ILRI Livestock Systems and Environment group in April 2013 after 11 years working in FAO's livestock policy group. He has spent a number of years developing the global livestock distribution and production system data layers that underpin the current estimates of GHG emissions from the livestock sector. His current research includes exploration of the environmental impacts of animal health interventions and of intensifying livestock production systems more generally.

Timothy would like to see the Network become more global in scope and in particular for the membership to grow from the developing regions of the World. Whilst the contribution to GHG mitigation made by animal health issues may not be the greatest compared, for example, to animal feeding, dealing with it is feasible and is likely to be cost-effective in many situations. There are also very important co-benefits to dealing with animal health issues (in addition to GHG emissions intensity reductions), particularly in developing countries where the burden of disease is greatest. These include, for example, human nutrition and health, and animal welfare.



## Inaugural Network Workshop

The first workshop of the Animal Health and GHG Emissions Intensity Network was held in Dublin on the 25th March 2014 in the margins of the Society for Veterinary Epidemiology and Preventive Medicine ([SVEPM](#)) conference. There were 21 participants from 7 countries: Vietnam, France, Mexico, the Netherlands, Ireland, the UK and Kenya including representatives from FACCE-JPI, ILRI and FAO.

The aim of the workshop was to provide an opportunity for participants to get to know one another, to discuss existing research and generate ideas for future collaborative





work, to identify Network objectives and tangible outputs, to scope regional animal health and GHG issues as well as global opportunities, and to explore funding sources particularly for enabling participation and promotion.

Presentations showed that there is a variety of work relevant to the Network underway such as modelling the impact of controlling endemic cattle diseases, quantifying the GHG mitigation effect of intervening against bovine trypanosomosis in Eastern Africa, and researching the effects of gastrointestinal nematode parasites on methane emissions from ewes and lambs.

Network participants agreed that healthier animals have lower emissions per unit

of output and that the Network has a role in raising international awareness of animal health, resource efficiency and GHG's. There are regional differences in livestock systems and mitigation potential that could be addressed through network subgroups.

Network objectives discussed at the workshop include avoiding duplication of effort by integrating with organisations such as FACCE-JPI and FAO, adding value and collaborating with other relevant Livestock Research Group networks, and working towards improving accuracy and availability of data.

A full summary of the workshop can be downloaded [here](#).



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



GRAMP provides a place where researchers can share information about biogeochemical ecosystem modelling and connect with other researchers. Through GRAMP, sharing of research and ideas can improve model predictions of soil carbon and nitrogen cycling in the context of climate change. The GRAMP website infrastructure has recently been developed to include the following new features:

- ▶ **Model repository and model tree:** As models are developed a number of model variants will emerge due to changes in underlying assumptions about the system. To allow users to understand which variant they are using and which is best for their given purpose, documentation is needed to explain how each model version differs and why each was created. To help in this respect, GRAMP describes a framework for developing a "Model Tree" which shows similarities and difference in model variants, and provides a model repository for users to store and retrieve different versions online. GRAMP enables seamless management and code sharing between the GRAMP site and the model repository.
- ▶ **Model performance tool:** Linking detailed model description with model performance might help improve process understanding and detection of the origin of model errors. Most of the time model calibration is carried out by trial and error or by using optimization techniques. Both of these methods are designed to search for combinations of parameters which provide the best fit. Model performance then has to be assessed against measurements. To allow the user to assess how well the model performs, a model application and performance tool has been developed which displays model performance in graphical and data format.
- ▶ **Publications database interface:** Within the GRAMP site an application which interfaces with the publications database is being developed, linking detailed description and model performance. This will illustrate (through pie or bar charts) how the various biogeochemical models hosted at the GRAMP website are applied (by geography, activity, land use, etc.) and will allow the user to find published papers describing how well they perform in each situation.



- » ► Communication tools have been developed and integrated within the GRAMP site which allows users to set up free online meetings, share desktops and telecast webinars. Our ambition is for the GRAMP website to become a vibrant virtual lab where modellers can come together to build capacity, share experience, correct errors and develop new insights.

The DNDC model is GRAMP's flagship project which is growing and evolving rapidly. The GRAMP site currently includes information on the capabilities of the different versions of DNDC and allows viewers to explore each model through the Model Browser (Figure 1). The intention is for GRAMP to include other models over time.

## Model Browser

Explore the models of the GRAMP network.

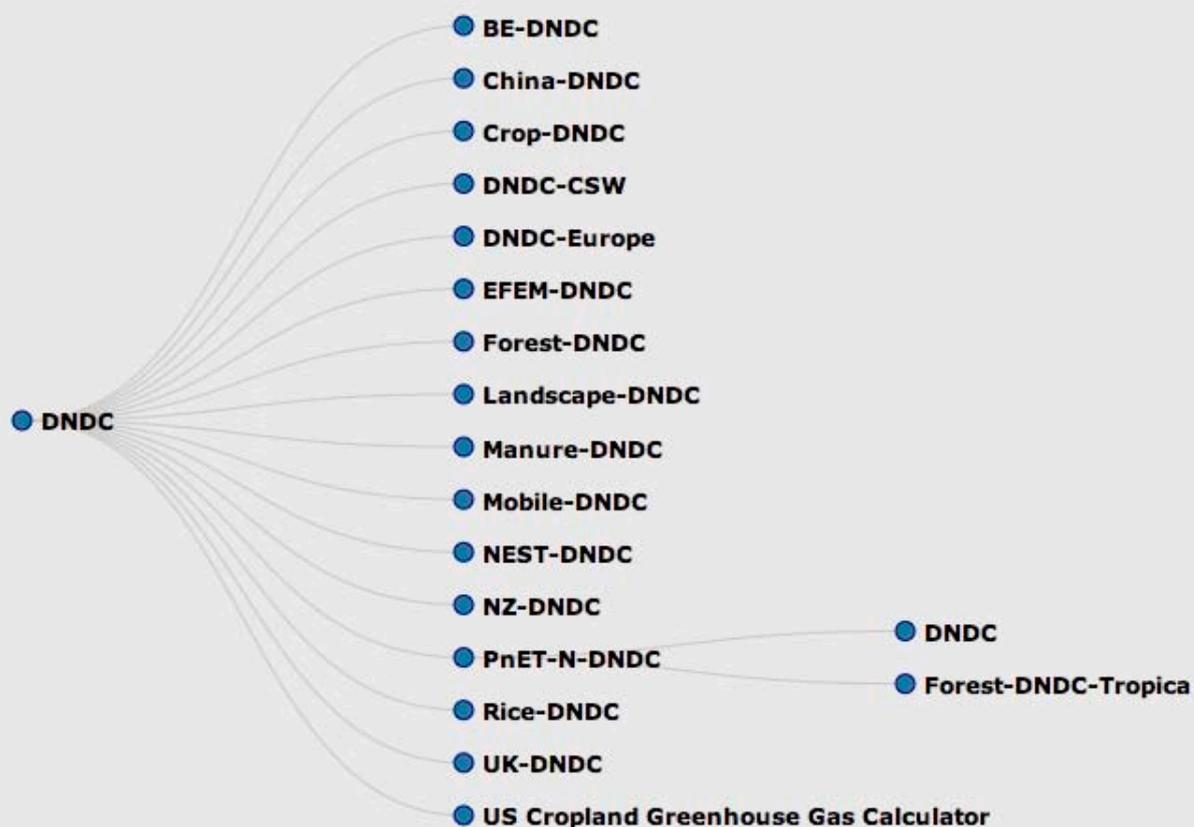


Figure 1. DNDC model tree in GRAMP

Also under the GRAMP project, two manuscripts have been communicated to journals and are currently being reviewed.

[GRAMP](#) will be soon open for public registration.



## Inventory and Monitoring Cross-Cutting Group meeting hosted by the UK

The GRA Inventory and Monitoring Cross-Cutting Group facilitates collaborative work to improve the estimation of GHG emissions and removals involving multiple segments of agricultural production. The Group complements and supports the work of the GRA livestock, croplands and paddy rice research groups.

For further information see the [GRA](#) website.



The third meeting of the Group took place from 17th – 20th December 2013 in the margins of the UK Agricultural GHG Research Platform meeting in Edinburgh, Scotland. The meeting was hosted at Scotland's Rural College (SRUC) and included international delegates from the Netherlands, Spain and Thailand. UK organisations (SRUC, the Centre for Ecology and Hydrology, ADAS UK Ltd and Bangor University) and the Department for Environment, Food and Rural Affairs (Defra) were represented.

### Discussions focussed on the four key work areas of the Group which are to:

- ▶ Share methods and lessons learned on the application of remote sensing to improve activity data;
- ▶ Produce guidelines for determining emissions intensity (sustainable intensification);
- ▶ Produce guidelines on best practice for measuring Soil Organic Carbon; and
- ▶ Improve capability to quantify GHG emissions and removals for farming systems and climates (development of farming systems typologies).

A strategic aim of the GRA Council is to promote mitigation and adaptation synergies and the meeting identified that the best way to address this within the Inventory and Monitoring Group is embedded in ongoing activities rather than as a separate standalone network.

Please contact [gra@adas.co.uk](mailto:gra@adas.co.uk) for further information on the meeting.



## International stock take on use of Earth Observation for agricultural activity information

The UK led project on scoping the potential for Earth Observation to cost effectively provide agricultural activity information for Agriculture, Forestry and Other Land Use (AFOLU) inventory compilation supports the first of the four key Inventory and Monitoring Group's work areas. The project will soon carry out an international stock take on activity data needs and current use of Earth Observation in providing activity data in land use and agriculture inventories. Relevant experts in GRA member countries will be asked to complete a web-based questionnaire to support the stock take and results will be disseminated via the GRA and at an international workshop in 2015.



### Increasing Efficiency of Dietary Nitrogen Use in Dairy Systems

Dairy cows are often fed diets with relatively high concentrations of crude protein to ensure an adequate supply of metabolisable protein for maximal production of milk and to maintain fertility. Dietary protein is used inefficiently by dairy cows, with approximately 75% of nitrogen intake excreted such that they excrete more nitrogen in the urine than they produce in milk. Nitrogen excretion is a significant environmental concern due to atmospheric losses as nitrous oxide and ammonia, and nitrate leaching contributing to aquatic eutrophication. Nitrogen excretion in manure is highly correlated with dietary nitrogen intake, thus one option for reducing nitrogen excretion is to feed less protein. While there may be clear benefits in offering lower protein diets to reduce excretion of nitrogen in manure, this strategy will only be acceptable to dairy farmers if it can be achieved without a significant reduction in milk production and without detrimental effects on health and fertility.



A collaborative project funded by Defra and DairyCo is underway to explore opportunities for reducing protein intake (i.e. reduced nitrogen intake) in dairy cattle without compromising lifetime productivity. In addition to determining the long-term impacts of reduced dietary protein concentrations for life-time production, fertility, and health, the project will evaluate the environmental and economic impacts for dairy systems in the UK. The 6 ½ year project that began in 2012 will measure the effects of different dietary levels maintained from weaning through to the end of the third lactation. The project is led by the Centre for Dairy Research at the University of Reading with collaboration from Aberystwyth University, Rothamsted North Wyke, the Basque Centre for Climate Change (based in Spain), SRUC, and an Advisory and Dissemination Committee comprised of leading figures from across the UK and United States of America (USA) dairy industry.

Measurements will determine the effects of reduced protein consumption on milk production and composition, fertility, body condition, and health in 300 cows of high genetic merit fed maize- or grass-based diets. The effects of incremental reductions in dietary nitrogen intake on manure output and associated excretion of nitrogen in urine and faeces will be measured, as will the effects of feeding lower protein diets to growing heifers on growth rate, manure output, nitrogen excretion and subsequent lactation performance.

Results of experiments will be integrated using simulation models to predict the effects of feeding lower protein diets on emissions of nitrous oxide, ammonia, and nitrate from dairy farms of varying type, and the impact of these responses on national and regional emissions. These data together with farm survey data will be used to assess the economic impact of reduced protein feeding on UK dairy farms.





Knowledge transfer of research results to the livestock industry will include practical information defining the long-term effects of reduced dietary protein intake on milk production, nitrogen excretion and environmental pollution for dairy cows. Comparisons will be made between old and new feeding regimes to illustrate the impact of the research at the farm level. These results will focus on economic and environmental sustainability in addition to improvements to nitrogen use efficiency. The project represents a major undertaking and offers numerous opportunities for collaborative research adding value to the existing project.

Running in parallel to this work is a 4 year DairyCo funded project to devise diets that allow dietary crude protein levels to be reduced below those currently used in commercial practice without compromising milk yield, milk composition, or herd fertility. The project which is led by the University of Nottingham aims to improve understanding of the effect of reduced crude protein levels on health and welfare in dairy cows, on the efficiency of nitrogen utilisation, and on GHG emissions. Leaflets and technical information on protein rationing for dairy cows will be produced as a project outcome.



## UK PARTICIPATION IN FACCE-JPI

### About FACCE-JPI



FACCE-JPI, established in 2010, brings together 21 European Member States and Associated Countries committed to addressing the interconnected challenges of sustainable agriculture, food security and climate change. FACCE-JPI aims to align national programmes under five core research themes including GHG mitigation, adaptation to climate change, and environmentally sustainable growth and intensification of agricultural systems. Further information is available at [www.facejpi.com](http://www.facejpi.com).

### FACCE-JPI GHG Mitigation projects with UK partners

The UK participated in the GHG Mitigation Call which was launched in 2013 by FACCE-JPI and the Governments of USA and New Zealand to strategically address the global challenge of mitigating GHG emissions from agriculture by supporting cooperation between national research programmes. Eleven projects were funded under the Call of which 7 have a UK partner. Details of the projects with UK participation are provided below.

#### Livestock projects

Global Network for the development and maintenance of nutrition-related strategies for mitigation of methane and nitrous oxide emissions from ruminant livestock (Global Network)  
Understanding the development and control of stability in the rumen microbiome as a basis for new strategies to reduce methanogenesis (RumenStability)

#### Modelling projects

Robust models for assessing the effectiveness of technologies and managements to reduce nitrous oxide emissions from grazed pastures (Models4Pastures)  
Carbon and nitrogen Models Intercomparison and Improvement to assess management options for GHG mitigation in agrosystems worldwide (CN-MIP)  
Whole-farm GHG estimation and environmental diagnostics platform (COMET-Global)  
Identifying ways to reduce agricultural GHG emissions: A multinational modelling approach to optimize carbon and nitrogen cycles between livestock and cropping systems (Idenways)

#### Economics project

Increasing Adoption of Mitigation Options to Minimise Agricultural GHG Emissions (I.N.C.O.M.E)

A full description of all projects is available at the [FACCE-JPI](http://www.facejpi.com) website





## UK REPRESENTATION AT GRA MEETINGS

**Inventory and Monitoring Cross-Cutting Group meeting** 17th – 20th December 2013, Edinburgh, Scotland

**Experimental databases and models of nitrous oxide emissions by croplands: Do we have what is needed to explore mitigation options?** 17th – 19th March 2014 Paris, France

**Model Intercomparison for agricultural GHG emissions** 19th – 21st March 2014 Paris, France

**First Animal Health and GHG Emissions Intensity Workshop** 25th March 2014 Dublin, Ireland

**GRA workshop on engaging central Europe** 7th – 8th April 2014 Warsaw, Poland

**FACCE-JPI workshop on Animal Health and Disease and GHG Mitigation** 21st May 2014 Madrid, Spain

**Rumen Microbial Genomics Network meeting** 16th June 2014, Aberdeen, UK.

**GRA Council meeting** 16th- 20th June 2014 Wageningen, The Netherlands

**Feed and Nutrition Network meeting** 20th July 2014, Missouri, USA

**Animal Selection Genetics and Genomics Network meeting** 17th August 2014 Vancouver, Canada

**Croplands Research Group meeting** 28th – 29th August 2014, Debrecan, Hungary

## FURTHER INFORMATION

Please contact ADAS UK Ltd for further information on UK participation in the GRA and FACCE-JPI. For more detail on UK GRA activities and to access previous UK Agri-Science & Innovation newsletters, you can also visit the UK page on the [GRA](#) website.

Please send your email address to ADAS UK Ltd using the contact details below to receive regular updates on GRA activities, meeting reports, funding opportunities, publications and events.

### Contact details:

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### GHG Marginal Abatement Cost Curves (MACCs) webpage

UK scientists have contributed to the GRA MACCs webpage which aims to facilitate sharing of experiences, journal articles and technical reports from organisations around the world working on MACCs.

Please follow this [link](#) to view all contributions.