GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

Meeting of the Livestock Research Group

Institute of Agricultural Science of South Viet Nam

Ho Chi Minh City, Viet Nam

15-16 May 2018

MEETING OUTCOMES AND REPORT

The 10th annual meeting of the Livestock Research Group (LRG) of the Global Research Alliance on Agricultural Greenhouse Gases (GRA) was hosted by Viet Nam from 14-16 May 2018. It was attended by representatives from 22 countries, four of the LRG's research networks and four partner organisations.

OUTCOMES

The meeting identified the following actions and outcomes:

- Request for a third Co-Chair (Asia/Africa) and a Europe replacement for the Netherlands.
- Introduction of the new coordinators for the Animal Health Network, Animal Selection Genetics and Genomics Network and the Manure Management Network.
- Call for new members to contribute to the re-start of the Manure Management Network.
- Agreement to provide data supporting three projects under the Enteric Fermentation Flagship (CEDARS, Rumen Microbiome and RumenPredict) as well as the DATAMAN proposal, a possible N_2O Flagship project.
- Agreement to develop another series of project proposals supporting GRA Flagships and LRG Networks ahead of the 2018 Council meeting.
- Agreement for the LRG to provide input to the GRA Flagship on Circular Food Systems.
- Agreement to support activities of the IPCC including:
    - Review of the upcoming Special Report on Climate Change and Land;
    - Contribution of data to the Emission Factor Database; and
    - Publication of regional assessments for agricultural mitigation.
- Identification of regional priorities for capability building in Asia, Africa and Latin America.
- Decision to establish an African regional network and hold a workshop in Southern Africa (Zimbabwe).

MEETING REPORT

1. This report is a summary of key discussions, outcomes and action points from the meeting. Presentation slides and background papers are provided separately on the GRA website (https://globalresearchalliance.org/library/livestock-research-group-meeting-ho-chi-minh-city-vietnam-may-2018/).

PARTICIPANTS

2. The meeting was attended by representatives from 22 GRA member countries and four observer countries, four of the LRG's research networks, and four partner organisations:

- **Countries attending:** Argentina, Australia, Belgium, Canada, Colombia, Denmark, Germany, Ghana, Italy, Japan, Malaysia, Netherlands, New Zealand, Philippines, Senegal, Spain, Thailand, United Kingdom, Uruguay, USA, Viet Nam, Zimbabwe.
- **LRG network coordinators attending:** Animal Health Network; Animal Selection, Genetics and Genomics Network; and Feed and Nutrition Network.
- **Partners attending:** Tropical Agricultural Research and Higher Education (CATIE), Climate and Clean Air Coalition (CCAC), International Centre for Tropical Agriculture (CIAT also representing CCAFS), UN Food and Agriculture Organisation (FAO).

3. The meeting was co-chaired by Martin Scholten (Wageningen UR, the Netherlands) and Harry Clark (New Zealand Agricultural Greenhouse Gas Research Centre). Refer to Appendix 1 for the full participants' list.

WELCOME

4. The Meeting was opened by Dr Nguyen Thanh Son, Director General of the National Institute of Animal Science and Prof. La Van Kinh, Director, Institute of Animal Sciences for Southern Viet Nam LRG participants were welcomed to Viet Nam and provided an overview of Viet Nam's animal sciences research.

5. Mr Tran Lim Long, Director General, International Cooperation Department, Ministry of Agriculture and Rural Development presented the challenges that Viet Nam's livestock sector faces to reduce agricultural greenhouse gas emissions, particularly the better management of manure from housed livestock and the integration of livestock and cropping systems, which are most often separated on different farms.

SCENE-SETTING CO-CHAIRS OVERVIEW

6. Martin Scholten, LRG Co-Chair from the Netherlands provided the overview of the Livestock Research Group (LRG). The Co-Chair gave an update on changes to the leadership of the Group; a third Co-Chair is being sought to enhance the group's coordination as LRG activities continue to increase. The Chair would preferably come from a country that has different livestock production systems from the existing Chairs, such as in Asia or Africa. The Netherlands is also planning to step down as Co-Chair of the LRG, and instead focus on the development of the GRA Flagship on Circular Food Systems. A replacement Co-Chair is still to be identified, but likely to be from Europe, with a similar production system to the Netherlands. Changes have also been made to the leadership of three of the Networks. The Animal Health and Greenhouse Gas Emissions Intensity Network is now

led by Dirk von Schoosten, Germany, the Animal Selection, Genetics and Genomics Network is led by Suzanne Rowe, New Zealand and the Manure Management Network is led by Hongmin Dong, China.

7. Key achievements for the LRG over the past year have been:

- Publication in *Nature* by the Hungate 1000 team, demonstrating the global nature and relevance of the GRA.
- Global Network project published in *Global Change Biology* confirming methane emissions can be predicted using simplified models.
- European research funding[1] was confirmed for 10 projects relevant to the LRG
- New capability building funds from the Climate and Clean Air Coalition.
- Latin America Platform on low emissions livestock was established and is developing projects.

Secretariat Update

8. The GRA Secretariat provided an update to the Group on activities of the GRA since the 2017 Council meeting, including new Members and Partners and the changes to Research Group pages on the GRA website.

9. The GRA now has 50 Member Countries, with the Democratic Republic of Congo, Senegal, South Africa and Zimbabwe joining in the past year. The GRA now works with 17 Partner organisations.

10. Outcomes from the Council meeting that are of relevance to the Research Group include the decision to complete an inventory of members capability building needs, and fellowships and training events that could be used to support GRA activities. The Research Group Co-Chairs also proposed developing regional capability building activities, which will be coordinated across all four Research Groups. This would make the benefit received from these activities, for the GRA and institutes and researchers attending, more visible. Council members have been asked to support these activities by identifying experts that could help to develop workshop programmes and deliver the workshops.

11. The 2018 Council meeting will be held 10-14 September in Berlin, hosted by Germany as the incoming Council Chair. Alongside the meeting will be an International conference on Agricultural greenhouse gas (GHG) emissions and Food Security: Connecting research to policy and practice. The conference is jointly organised by GRA and FACCE-JPI, in partnership with CCAFS, and hosted by the Thünen Institute. The conference consists of two parts; a Science Conference (10-11 September), at the same time as the Council meeting, and a Stakeholder Conference (11-12 September). The objective for the stakeholder conference is to communicate research outcomes of the GRA, FACCE-JPI and Agriculture, Climate Change and Food Security (CCAFS) research programme of CGIAR to policy makers, research coordinators, non-government organisations, and industry and farmer organisations.

12. Recent updates to the GRA website had provided additional space for each of the four Research Groups to showcase activities and the work of their Networks. The Group and Networks were encouraged to review the website, and provide updates on activities as well as any documents and overviews of group activities to the Secretariat for uploading to the website.

[1] Via ERA-GAS, a 'Research Area Network - Monitoring and Mitigation of Greenhouse Gases from Agri- and Silvi-culture' research call

WORKING TOGETHER TO IDENTIFY SHARED INTERESTS

13. Recognising the number of new countries and individuals attending the LRG meeting this year, a working group session brought participants together to discuss work happening in their own countries. People spoke to a specific development in their country that others could get involved or replicate; or raised a challenge their country is facing, seeking to learn how other countries have approached similar issues. Summaries of the report back from each group are listed in Appendix 2.

14. Harry Clark summarised the five discussions by identifying common themes that were repeated across the group discussions:

- Greenhouse gas inventories: improved data, improved emission factors and sharing experiences.
- Framing the debate on productivity, food security and mitigation so it is relevant to our stakeholders.
- Estimation and measurement of emissions, do we have the tools to measure and demonstrate mitigation at a range of scales.
- What is possible, practical and what is the impact of system relevant mitigation options?
- Sharing country experiences of adoption and extension.
- Funding for activities.

NETWORK UPDATES

15. The LRG has five global networks, focused on strengthening collaboration in the main areas of livestock GHG research. Representatives from four of the Networks were able to attend this meeting and provide an overview of activities in the last year. Martin Scholten presented the update on behalf of the Manure Management Network.

16. The meeting discussed the value of greater collaboration between the networks, including the development of shared activities between networks, as it is useful to consider the impacts of one part of the system (e.g. feed) on others parts (e.g. breed, manure management, and rumen microbial composition).

Animal Health and Greenhouse Gas Emissions Intensity Network (AHN)

17. The new AHN coordinator Dirk von Schoosten from the Friedrich-Loeffler-Institut in Germany outlined the objectives of this network. The AHN has more than 80 members across 25 countries, and was previously coordinated by the United Kingdom and the International Livestock Research Institute (ILRI).

18. Globally, 20% of animal productivity is lost due to animal diseases. The aim of the network is to investigate the connection between animal diseases and greenhouse gas (GHG) emissions and to demonstrate how disease control helps to reduce GHG emissions.

19. The Network has five champions from the United Kingdom, the Netherlands, and Norway who can speak on the activites of the network, the AHN welcomes champions from other countries.
20. In October 2017 Network participants presented their results via a webinar. Publications from this Network include modelling work, the connections between animal disease and GHGs, and the impact on vaccination on GHG emissions intensity.

- Challenges and priorities for modelling livestock health and pathogens in the context of climate change: https://www.sciencedirect.com/science/article/pii/S001393511630319X?via%3Dihub
- Study to model the impacts of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions: http://randd.defra.gov.uk/Document.aspx?Document=13320_AC0120Finalreport.pdf
- Greenhouse gas abatement potential of productivity improving measures applied to cattle systems in developing region: https://doi.org/10.1017/S1751731117002294
- Animal Health and greenhouse gas emissions intensity: the paradox of periparturient parasitism: https://linkinghub.elsevier.com/retrieve/pii/S0020751917301340

21. Challenges faced by the AHN include funding support for the coordination of the Network and long term funding for projects. A proposal for funding European researchers to coordinate activities is currently under development with several network partners.

Animal Selection, Genetics and Genomics Network (ASGGN)

22. The new coordinator of the ASGGN, Dr Suzanne Rowe, AgResearch New Zealand, presented the Network activities to the Group. The ASGGN is focused on breeding livestock to mitigate methane or other greenhouse gases, and also identify other traits that are linked to these mitigation goals, as breeding is a long term strategy. The priority is to define the key traits and breeding objectives. Researchers need to understand different systems and species as well as share data, methods and protocols.

23. The current research efforts are to understand genotypes of the microbial communities within the rumen, by sampling a small percentage of each microbiomes, and use the microbial genotypes as a proxy for high and low methane emitting livestock. This method has been demonstrated to work in sheep. The Flagship project proposed by this group will use cattle (e.g. *Bos indicus, Bos taurus* and buffalo).

24. Achievements of the Network include a white paper, Consensus methods for breeding low methane emitting animals: http://www.asggn.org/publications,listing,95,mpwg-white-paper.html.

25. The Network has also contributed to an International Committee for Animal Recording (ICAR) working group, recording the trait definitions and metadata.

26. Three workshops have been held in 2014, 2016 and 2018, with the possibility of holding a further workshop this year alongside the European Federation of Animal Science (EAAP) conference in August 2018 (http://www.eaap2018.org/).

Feed and Nutrition Network (FNN)

27. The FNN has been coordinated by Dr Alex Hristov of Penn State University, USA for 5 years. A key achievement is the Global Network project https://globalresearchalliance.org/research/livestock/collaborative-activities/global-research-project/), which involves core FNN members. The project is in the final stages, having received 1 year extension of funding from FACCE-JPI and has established a database of feed types and mitigation strategies. Other Global Network activities include the publication of measurement techniques, led by the United Kingdom, and a set of reviews:

- Design, implementation and interpretation of *in vitro* batch culture experiments to assess enteric methane mitigation in ruminants—a review: https://doi.org/10.1016/j.anifeedsci.2016.03.016

- Review of current in vivo measurement techniques for quantifying enteric methane emission from ruminants: https://doi.org/10.1016/j.anifeedsci.2016.05.018
- Symposium review: Uncertainties in enteric methane inventories, measurement techniques, and prediction models: https://doi.org/10.3168/jds.2017-13536

28. Other activities of the FNN include the recently completed dairy feed database publication, linked to similar data for beef cattle and small ruminants' now being compiled. The data included is mostly from housed systems, not much pasture/grazing systems data. Limited data has been provided from outside of Europe and North America.

29. The Capturing Effects of Diet on Emissions from Ruminant Systems (CEDERS) project is another core activity for the FNN. It builds on the Global Network activities and is funded by ERA-GAS.

Rumen Microbial Genomics (RMG) Network

30. The update of activities from the RMG Network was presented by Dr David Yanez-Ruiz on behalf of the Network coordinator Dr Sharon Huws. The Network focuses on understanding the microbes that affect methane emissions from ruminant livestock. Initial activities have included generating a reference dataset and sharing methodologies, as well as focusing on capability building and training of students through exchanges and fellowships.

31. The two main projects of the RMG have been the Global Rumen Census (https://globalresearchalliance.org/research/livestock/collaborative-activities/global-rumen-census/), sequencing ribosomal RNA of microbes from ruminant species across the world, and the Hungate 1000 project to develop a reference set of rumen microbial genome sequences.

32. Other activities of the Network:

- Two Collaborative research projects, funded through FACCE-JPI, RumenStability (now completed) and RumenPredict (now underway). RumenPredict is a continuation of the Network's activities to understand host genome and rumen microbiome interactions, feed based mitigation strategies, develop an analytical platform, and identify biomarkers to predict nitrogen and methane losses.
- Six network meetings have been held, the 7th meeting will be held in June 2018 in Aberdeen.
- Contribution to a special topic in 'Frontiers in Microbiology' journal, 27 papers published so far with an expected 35-40 in total.
- A second research topic on Gut microbiome modulation in ruminants, also in 'Frontiers in Microbiology', has recently opened for applications (closing 30 September 2019), LRG members are encouraged to submit publications.

Manure Management Network (MMN)

33. The Network coordinator Dr Hongmin Dong, Chinese Academy of Agricultural Sciences, was unable to attend the LRG meeting so Martin Scholten gave an overview on her behalf. Previously this Network was involved in the development of the Manure Management Kiosk project funded through CCAC. However, only limited network activities have taken place since. With new coordinators now in place – Dr Hongmin Dong, Dr April Leytem (USDA) and Dr Julio Mosquera (Wageningen, Netherlands) the Network is looking for researchers to join, in particular from regions outside of Europe.

34. Plans for re-scoping the network include understanding the different practices and regulations each country has in place for monitoring, measurement methods, manure treatment to reduce emissions and the use of manure as an organic fertiliser.

35. The Network is developing a proposal to improve emission factors for national inventories, the project will include Monitoring, Reporting and Verification (MRV) protocol and a central database of practices. The MRV protocol will be developed by CCAFS and include a publication on manure management strategy – which considers greenhouse gases and ammonia. The Network is planning a meeting in late 2018 or early 2019.

GRA FLAGSHIPS

36. The GRA Council is establishing flagship programmes in several core areas of research and capability building. Flagships are designed to be focal point activities of the GRA, and involve all GRA Members and partners. The LRG meeting received updates on progress with the flagships and opportunities for LRG involvement.

Overview of the Enteric Fermentation Flagship

37. The Enteric Fermentation Flagship, led by Harry Clark and other LRG members, is of direct priority for the LRG. Enteric methane reduction is a significant and difficult challenge, but there are opportunities to reduce emissions while increasing productivity and to put these findings into practice. Projects within this flagship cover three key areas: developing solutions, quantifying data and identifying appropriate mitigation actions for different production systems.

38. The flagship has two projects underway:

- Rumen microbes to predict methane
- Expansion of the FNN's CEDERS project

39. A proposal for a third project is being developed by the RMG network to expand the existing RumenPredict project. See below for more details on the three projects.

40. They were chosen because they would return benefits in a short time frame, were built on existing funding/projects, had committed project leaders and identified sources of funding. Countries are invited to contact the project coordinators to should take the opportunity to contribute to Flagship projects by contributing data or samples.

41. The Co-Chairs also asked if there were new project suggestions for inclusion into the Enteric Methane Flagship, for example whether there are any multi-country projects that already exist that could be expanded or reproduced in other areas. LRG members will be asked to submit new project ideas ahead of the 2018 GRA Council meeting.

Rumen Microbiome Project

42. The objective of this project is to take a different approach to the microbes and use microbial communities to identify a low methane trait that can be characterised for breeding purposes. Rumen fluid from a wide range of livestock will be sequenced to understand the heritability of microbial communities and structures.

43. A method has been developed and tested in sheep to sample a small percentage (3-4%) of the microbial genomes from rumen fluid samples. This has demonstrated ability to predict methane status (e.g. high or low emitting animals) and type of feed in ruminants.

44. As a flagship project, the sheep work will be expanded to sampling cattle. A LEARN post-Doc (https://livestockemissions.net/) has been employed by AgResearch, New Zealand to sequence the rumen samples and undertake the analysis to identify trait data. The project needs additional rumen samples, from all systems and species, particularly tropical countries, and LRG members are actively encouraged to get involved.

45. To contribute you will need to provide the rumen sample and methane emissions data. Samples will cost ~30euro each to run. The project has money to run a limited number of samples, including to support developing countries wishing to participate, but will be asking other partners to fund their own samples (data will be returned to those submitting samples).

Contact the project leader Suzanne Rowe (Suzanne.rowe@agresearch.co.nz) for more information.

FEED/METHANE RELATIONSHIPS

46. The CEDERS project mentioned above will be expanded under the Enteric Fermentation Flagship to include a wider range of countries and production systems.

47. The project targets data from South East Asia and South America specifically and will support two post-Docs, one for each region, to deliver this work.

48. The outcomes will be:

- Better quantitative information on feed characteristic/methane relationships;
- Identification of region-specific feeds that could offer the most significant reductions in methane emissions; and
- More specific methane yield values for local feeds and production circumstances in the target regions, and updates to national GHG inventories needed to take into account these values and the new dietary mitigation options.

49. The project leaders of FEED/METHANE RELATIONSHIPS and the rumen microbiome project will discuss ways to share resources across these activities. For more, contact the project leaders Alex Hristov (anh13@psu.edu) and Andre Bannink (andre.bannink@wur.nl).

RumenPredict

50. There is also an opportunity to turn a second ERA-GAS-funded project into a GRA flagship. RumenPredict, mentioned on page 8, is looking at the interactions between the animal genome and the rumen microbiome. The project will review feed based mitigation strategies and compare microbial genes, biomarkers to predict nitrogen and methane losses. Its leaders are currently investigating ways that this work could be extended to include other countries. A proposal will be circulated to the LRG in due course.

Circular Food Systems

51. A new Flagship proposal on Circular Food Systems is currently under development. A taskforce has been established to develop the proposal led by the Netherlands and involving CGIAR and FAO, as well as experts from GRA countries. A workshop of the taskforce will be held on 9 September 2018, alongside the GRA Council meeting in Germany. However, the complete proposal is not likely to be developed for review by the Council this year.

52. The concept of Circular Food Systems is to avoid waste in food production chains, turning our currently linear systems to circular systems. The Flagship will focus on understanding the scale of circularity and developing innovations. What is recognised is that Livestock systems are key to the development of circular food systems, as crop/food by-products can be used as animal feed, and animal manure is a valuable fertiliser.

53. The Netherlands already has a focus on developing these circular systems, scientists at Wageningen University are identifying the differences between circular and other systems, including the mitigation of agricultural GHGs that can be achieved by shifting to circular systems.

Other Flagships

54. The **GHG Inventory Flagship** has identified an initial set of projects for the Flagship. However, none of the projects have yet nominated a project lead or the resources to further develop the activity. The Flagship Co-Leads have identified the project "Shared Farm Systems/Production typologies" to progress as this has the most support at this stage, with leadership from CCAFS and the GHG Inventory Network.

55. The **Soil Carbon Sequestration Flagship** aims to understand the soil carbon sequestration potential at an almost global scale for arable and grasslands systems – with countries providing the underpinning data. A number of partners and initiatives will be involved in Flagship activities such as the Global Soil Partnership (GSP) to develop methodologies and guidelines, cooperation of GRA members and others for the adoption of solutions, and the project "Coordination of International Research Cooperation on soil carbon sequestration in Agriculture" (CIRCASA) to develop the online pilot knowledge information system. There were a number of potential projects and project leaders identified at the Integrative Research Group meeting in January 2018. Proposals are now being developed for six projects (refer to the meeting presentations for the complete list).

56. The Croplands Research Group is currently developing the **Nitrous Oxide Flagship**, which will be presented at the 2018 Council meeting. At this stage, a number of research areas have been identified under the component headings: developing solutions; improved quantification of nitrous oxide emissions and mitigation; and implementation of mitigation solutions. New Zealand has put forward its DATAMAN project as a potential activity for the Nitrous Oxide Flagship once it is developed. For now it is an activity of the LRG. DATAMAN is a project to establish a global database to help refine national GHG inventories associated with manure and to improve our understanding of the influence of key variables affecting N_2O, NH_3 and CH_4 emissions from manure including housing, storage, land-application, and direct deposition by livestock. The project is about better quantification and bringing together existing data to help develop emission factors for manure from housed systems or from pasture systems, rather than comparing the processes involved in each system. Contact the project leader, Tony van der Weerden (tony.vanderweerden@agresearch.co.nz) to get involved.

WORKING TOGETHER TO ENGAGE INTERNATIONANLLY

57. The group held a session to explore how the LRG can contribute to other international initiatives. Presentations were given on these initiatives ahead of a discussion from the wider group.

Intergovernmental Panel on Climate Change (IPCC)

58. Dr Andy Reisinger, a member of the IPCC Bureau for Mitigation and Climate Change, presented the activities of the IPCC to the Group. Two special reports from the IPCC will be coming out shortly, the first *Special Report on Global Warming of 1.5°C* due later this year and the *Special Report on Climate Change and Land* is due next year.

59. There is an opportunity to ensure that the work of the GRA is reflected in these special reports and also the assessment reports from the IPCC. Governments and policy makers rely on the information provided in these reports, and to understand the options for agricultural mitigation. These reports reflect published research, and rely on reviews and suggestions from the research community. To align the messaging between the GRA and the IPCC we need GRA representatives to provide comments on the draft reports.

60. It is now too late to provide further comments on the Global Warming of 1.5°C report. Unfortunately agricultural mitigation was not well covered in this report, which was a missed

opportunity for the GRA community. The Special Report on Climate Change and Land provides another opportunity for input from this group; the draft report will be available for comment from 11 June- 5 August 2018. LRG members should provide constructive comments demonstrating how and why emissions intensity is a valid way of meeting the Paris Agreement and provide references to peer reviewed publications that supports these comments.

61. The Group discussed how publishing regional assessments of mitigation potentials and strategies would be of use to support IPCC reports. These assessments should integrate mitigation and food security goals, and identify emerging options for agricultural mitigation. Regional assessments of mitigation options were identified as a potential Flagship project for the group to develop.

62. Members also discussed the importance of adding national data to the IPCC Emission Factor database. The United Kingdom has recently submitted all its GHG Inventory data to this database, and the New Zealand-funded Flagship projects will also contribute valuable data.

Climate and Clean Air Coalition (CCAC)

63. James Morris, from the CCAC Secretariat, presented the CCAC's revised agriculture initiative strategy to the Group. The CCAC helps to develop control measures for short lived climate pollutants (including methane) to reduce near term climate warming, also providing health and crop benefits. The organisation objective is to achieve widespread adoption of the solutions and policies developed.

64. The revised Agriculture Initiative strategy builds on the recent increase in political support for the agriculture sector, and the inclusion of livestock solutions in modelling. The strategy is still under revision but the draft objectives are:

1. Countries to raise ambitions regarding the reduction of agricultural short-lived climate pollutants. CCAC to work with countries, identify tools for reporting and inclusion of partners.
2. Develop evidence to finance large scale climate impact, linked to the CCAC finance strategy, leveraging climate finance champions, public-private investment, and political support.
3. Build national capacity and capability, promote CCAC programme Supporting National Action and Planning on Short Lived Climate Pollutants (SNAP) to developing countries.

65. The CCAC has funding available to finance meetings and workshops (e.g. on inventory) that could support GRA activities. Any requests for this funding should come from CCAC member countries.

66. The CCAC has regional assessments underway for all short lived climate pollutants and key sources. The Latin American assessment is complete, the South East Asia assessment will be released soon and the African review is underway.

Opportunities for LRG to engage with the UNFCCC

67. The Koronivia joint work programme on agriculture, adopted at United Nations Framework Convention on Climate Change (UNFCCC) 23rd Conference of the Parties (COP23) was presented to the group by Jacobo Arango, CIAT, with input from Hayden Montgomery, GRA Special Representative.

68. Countries have agreed to develop a plan for agriculture under the UNFCCC, and the technical and implementation subsidiary bodies (working groups) of the UNFCCC have been requested to develop activities for agriculture. This will include assessment methods for soil carbon

sequestration, water management, nutrients, manure, livestock, as well as the consideration of socioeconomic and food security issues.

69. The development of these activities is an obvious way for the GRA to link into the UNFCCC activities and support the subsidiary bodies. The recent meeting in Bonn (May 2018) concerned the agreement of activities and the development of roadmaps. A timeline of activities outlines when submissions are expected on the identified topics. Workshops will then be held to discuss the topic submissions. The topic areas are:

1. Methods and approaches for assessing adaptation, adaptation co-benefits and resilience and improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management -submissions by **6 May 2019**.
2. Improved nutrient use and manure management towards sustainable and resilient agricultural systems submissions by **30 September 2019**.
3. Improved livestock management systems, including agro-pastoral production systems and others) and socioeconomic and food security dimensions of climate change in the agricultural sector submissions by **20 April 2020**.

70. The role of the LRG is to provide information to member countries on key topics (e.g. improving livestock inventories, best practices to reduce emissions and maintain food security, future practices and technologies to reduce emissions, and experiences from countries on developing policies and measures). This work could be in collaboration with partner organisations, to provide consistent information.

REGIONAL BREAKOUT DISCUSSIONS

71. Countries divided into regional breakout groups to discuss ways that the LRG could contribute to the international initiatives.

Europe

- For future meetings provide a list of affiliations and the full names rather than acronyms of the organisations attending.
- IPCC and inventories discussions should be directed to the council representatives, who are more involved in political processes, not all researchers are involved.
- The Inventory Flagship should include a LRG representative.
- Document produced by the GRA/LRG on the latest data published to share with IPCC.
- Inventories are addressed at national levels, Europe has many similarities and could better use the GRA to harmonise methods and reporting.
- Governments request lists of possible mitigation strategies from researchers, but disconnects between science and policy mean these are not reflected in policy decisions.
- Future Research frameworks in Europe seem to be less focused on climate, but include climate activities as co-benefits alongside other issues.
- Europe has a focus on reduction of animal products as a mitigation option, how to explain leakage issues?
- IPCC and food security discussions may not be useful for Europe.

Americas

- Develop a joint partnership (GRA, CCAFS, CCAC etc.) and give more weight to our responses on the Koronovia work plan.

- GRA waiting for voluntary actions of members does not produce the results we want, emails are too easy to ignore. The GRA should promote actions, find a mechanism to incentivise contribution.
- Publication of reviews, opinions and synthesis papers are needed to recognise the issues. Mitigation and adaptation co-benefits (including animal welfare and silvopastural systems) should be a focus.
- Circulate a survey for data collections, with the aim of improving emission factors, and identifying mitigation options for the region.
- Expert support from the GRA should be provided to other initiatives.

Africa

- Few African members involved in the GRA, need to develop activities to increase membership.
- Proposal to host a workshop in Africa, inviting government, partners and scientists.
- Use the workshop to develop a regional contribution to UNFCCC and SDGs, and as a consultative platform for CCAC activities.
- Greater demonstration of adaptation co-benefits alongside mitigation projects.

Asia/Pacific

- LRG could help facilitate guidance or criteria that countries could use to engage colleagues when communications are received from the GRA Secretariat.
- A list of Council representatives should be provided to the Research Groups.
- Develop an information portal on the various initiatives and contacts for each. Countries need all the info on international organisations on one website.
- Provide links to social media so that countries can share data, research papers and forum.
- Experts email addresses should be shared.
- GRA to encourage members to participate in peer reviews, such as for the IPCC, and other collaborations across the livestock sector.

72. Four main priorities were identified as common themes expressed across all regions, and the next steps for the LRG to develop better connections with international organisations.

1. Provide an overview for LRG members of the international platforms/acronyms/related activities and how these align with each other as well as areas of interaction with the LRG.
2. Develop better connection between GRA researchers/experts and these other initiatives, who are the key people from the GRA, and who are the contacts in these other initiatives.
3. Call for concerted action, develop shared messaging on mitigation actions across organisations (GRA, CCAC, CCAFS, FAO) and build on activities.
4. Engagement with Africa, organise workshops to build on the increasing membership in the region and increase interest for others to join by demonstrating the value in participating.

BUILDING CAPABILITY

73. The LRG workplan is updated after each meeting and reflects the activities and focus areas of the Group. Building research capability has always been an important focus of the LRG.

74. Current capability building activities:

- Working with CCAFS and Andres Wilkes (UNIQUE) to develop a collection of GHG inventory experiences and practices, MRV guidelines to address gaps and uncertainties, and an online platform of tools.
- Updating guidelines for measuring GHGs.
- Workshop held in South East Asia on Quality Assurance/Quality Control in GHG inventories.
- Provided expert assistance to support Thailand GHG inventory - N_2O from manure.
- Technical training provided on measuring GHG emissions from small ruminants (Malaysia).
- LEARN Awards, ongoing applications.
- Cliff-GRADS fellowships.
- GHG Inventory training course.
- East Africa regional workshop on pathways to low emissions livestock

Reducing enteric methane for food security and livelihoods

75. This project is funded by the CCAC and implemented by NZAGRC, GRA and the FAO. Phase 1 of the project has been completed; building evidence and awareness among stakeholders in South America, sub-Saharan Africa, and South Asia. Over 45 institutions were involved and identified key issues and mitigation options for livestock systems in their region. More information is provided on the FAO website: http://www.fao.org/in-action/enteric-methane/en/.

76. Phase 2 of the project is now underway to include climate change and particularly the mitigation of enteric methane in large development projects and pilot projects. Existing regional practices will be included to understand the impact on production and reduction of enteric methane. The project is taking place in Uruguay, Ethiopia and Bangladesh, where countries are already investing in improving the livestock sector. Capability building activities for phase 2 include:

- Institutional capacity building, improving data collection.
- Strengthening national GHG accounting.
- Training national experts for GHG accounting.
- Tier 2 inventory development.

77. Future activities:

- Institutional capacity building
- Regional workshops on methane mitigation and building capacity to meet Nationally Determined Contributions (NDC).
- Regional demonstration projects reviewing higher Tier inventories.

MRV Guidance

78. The development of materials that support good 'Measurement, Reporting and Verification' (MRV) practices in GHG inventories is an important activity of the LRG, building on countries' priorities to improve their livestock inventories. The publication of an MRV information note and report on current processes, developed in collaboration, with CCAFS led to a recommendation of further documentation that could help countries to share experiences of designing MRV systems. The GRA and CCAFS, sponsored by the New Zealand Government, are now working to develop those recommended resources. They include an online platform of MRV tools, a collection of country experiences implementing MRV of livestock greenhouse gases and a guideline on addressing gaps and uncertainties in activity data. The work is due to be completed at the end of 2018, and will all be housed in the online platform. The platform is designed to be a 'one-stop-shop' for MRV resources and tools and will be easily searchable especially for those who are not familiar with the MRV, or who do not have English as their first language.

Cliff-GRADS Scholarship

79. CLIFF-GRADS is a joint GRA and CCAFS scholarship open to students from developing countries currently enrolled in PhD programs. It provides funding for short-term scientific training and research stays on topics related to measurement and management of greenhouse gas emissions and carbon storage in agricultural systems. Initial funding has been provided by New Zealand to support 30-40 scholarships (student costs only). GRA members are asked to provide in-kind support through hosting and supervision of students.

80. The first call for applications opened in December 2017 with 13 placements available. Sixty-five applications were received, and following assessment by a panel, nine scholarships were awarded to recipients from Nigeria (2), Tunisia, Ethiopia, Colombia, and Argentina (4). While completing the projects the students will be hosted at CGIAR centres (CIAT, CYMMIT) and GRA member country research institutes (Netherlands, Chile, UK).

81. The LRG was asked to help identify projects that can be advertised for the second call later in 2018. Projects can be used to support activities of the Networks, or Flagship projects.

South East Asia Inventory Network

82. The South East Asia Network activities were presented by Azizi Azmin, Malaysia. The Network has been active since 2012 helping countries in the region to understand the need to move from Tier 1 to Tier 2 livestock inventories and develop robust MRV practices. Activities have included:

- Comparison of Tier 1 and Tier 2 approaches for livestock GHG inventories
- Five workshops held in the region.
- Training in New Zealand on measurement methodologies.
- Regional technical training, including most recently (April 2018) in Malaysia on the construction and use of respiration chambers for small ruminants.

Latin America Platform

83. Latin American and Caribbean countries have large numbers of livestock and make up 17% of global agricultural GHG emissions. The region aims to develop better policies to achieve sustainable livestock intensification. The Platform is a network of key public and private stakeholders working to coordinate sustainable intensification and adaptation/mitigation in the region. It currently involves 16 countries, with representatives from industry, farming, international agencies and other organisations. It is supported by funding from Fontagro and New Zealand.

84. The Platform meet in Costa Rica, 16-19 April 2018, outcomes included:

- The Platform focus will be more than agricultural mitigation, also restoring degraded agricultural lands to improve carbon sequestration.
- Carbon sequestration will be considered across all livestock systems and agroforestry.
- The Platform will have a focus on capability development.
- The World Bank attended the meeting and were encouraged country participants to develop project proposals.
- For projects to be sustainable they must consider environmental, economic and social issues within the project.

REGIONAL CAPABILITY BUILDING NEEDS

85. The regional breakout groups for Africa, Asia and Latin America were reconvened to discuss capability building needs in these regions. Partners and participants from Europe, North America, Australia and New Zealand were asked to spread out and join these groups, to better understand the requirements of other members.

Africa

86. Priorities are:

- Understanding the link between mitigation and productivity.
- Improving capability and training for GHG inventory, moving from Tier 1 to Tier 2.
- Better data for animal numbers emission factors.
- Establish methodology for collecting measurements specific for Africa and develop emission factors.
- Training and exchange programmes for the region.
- Establish a regional network – meetings of scientists to exchange research etc.

Latin America

87. The goals for the region are:

- Decoupling deforestation and livestock production.
- Development of specific emission factors.
- Carbon neutrality, through carbon sequestration.

88. Capability needs include:

- Life Cycle Analysis (LCA) training, to understand effective on-farm mitigation strategies.
- To develop better databases.
- Better data/measurements for dry matter intake in grazing systems.

Asia

89. The priority for this region is to move from Tier 1 to Tier 2 GHG inventory, nationally but also regionally. Needs include technical assistance and funding assistance to support these activities. The Group identified the following technical needs:

- Assistance for pilot research studies.
- Technical training to improve measurement methodologies.
- Standardisation of basic activity data for improved accuracy.
- Shared experiences of GHG measurements from the global community.
- Simplification/translation of the IPCC guidelines, including to local languages.

90. Potential sources of funding were discussed, noting that although New Zealand has been a primary funder of the LRG activities to date, other countries need to support this work as well. Japan was willing to share its experiences of moving to a Tier 2 inventory, and experience of measuring emissions from rice. Germany has funding that could be used to support these types of activities. India has previously held training events involving a number of experts and would be able to host something similar again. Other funding sources such as the FAO, Green Climate Fund and Global Environment Facility offer support for countries to improve their GHG inventory.

OUTCOMES AND NEXT STEPS

91. The Co-Chairs provided a wrap-up of discussions from across the two day meeting. The four priority areas for the LRG were identified as:

- GHG Inventories, bringing together all activities of the LRG.
- Improved methodologies for measurement, building capability and standardisation.
- Identifying regionally appropriate mitigation actions.
- Extension of shared experiences and practices for different systems.

Networks

- A common focus needs to be identified and activities supported to bring a Network together.
- DATAMAN project has been funded and will support the Manure Management Network.
- Activities need to be developed to support the Animal Health Network.
- A need for greater collaboration between Networks and Network activities.

Flagships

- A call for new projects will be circulated soon after this meeting. When developing a new project consider the principles behind the flagship and involve a broad range of members as well as capability building activities.
- The LRG will provide a representative to the taskforce developing the Circular Food Systems Flagship.

Next meeting

92. The LRG expects to meet alongside the 2019 Greenhouse Gas and Animal Agriculture (GGAA) conference in Brazil, 4-10 August 2019. However, if members have any further options for the 2019 meeting they are asked to provide these suggestions to the Co-Chairs.

APPENDIX ONE: Participants List

Country	Name	Organisation	Email
Argentina	José Ignacio Arroquy	INTA –CONICET	arroquy.jose@inta.gob.ar
Australia	Anna Okello	Australian Centre for International Agricultural Research	anna.okello@aciar.gov.au
Belgium	Sam De Campeneere	ILVO	sam.decampeneere@ilvo.vlaanderen.be
Canada	Karen Beauchemin	Agriculture & Agri-Food Canada	karen.beauchemin@agr.gc.ca
Colombia	Olga Mayorga-Mogollón	Corporación Colombiana de Investigacion Agropecuaria-CORPOICA	lmayorga@corpoica.org.co
Denmark	Peter Lund	Aarhus University	peter.lund@anis.au.dk
Germany	Dirk von Soosten	Friedrich-Loeffler-Institut, Federal Research Institute for Animal Health **Animal Health Network coordinator**	dirk.von_soosten@fli.de
Ghana	Christopher Antwi	Kwame Nkrumah University of Science and Technology	cantwi@icloud.com; cantwi.agric@knust.edu.gh
Italy	Giacomo Pirlo	Council for Agriculture & Economics (CREA)	giacomo.pirlo@crea.gov.it
Japan	Koki Maeda	Japan International Research Center for Agricultural Science	k_maeda@affrc.go.jp
Japan	Satoshi Tobita	Japan International Research Center for Agricultural Science	bita1mon@jircas.affrc.go.jp
Malaysia	Azizi Ahmed Azmin	Malaysian Agricultural Research & Development Institute	aziziazmin@mardi.gov.my; aziziazmin.mardi@gmail.com
Malaysia	Mohd Saufi Bastami	Malaysian Agricultural Research & Development Institute	msaufi@mardi.gov.my
Netherlands	Henk Van Der Mheen	Wageningen University & Research	henk.vandermheen@wur.nl
New Zealand	Andy Reisinger	NZAGRC	Andy.Reisinger@nzagrc.org.nz
New Zealand	Gavin Kenny	NZAGRC	gavin.kenny@nzagrc.org.nz
New Zealand	Sinead Leahy	NZAGRC	sinead.leahy@nzagrc.org.nz
New Zealand	Suzanne Rowe	AgResearch **Animal Selection, Genetics & Genomics Network Coordinator**	Suzanne.Rowe@agresearch.co.nz
Philippines	Virginia Bathan	Philippines Statistics Authority	v.bathan@psa.gov.ph
Philippines	Precious Sumabat	Philippines Statistics Authority	p.sumabat@psa.gov.ph
Senegal	Sega Ndao	Institut Sénégalais de Recherches Agricoles	ndaosega@gmail.com
Spain	David Yanez-Ruiz	Spanish Research Council, CSIC **Rumen Genomics Network representative**	david.yanez@eez.csic.es
Thailand	Sutida Onsongchun	Department of Livestock Development	osutida@hotmail.com
Thailand	Yaowaluck Leephaijit	Department of Livestock Development	dwedy19@hotmail.com
UK	Luke Spadavecchia	DEFRA	Luke.Spadavecchia@defra.gsi.gov.uk
Uruguay	Verónica S. Ciganda	Instituto Nacional de Investigación Agropecuaria	vciganda@inia.org.uy
USA	Jim Dobrowolski	US Department of Agriculture National Institute of Food and Agriculture	jdobrowolski@nifa.usda.gov
USA	Alex Hristov	Penn State University **Feed & Nutrition Network Coordinator**	anh13@psu.edu
Viet Nam	Kinh La Van	Institute of Agriculture for the South, Vietnam Academy of Agricultural Sciences	Kinh.lavan@iasvn.vn

Viet Nam	Việt Hùng Lý	Department of Climate Change, Ministry of Natural Resources and Environment	Lyviethung.vepa@gmail.com
Viet Nam	Tất Quang Quách	Department of Climate Change, Ministry of Natural Resources and Environment	qtquang8@gmail.com
Zimbabwe	Walter Svinurai	Marondera University of Agricultural Science and Technology	wsvinurai@gmail.com
Observer countries			
India	Raghavendra Bhatta	ICAR- National Institute of Animal Nutrition and Physiology, Bangalore, India	Ragha0209@yahoo.com
Kenya	Joseph G Mureithi	Kenya Agricultural and Livestock Organisation	Joseph.mureithi@kalro.org; mureithijg@gmail.com;
Mongolia	Sanaa Enkhtaivan	Environment & Climate Fund	ezsanaa@gmail.com
Myanmar	Kyaw Moe Aung	Environmental Conservation Department	kyawmoeaung@nationalcommunication.org
Partners			
CATIE	Claudia Arndt	CATIE	claudia.arndt@catie.ac.cr
CCAC	James Morris	UN Environment / CCAC Secretariat	James.morris@unep.org
CIAT & CCAFS	Jacobo Arango	International Center for Tropical Agriculture	j.arango@cgiar.org
FAO	Carolyn Opio	UN Food and Agriculture Organisation	Carolyn.opio@fao.org
UNIQUE	Andreas Wilkes	UNIQUE Forestry & Land Use GmbH	Andreas.wilkes@unique-landuse.de
LRG Co-chairs and GRA Secretariat			
New Zealand	Harry Clark	New Zealand Agricultural Greenhouse Gas Research Centre	harry.clark@nzagrc.org.nz
Netherlands	Martin Scholten	Wageningen University & Research	martin.scholten@wur.nl
GRA	Deborah Knox	Ministry for Primary Industries	deborah.knox@mpi.govt.nz

APPENDIX TWO: Shared Interests - Breakout Group Summary

Group one (Argentina, Canada, Ghana, Japan, New Zealand, Thailand, Viet Nam)

- Inexpensive and standard methods to measure greenhouse gas emissions from pasture and manure is needed to improve inventories.
- Dairy systems have more opportunities to reduce emissions (e.g. use of feed additives etc.) less options for extensive pasture grazing systems.
- Communication of best management practices for grazing systems, where measuring feed intake is difficult.
- Demonstrate the efficiency of livestock systems through the development of GHG footprints.
- Identify practices to reduce emissions and increase production, so farmers will uptake practices.
- Need to understand forage species to select for low emissions, digestibility, and drought tolerance.
- Productivity is the main issue for smallholders, better demonstration of the links between GHG and food security.
- Critical to develop a strategy for livestock and restoration of degraded lands using silvo-pastoral systems.
- New Zealand is facing land use concerns and the suitability of different production systems.

Group 2 (Colombia, Germany, Italy, Mongolia, Philippines, Senegal, Viet Nam)

- Colombia has a database on tropical forages which could be used in other countries, this will be shared with the Feed and Nutrition Network.
- Countries identified challenges of data availability, and constructing inventories, including characterising different production systems. This is an opportunity to link with the Inventories flagship
- Improved activity data related to production systems especially manure management.
- Viet Nam identified the data requirements of their inventory through a pilot programme and provided these needs to their statistics department.
- Mongolia has a MoU between government departments to collect the required data for the inventory.
- Develop communications that help explain the links between adaption and mitigation to share with farmers and funding agencies.
- Mitigation impact needs better communication.
- Focus should be on capacity to collect data so mitigation can be used as a tool/measure to build consumer acceptance.

Group 3 (Denmark, Ethiopia, Japan, Netherlands, Thailand, USA, Vietnam)

- Research to reduce enteric methane emissions using diverse forages.

- In developing countries the emphasis needs to be on improved efficiency of livestock production rather than reducing total emissions.
- Other regions should replicate the South East Asian regional approach to GHG inventories, including in Europe.
- Researchers should be encouraged to be active in existing networks and develop projects that are able to bring together researchers and understand mitigation options.
- Face to face meetings are important, but some countries may need more information to prepare in advance and consult across departments.
- To increase and deepen African country engagement in the GRA, the African regional group proposed to convene a regional workshop in 2018 to:
    - Raise awareness of GRA research that shows the importance of both mitigation-for-adaptation and adaptation-for-mitigation purposes.
    - Contribute an African regional perspective to the proposed paper/article linking Sustainable Development Goals (SDGs) with agriculture climate action (i.e. the proposal in Andy Reisinger's presentation), ideally based on a draft.
    - Provide data from African scientists and research institutions to the Climate and Clean Air Coalition (CCAC) African Regional Assessment of Short Lived Climate Pollutants (SLCP) that will commence in the 3rd or 4th quarter of 2018.
    - Zimbabwe offered to host the workshop.

Group 4 (Belgium, Ethiopia, Malaysia, Myanmar, New Zealand, Spain, Zimbabwe)

- Inventory development issues including the collection of quality data, typology of production systems to improve inventories and working with other countries to develop emissions factors.
- Coordination within countries is challenging.
- Inventory accuracy vs. mitigation efforts – what should be the focus?
- Researchers and policy makers have different views/understanding e.g. governments think of reducing emissions as reducing overall production and do not consider efficiency, global emissions and leakage.
- Opportunity to share experiences between countries that have improved inventories, and groups in similar zones to share information.

Group 5 (Australia, India, Kenya, Malaysia, New Zealand, Philippines, UK, Uruguay)

- Better defined carbon footprints of pastures in Australia.
- Identify the most efficient greenhouse gas mitigation options and promote the benefits of these systems.
- Better understanding of residual feeds and feed efficiency in beef production systems in Uruguay.
- Breeding methods and quantifying greenhouse gas emissions from livestock breeds.
- What is possible for implementation and mitigation – working with industry, science and government to identify mitigation options?

- Better characterisation of specific emission factors for country production systems that need more information.
- Improve productivity of native breeds e.g. resistance to environmental factors vs. consumer demands.
- How to involve farmers and increase adoption of technologies on farms? Understand what is practical and what is feasible.
- Understanding of the barriers farmers face, extension is very weak and needs to include social science and use local languages.