

Livestock Research Group

GLOBAL RESEARCH ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES

What is the Global Research Alliance?

Agriculture has a vital role to play in the coming decades with the world's population estimated to reach 9.6 billion by 2050. With more mouths to feed but limited natural resources to draw on, the sector must find ways to produce additional food and fibre sustainably, while also contributing to broader development goals.

The Global Research Alliance (GRA) seeks to increase cooperation and investment in research activities to help reduce the emissions intensity of agricultural production systems and increase their potential for soil carbon sequestration. It also seeks to improve their efficiency, productivity, resilience, and adaptive capacity. This contributes in a sustainable way to overall mitigation efforts but also helps meet food security objectives.

The main work of the GRA occurs in its four research groups. These are focused on key agricultural sub-sectors (Paddy Rice, Croplands and Livestock) and issues common to those sub-sectors managed by the Integrative Research Group.

What is the Livestock Research Group?

The GRA's Livestock Research Group (LRG) is focused on reducing the emissions intensity of livestock production and increasing the carbon stored in soils supporting those systems. The LRG works with scientists, farmers and farm advisors, industry and policy makers to research mitigation options, share knowledge and experiences and help strengthen the resilience of livestock farming.

Members collaborate to advance global research on livestock emissions intensity at the same time as supporting countries to achieve their own agriculture and climate change priorities. In this way, the GRA enables progress to be achieved on challenges that any country would struggle to approach on their own.

The LRG includes official representatives from GRA member countries, mostly from scientific and government organisations, and key international and regional partners. New member countries and organisations are always welcome.

The LRG's work plan spans six areas of activity as shown in the diagram. This brochure provides details on each of these work areas.



Key areas of work

1. Understanding the current research landscape

Advancing research collaboration between countries relies on a collective understanding of individual countries' current research priorities and activities. The LRG routinely carries out 'stocktakes' to identify knowledge gaps, capability building needs and opportunities for joint research. Information from countries on who is doing what helps ensure that the LRG's efforts are appropriately targeted and add value, and also helps internal coordination within countries.

2. Building capability

Building the capability of countries to measure, report and verify greenhouse gas (GHG) emissions from livestock systems is a critical area of work for the LRG. Activities take place in several ways. Technical training workshops bring scientists and technicians from a region together with global experts. These workshops can lead to targeted projects set up to address particular issues in a region (see Examples). LRG countries and partners also make fellowship and award schemes available. These enable researchers and technicians to undertake 'on-the-job' training and can help seed new collaborative ideas.

A core part of the LRG's capability building effort is focused on supporting countries to develop more advanced (Tier 2) inventories for estimating livestock GHGs. These inventories enable countries to capture the reductions in GHG emissions

intensity that results from improvements to livestock farming. This is important as more countries look to find ways that agriculture can contribute to both development and climate outcomes. The LRG is working with partners to review country experiences and develop regional initiatives to help overcome the barriers to change.



Examples of building capability

Reducing enteric methane for improving food security and livelihoods

The LRG has contributed to a major capability building project identifying regionally appropriate low emission pathways for livestock development in South Asia, Sub-Saharan East Africa and South America. The project has enabled thirteen countries to identify and model cost effective, technical interventions that will significantly improve the efficiency of livestock production and reduce enteric methane emissions intensity. Planning is underway for a second phase that may include farm-scale testing. The UN's Climate and Clean Air Coalition and the New Zealand Government provided financial support, with the work being led by FAO and the New Zealand Agricultural Greenhouse Gas Research Centre, with support from the World Bank. See: <http://www.fao.org/in-action/enteric-methane/en/>

Improving livestock greenhouse gas inventories in South East Asia

The LRG has an extensive programme of work underway in South East Asia to support countries to improve their national greenhouse gas inventories for livestock emissions. Several workshops have taken place to better understand livestock systems in the region, their changes over time, and impact on greenhouse gas emissions. Technical training has enabled countries to progress towards more advanced inventories for estimating livestock emissions, including data collection, statistical analysis and measurement techniques. International inventory experts have peer reviewed draft inventories and provided advice on overcoming barriers. Participating countries are now linking inventory development and greenhouse gas mitigation research with national and regional climate change development plans.

Joint livestock mitigation work in Latin America and the Caribbean

A partnership between the LRG, FONTAGRO and the New Zealand Government has supported countries in Latin America and the Caribbean to better understand and reduce greenhouse gas emissions from livestock.

Since this initiative began, countries have:

- Improved and standardised their measurement of enteric methane and nitrous oxide emissions from different farm systems
- Identified regionally appropriate mitigation options consistent with farming practices and development goals
- Established a regional platform to coordinate research activities relating to the sustainable intensification of livestock production

3. Research networks and databases

Much of the LRG's work relies on experts working together across boundaries to advance collective knowledge. To support this goal, the LRG has established global networks addressing specific aspects of livestock emissions research. The LRG also has several regional networks helping scientists and policy makers address regional challenges in the Mediterranean, Latin America and the Caribbean, and South East Asia.

The LRG's networks are its engine room, linking researchers up to address critical knowledge gaps, analyse and improve data, standardise modelling assumptions, develop common protocols for measurement and find new ways of working together to advance shared priorities. LRG networks actively collaborate to identify priority projects. Funding is sought from relevant regional and international sources.



Participation in any of the LRG's networks is not limited to people from GRA countries but includes experts from research, industry and farm practice around the world.



Animal Health and Greenhouse Gas Emissions Intensity Network

This network is exploring the interactions between efforts to improve animal health and reduce GHG emissions per unit of product. This is a win-win situation where animal health improvements may lead to reductions in environmental impact. The approach offers strong synergies with broader development and food security goals. It also links with efforts to adapt to a changing climate by improving the resilience of livestock systems.



Animal Selection, Genetics and Genomics Network

This network is a forum for scientists exploring the impact of genetic technologies for managing livestock greenhouse gas emissions. This includes sharing information and data relating to breeding low-emitting animals, defining common traits and developing common measurement protocols.



Feed and Nutrition Network

Feed, feed additives and nutrition directly affect an animal's productivity and health status and can strongly influence absolute or per unit of product greenhouse gas emissions. Participants in this network are analysing data and developing measurement protocols and mitigation options based on nutritional means.



Manure Management Network

Researchers in the Manure Management Network are identifying management practices to reduce GHG emissions from livestock manure and improve the efficiency of nutrient use. Sharing available information and adapting it to national circumstances and diverse livestock systems is also a priority for the network.



Rumen Microbial Genomics Network

Rumen modification (manipulating the microbes that produce methane) is a promising area of research for reducing enteric methane emissions. This network is a forum for researchers using genomics approaches to understand enteric methane emissions and how they might be reduced without compromising animal health or productivity.

For more information visit: <http://globalresearchalliance.org/research/livestock/>



4. Collaborative research

Collaborative research projects are at the heart of the LRG's work. They allow scientists to achieve results that would have been impossible working in isolation, for example:

- Sharing data sets
- Harmonising measurements and methodologies
- Pooling resources for analysing large numbers of samples or model inter-comparisons

Specific projects may be identified within research networks or at annual meetings of the LRG, with participating countries then collaborating to source funding for the work. A significant number of projects are underway at present – some highlights are presented below.

Global Rumen Census

Global solutions to reduce methane emissions from ruminant animals are feasible, because the microbes causing the emissions are similar around the world. This was the major finding of an LRG project, sponsored by the New Zealand Government, that surveyed the diversity of microbes present in rumen samples from 34 countries and a range of farm systems. As well as the expected samples from sheep, cattle, deer and goats, there were also some from buffalo and giraffes. The project found that the same major groups of methanogens dominate in nearly all rumens across a wide variety of species and animal diets. This means that new technologies that seek to reduce methane emissions by influencing rumen microbes should have worldwide application. Globally, 140 scientists from 73 organisations contributed to the rumen census, with microbial samples collected over two years. The study has provided knowledge that no country could have delivered on its own, and the benefits are also global. The project was a collaboration of the [Rumen Microbial Genomics Network](#).

GLOBAL NETWORK project

Strategies relating to animal nutrition are an important way of reducing ruminant livestock emissions. A large body of data is available internationally but it is not well-organised and would benefit from further analysis. GLOBAL NETWORK is a four-year project to address these issues, led by the LRG's [Feed and Nutrition Network](#) and funded by GRA countries and the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). The project is developing two databases on mitigation and prediction. The first analyses experimental treatment means from over 400 publications to enable the recommendation of science-based mitigation options. The prediction database collates individual animal data relating to diet, intake, emissions and performance. This supports the development of models for predicting methane emissions for various ruminant species and nutritional, animal and farm management scenarios. GLOBAL NETWORK has also contributed major reviews of *in vitro* and *in vivo* methods used in experiments measuring feed and nutrition effects on methane emissions. These reviews complement the databases by forming the basis for standard operating procedures.

Selecting naturally low-emitting animals

Animals vary naturally in the amount of methane they produce. Selective breeding of animals with low methane emissions per unit of feed consumed could result in a permanent methane reduction of up to about 10%, with no negative impacts on productivity recorded so far. Faster progress will be made in this important area of research if countries coordinate their efforts and also use the same metrics. This project is focused on optimising genetic, genomic and phenotype measurement parameters in cattle and sheep through international collaboration to share data and develop common measurement protocols. It is a collaboration of the [Animal Selection, Genetics and Genomics Network](#).



Models and management options to reduce nitrous oxide emissions from grazed pastures

Emissions of nitrous oxide from grazing animals are hard to monitor by measurements alone, due to their great spatial and temporal variability. Models are therefore crucial to understand the long-term effect of mitigation options and the influence of grazing management practices. No model is perfect though, and some may be calibrated to a particular set of circumstances but perform poorly in other situations. Two projects, combining efforts of the LRG and the GRA's soil carbon community, are seeking to test and improve a range of commonly used models through large-scale inter-comparisons that pool modelling resources, expertise and datasets across participating countries. These help to better understand areas of agreement and disagreement between models, and increase their reliability to predict nitrous oxide emissions and the effectiveness of mitigation options.

Increasing soil carbon under grasslands

Pastoral soils have significant potential to sequester carbon, offering a way to offset unavoidable emissions from livestock grazing those pastures. Increasing soil carbon can also help improve yield and resilience. However, soil carbon can also be lost as a result of management practices and climatic extremes such as droughts and floods – events that are expected to increase in many locations with climate change. An international project is underway to identify and test management options for increasing the storage and, crucially, the stability of carbon in pastoral soils. Researchers will use the findings of this work to develop a model for estimating carbon inputs and losses, shedding light on their longer-term implications for soil carbon storage. The project will combine net ecosystem carbon exchange measurements with cutting edge stable carbon isotope techniques and use this to improve modelling of soil carbon, to develop a comprehensive understanding of the soil carbon dynamic in intensive pasture systems.

Funding for joint projects

The GRA is a voluntary organisation and currently has no central fund. This means that turning research and capability building opportunities into viable projects has to rely on flexible and creative approaches to funding from countries and other partners and institutions. For example:

- Individual countries making dedicated funding available to support international collaborative projects in areas of their particular domestic interest, e.g. the New Zealand Fund for Global Partnerships in Livestock Emissions Research.
- Multi-country collaborations, e.g. the Inter American Development Bank's support for Latin American livestock mitigation research, expansion of European funding models to include other GRA countries.

But dedicated new funding is not always necessary to allow collaborative research to proceed. Almost all GRA member countries have domestic funding mechanisms that include agricultural productivity, efficiency and GHG implications within their goals. Aligning the priorities of such funds with collaborative opportunities presented through the GRA allows countries to combine domestic priorities with expertise and resources located in other countries to work towards common goals.



5. Providing policy support and links to international initiatives

Turning research into practical solutions is at the heart of the LRG's efforts. Partnerships with other international and regional organisations that work directly with farmers, industry and policy are vital to achieve this goal.

The LRG works closely with the FAO, the World Bank and the CGIAR, in particular its Climate Change, Agriculture and Food Security (CCAFS) programme. The LRG has also built strategic relationships with other organisations working in similar areas for example the Sustainable Agriculture Initiative (SAI) Platform, European Commission, International Dairy Federation and the Global Agenda for Sustainable Livestock. These organisations share many of the objectives pursued by the LRG – seeking to reduce the emissions intensity of livestock production while promoting food security and farmer livelihoods.

A key mechanism for engaging with partners and supporting policy-relevant outcomes will be the GRA's newly established flagship research programmes. Each flagship presents a coordinated programme of work that will seek to address priority challenges facing GRA members. Out of four flagships currently in development, three relate directly to livestock farming: enteric fermentation, soil carbon, and GHG inventory issues.

The LRG is leading the enteric fermentation flagship, which aims to:

- Develop research-based mitigation solutions
- Improve the quantification of livestock GHGs
- Help identify, test and implement locally appropriate mitigation solutions

While the focus is on enteric methane, the success of this multifaceted flagship rests on its ability to generate co-benefits for climate and development policy, improving rural livelihoods and resilience to climate change. International

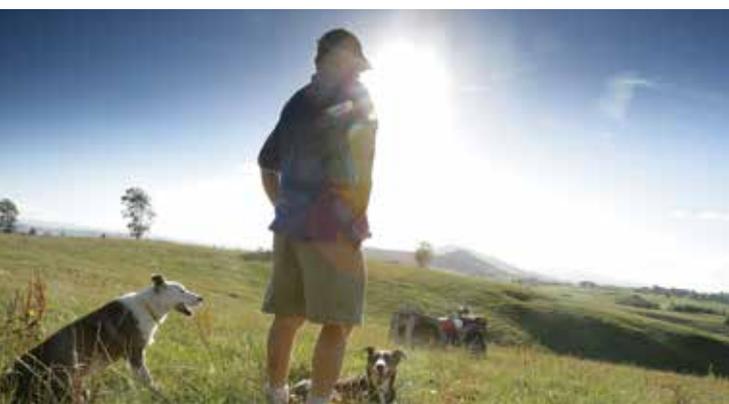
partnerships will be critical to achieve these goals. The flagship will also foster improved science/policy links to support countries in addressing livestock's contribution to climate change.

Pastures used for livestock grazing play an important role in the global carbon cycle. The potential for storing carbon in pastures is high but it is challenging to demonstrate and sustain in practice. The LRG is contributing its expertise to the GRA's soil carbon flagship, which is aligned with related international activities on soil carbon and the role of agricultural soils in food security and climate change.

The LRG is also working with CCAFS and the FAO to support countries to improve their measurement, reporting and verification (MRV) of livestock GHGs to help meet their climate and sustainable development goals. This connects closely with the LRG's capability building efforts on GHG inventories (see page 2) and the GRA's planned inventory flagship. Many countries have included agriculture in their Nationally Determined Contributions (NDCs) under the Paris Agreement. However, transparent MRV of livestock GHGs – including capturing mitigation outcomes – is challenging. A programme is underway to:

- Describe the expectations and needs of countries and users of MRV of livestock emissions
- Identify the different approaches that countries are taking and the barriers they face
- Highlight opportunities for improvement and learning

The LRG is also forging links with the IPCC, including through the GRA's status as a formal IPCC observer. This enables attendance at IPCC Panel meetings, being more directly informed of its work, and being able to coordinate activities to support the IPCC's efforts. The LRG's unique position as the international hub for livestock emissions research places it well to contribute to the suite of IPCC work addressing land-based issues, including the Sixth Assessment Report.



Examples of international linkages

Engaging with industry

The LRG and the SAI Platform have jointly published a guide for farmers and industry leaders on reducing the emissions intensity of livestock production: *'Reducing greenhouse gas emissions from livestock: Best practice and emerging options'*. It covers animal feed and nutrition, genetics and breeding, rumen modification, animal health, manure and grassland management and was reviewed by experts from the [LRG research networks](#). The guide highlights positive environmental impacts as well as the financial implications of implementing the various options. It underlines the importance of GHG reduction efforts in supporting a sustainability approach to farming. The guide is now available in French and Spanish and will soon be available in Mandarin.

"The practical options provided in this resource allow farmers to make informed decisions about greenhouse gas reduction activities and efficiencies benefitting their farms. It is based on the latest science, demonstrating that proper cooperation between research and industry can be very rewarding" – **Keith Kenny, Head of Sustainability and CSR, McDonald's Europe and chair of the SAI Platform Beef Working Group.**

World Farmers' Organisation

Grassroots support for the GRA is just as important as support from international organisations. The World Farmers' Organisation (WFO) is a formal GRA partner, helping take the GRA's efforts out to farmers, including the work of the LRG. The LRG and the WFO have organised several joint study tours aimed at better connecting the farming, science and policy sectors. These tours expose pastoral livestock farmers to a range of technologies and management practices to help improve on-farm productivity while reducing greenhouse gas emissions. Farmers from Latin America, Europe and Asia-Pacific have taken part.

Demonstrating country experiences in reducing emissions intensity

Farmers in a number of countries have been systematically improving livestock productivity and reducing GHG emissions intensity. The LRG has compiled these success stories into case studies, covering experiences from the local to national level and enabling mutual learning between countries. Parallel work is also underway to document the benefits of improved emissions inventories to monitor and report the reductions in emissions intensity that result from increasing the productivity and efficiency of livestock systems. Together, these projects help countries showcase and celebrate the achievements they have made in meeting environmental as well as food security goals, while enabling them to move further along this pathway consistent with their national development priorities. The case studies are available at: www.globalresearchalliance.org/livestock



6. Good practice guidance and technical methodologies

Scientists in the LRG have worked together to produce good practice guidelines and technical manuals on key areas of livestock emissions research including:

- Good practice guidelines on soil chambers for measuring nitrous oxide emissions, and the sulphur hexafluoride (SF₆) tracer technique for measuring enteric methane emissions.
- A technical manual on respiration chamber designs from around the world to help new groups developing their own chambers.
- An evaluation of the GreenFeed system for daily measuring of methane emissions from freely ranging cattle.

Sharing information in this way means that new research teams can quickly adopt and tailor research techniques so that they meet their individual needs, while still being consistent with international best practice. This also helps enhance comparability of results and makes it easier for teams to collaborate in future projects. The LRG uses these publications in its capability-building activities.

Further Information

For more information and contact details for the LRG Co-Chairs and network coordinators, please visit the LRG's website:

www.globalresearchalliance.org/research/livestock



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