Croplands Research Group Meeting

The Marriott Riverwalk, San Antonio, Texas, USA

14 November 2019

MEETING REPORT

The 2019 meeting of the Croplands Research Group (CRG) of the Global Research Alliance on Agricultural Greenhouse Gases (GRA) was held at The Marriott Riverwalk, San Antonio, Texas, USA on 14 November 2019, following the American Tri-Societies (ASA-SSSA-CSSA[1]) annual conference. The meeting was chaired by Mark Liebig, USA, and María Rosa Mosquera Losada, Spain (co-Chairs of the CRG).

This report is a summary of the key discussions and outcomes of the meeting. PDF's of the presentations are provided separately on the GRA's website.

PARTICIPANTS

The meeting was attended by 18 participants, representing ten member countries of the CRG (Appendix 1). Several key scientists also attended the meeting. Apologies from Brazil (CRG co-Chair) due to scheduling conflicts.

- **Countries represented:** Canada, China, Denmark, Germany, Japan, New Zealand, Republic of Korea, Spain, United Kingdom and United States of America.

MEETING OUTCOMES

The meeting updated attendees on the outcomes of the GRA Council meeting, other Research Groups' progress, other countries' contributions, Networks' progress, and opportunities that have arisen. The CRG also committed to the following:

- developing a CRG collaborative manuscript addressing biophysical opportunities, constraints and caveats of greenhouse gas mitigation options;
- producing a CRG webinar series on CRG related topics;
- reviewing the content of the CRG website and updating it where applicable; and
- reviewing the CRG Network structure prior to the next update report to the GRA Council.

Next meeting:

- CRG expects to meet August 2020, location to be confirmed.

[1] The American Society of Agronomy, the Soil Science Society of America, and the Crop Science Society of America

ACTIONS ARISING FROM THE MEETING

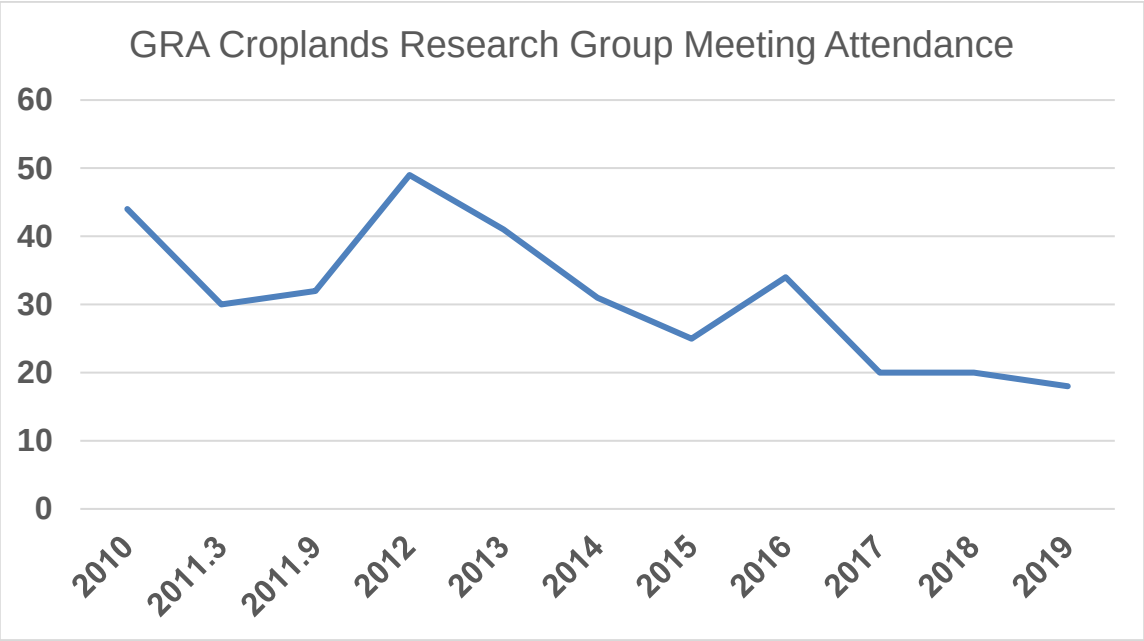
Action Item	Whom	Deadline
Distribute the Flagship template to CRG representatives.	GRA Secretariat	Dec 2019
Quarterly newsletter contributions are continually sought.	María Rosa Mosquera Losada	Ongoing
Conservation agriculture meta-analysis manuscript to have: • Final data contributions identified and submitted. • Expressions of interest for complementary research articles for the special journal issue. • Research submitted to journal.	Craig Drury	 21 Jan 2020 1 Mar 2020 31 Aug 2020
Submit contributions on Agroforestry for: • A manuscript addressing agroforestry as a climate change mitigation and adaptation tool. • The Agroforestry handbook • A Springer book about soil carbon sequestration and agroforestry	María Rosa Mosquera Losada	 Mid Dec 2019 No deadline Mid Dec 2019
CRG collaborative manuscript addressing biophysical opportunities, constraints and caveats of greenhouse gas mitigation options to be developed. *Initial work team includes; Mike Beare, Chuck Rice, Hero Gollany, Ladislau Neto, Lars Munkholm, Jane Johnson, Maria Rosa Mosquera Losada, and Mark Liebig*. • Draft outline. • Feedback on outline and expression of co-author interest gathered. • Google Document created and shared that everyone can contribute to define the scope. • Reach out to CLIFF-GRADS for participation once scope clearly defined. • Distribute IRG paper as example of collaborative manuscript effort.	Initial team Co-Chairs GRA Secretariat GRA Secretariat	 14 Dec 2019 17 Jan 2020
Structure of the CRG Networks: • Request status of CRG Network engagement email sent. • Response returned from leads. • Realign CRG network structure based on responses. • Clarify network attributes prior to assessing network engagement.	 Co-Chairs Network leads Co-Chairs GRA Secretariat	 30 Nov 2019 31 Jan 2020 Mid Mar 2020 Dec 2019
2020 CRG meeting: • Explore meeting location options. • Consider length and timing of CRG meeting (e.g. over a 1.5 day period, afternoon followed by a full day). • Consider the best structure for next year's meeting (e.g. discussion first, updates shared before meeting with discussion as needed later in the agenda).	Co-Chairs	 1 Feb 2020 July 2020 July 2020
Update CRG portion of GRA website.	Co-Chairs and GRA Secretariat	1 May 2020

Initiate webinar series. Initial presenters include Michel Cavigelli, Ayaka Kishimoto-Mo, Mike Beare, Mark Liebig, Landislau Neto and Maria Rosa Mosquera Losada.	María Rosa Mosquera Losada	Mar 2020
Conduct necessary groundwork to establish a GRA-CRG podcast	Mark Liebig	Aug 2020
Consider how to increase global participation in CRG activities; given Africa and Asia under represented (and to increase engagement with new GRA countries).	Co-Chairs	Ongoing

SUMMARY OF DICUSSIONS

OPENING REMARKS

1. The meeting of the Croplands Research Group (CRG) was chaired by Mark Liebig and María Rosa Mosquera Losada, who welcomed participants to the meeting. They reflected on the progress and changes to the CRG since its creation in 2011. Key points of interest included the timings of when Networks had been established, along with the MAGGnet[2] project, AFINET[3], GRAMP[4] and the CRG Literature Database. Participation levels of previous CRG meetings were also outlined.



2. Mark Liebig outlined the proposed agenda for the meeting and highlighted some issues that the CRG co-Chairs felt were important to address. These included:
   - looking at what goals CRG wants to achieve;
   - deciding how to leverage collective resources to meet identified goals;
   - developing an efficient group structure to increase impact; and
   - establishing effective channels for communication to get best value from CRG's effort.

REVIEW OF 2018 MEETING MINUTES

3. The agenda was formally proposed and accepted by the attendees.

4. The GRA Secretariat reviewed the previous meeting minutes and requested progress updates on the outcomes agreed at the 2018 CRG meeting. There has been mixed levels of progress since the last meeting.

[2] Managing Agricultural Greenhouse Gases Network (MAGGnet)
[3] Agroforestry Innovation Networks (AFINET)
[4] Global Research Alliance Modelling Platform (GRAMP)

UPDATE FROM THE SECRETARIAT

5. The GRA now has 61 Member Countries. Nine African members (Benin, Cameroon, Cote d'Ivoire, Ethiopia, Eswatini, Malawi, Mongolia, Nigeria and Uganda) joined in the past year. The GRA now works with 21 Partner organisations, and the Council agreed to invite the Greenhouse Gas Management Institute (GHGMI) to become a partner to the GRA at the recent GRA Council Meeting. The four partners that have joined since the 2018 CRG meeting are:
   - Caribbean Agricultural Research & Development Institute (CARDI);
   - The Agricultural Model Intercomparison and Improvement Project (AgMIP);
   - International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM); and
   - The European Union (EU).

6. Outcomes from the 2019 Council meeting that are of relevance to the CRG include:
   - Indonesia took on role of Chair with Australia confirmed as Vice-Chair.
   - The terms of reference for the Enhanced Secretariat and the GRA Special Representative were noted as approved.
   - The proposed new framework for Flagship projects was accepted by the Council. Under the new framework, existing Flagships will be reviewed for alignment.
   - The Council proposed that the Circular Food Systems Flagship taskforce be established as a Network, in light of the re-framed criteria for Flagship Projects. The Integrative Research Group (IRG) were asked to consider hosting this new Network.
   - The Secretariat will update the Operational Plan to reflect completed and new or consolidated actions from the previous Council meeting. Further, the Communications Strategy document has been adopted.
   - The Council established a working group to develop the 2021-25 Strategic Plan, which will replace the current 2016-20 Strategic Plan. The Council members in the working group are Australia, Canada, China, Germany, Indonesia, Netherlands, New Zealand, Tunisia and Zimbabwe. The working group will give consideration to synergies between mitigation and adaptation practices and technologies and develop a communications action plan.

7. Activities of other Research Groups that are of relevance for the CRG include the following:
   - The Livestock Research Group (LRG) held three low emissions livestock development capability building regional workshops in East Africa (July 2018), West and Central Africa (April 2019) and Southern Africa (July 2019), resulting in nine new member countries joining the GRA. The increasing commitment to, and involvement in, GRA activities by African states will be crucial in the successful establishment of a Paddy Rice Research Group (PRRG) African sub-Group.
   - The LRG is establishing a 'roster' of experts for use in disseminating knowledge and skills specifically in the context of greenhouse gas inventories, for monitoring, reporting and verification (MRV) and Nationally Determined Contributions (NDCs). This is of relevance to the CRG, who may wish to consider how expertise can be shared in a similar way across CRG.
   - The MRV platform, established by the LRG, shares case studies, analysis, databases, methodologies, technical guidelines and emission factors, among other resources for quantification of agricultural greenhouse gases. There are a number of resources specifically related to cropland emission measurement and quantification.
   - IRG established a refocused Inventories and Nationally Determined Contributions Network which is of relevance to all Research Groups, and brings together 116 people from 57 member countries.

- The IRG is also hosting a series of webinars, with three successful webinars to date, of over one hundred registrants each. Topics of the webinar series have included linking with global soil carbon initiatives, carbon offset methods in Australia, impacts of climate change on soil carbon, and greenhouse gas inventories and NDCs.
- Senegal has been confirmed as the third co-Chair of the PRRG.
- The PRRG has submitted, to the GRA Secretariat, the "Mitigation in Irrigated Rice Systems in Asia (MIRSA)" project as a flagship under the new guidelines.

Flagship Project Guidelines

8. The following criteria form the basis for which a proposed Flagship Project will be assessed, and recommended to Council for endorsement by consensus. A Flagship Project template (Appendix 2) is to be completed by the Flagship Project lead and once endorsed the Flagship will be profiled on the GRA website. Once the project is completed, final outcomes will be presented to the Council.

9. Criteria for a flagship project include:
    - **Project Scope:** Project timeline (defined end date) specified, project outcome defined and globally applicable.
    - **Project Participation:** The project will benefit from GRA wide collaboration and, where possible, global participation in their delivery. The project will have an identified community of experts within GRA Membership (i.e. be proposed by one of the Research Groups, or their Networks, or have key Members act as coordinators if the flagship project focuses on a cross-cutting issue). The project will provide a range of collaboration opportunities, including low cost data, sample or knowledge sharing.
    - **Research:** It is proposed that flagship projects develop new knowledge, validate approaches, methods or hypotheses; and have high scientific impact.
    - **Resourcing:** Flagship project leaders should be clearly identified and resourced to complete the project within the specified time-frame. Research Group co-Chairs should not bear the responsibility of leading Flagship projects, except presenting updates at the annual Council meeting, if required. Flagship Projects must identify at least five Council Champions, Members and Partners, consisting of at least three GRA Member countries. A minimum of 30% of required funding must be confirmed for the Flagship project lead and core project activities (cash or in kind contributions of total project costs). Proposed funding mechanisms for additional activities and contributions must also be identified (i.e. fellowship fund, workshop funding, or research call).

CLIFF-GRADS Programme (est. 2018)

10. The Climate, Food and Farming - Global Research Alliance Development Scholarships (CLIFF-GRADS) programme is a joint initiative of the GRA and CGIAR's CCAFS[5] programme. These scholarships support short research visits of not more than 6 months, of up to $12,000 USD, for PhD students from developing countries.

11. The CLIFF-GRADS programme is a platform that CRG members could use to advertise existing research projects that are under-resourced, for short-term scientific training and research stays

[5] Climate Change, Agriculture, Food Security (CCAFS)

on topics related to the measurement and management of greenhouse gas emissions and carbon storage in agricultural systems.

12. A rigorous application process ensures PhD students of a high calibre. The programme fosters capability building in developing countries, generational knowledge transfer and bilateral collaboration. Researchers and project leaders can consider submitting a research opportunity for consideration for the next call for student applications which will happen in early 2020. Researchers may contact cliffgrads@globalresearchalliance.org for more information.

13. In 2019, there were seven CLIFF-GRADS fellows (from Benin, Brazil, Cameron, Ghana, Nigeria, South Africa and Vietnam) working on croplands research. In 2018, there were two (from Ethiopia and Nigeria).

COUNTRY REPORTS

Canada – Craig Drury

14. Canada has identified the GRA as an international science co-operation priority, which has increased the focus on GRA aligned research. This year, four CRG aligned projects received $3.3m. This includes work in crop diversification and efficient use of manure. There is also ongoing support for continuing other GRA linked projects.

15. There are opportunities for wider participation in a meta-analysis on conservation agriculture practices and greenhouse gas emissions, conservation projects to improve soil health and decrease greenhouse gas emissions, nutrient management projects, and DNDC[6] modelling activities.

China – Xunhua Zheng

16. China's contributions include: having proposed a nitrous oxide flagship project; implementing a NSFC-UNEP[7] joint research project involving field experiments in Kenya and DNDC modelling; developing the core CNMM-DNDC model; designing the Agro-GHG platform (an internet based system for calculating greenhouse gas emissions for agricultural enterprises); and hosting a PhD and Masters students.

17. They have opportunities for others to participate by contributing to the models; CH4MOD (methane emissions from wetlands and rice), Agro-C (carbon fluxes under cropland), CNMM-DNDC (wide ranging model for greenhouse gases and nutrient losses across many land uses), and Agro-GHG. They also have opportunities for bilateral cooperation projects and scholarships open to all countries for Masters level and above (UCAS[8], TWAS[9] and B&R[10] scholarships and the CAS[11] programme).

[6] DeNitrification-DeComposition (DNDC)
[7] National Natural Science Foundation of China - United Nations Environment Programme (NSFC-UNEP)
[8] University of Chinese Academy of Sciences (UCAS)
[9] The World Academy of Sciences (TWAS)
[10] Belt and Road (B&R)
[11] Chinese Academy of Sciences (CAS)

Denmark – Lars Munkholm

18. Denmark is contributing to activities of the Peatlands, Conservation Agriculture and Nutrient Management networks. They have completed their fourth round of carbon sequestration grid sampling, providing 40 years of data across 600 sampling points.

19. The Danish government has committed to reducing emissions 70% by 2030. To achieve this they are investing in new projects, including $40 million USD for projects on rotational grasslands, nitrification inhibitors, cover cropping and wetlands. More will be announced next year. Their biggest activity in the coming years will be the European Joint Programme Co-fund on Agricultural Soil Management.

Germany – Heinz Flessa

20. The first national soil carbon inventory for Germany has been completed, sampling down to one metre deep. Resampling is scheduled to begin in 2023.

21. Thirty-three joint projects have been funded €40 million over three years, beginning January 2019. These are mainly cropping, soils and livestock projects. Germany also hosted two croplands related CLIFF-GRADS fellows.

22. Germany's Climate Protection law (2019) set mandatory emissions targets and specifies mitigation options. Greenhouse gas mitigation activities in Germany are increasing and they are looking for further opportunities to collaborate with others. They currently have two SPACES[12] partnerships available to help build the capacity of Southern African students and technicians.

Japan – Ayaka Kishimoto-Mo

23. Japan is involved in all four GRA research groups. The focus of work has been operating as a lead author in the IPCC[13] Refinement 2019 Guidelines. They have also managed the CRG Facebook page, developed the ALTENA network (see later notes), some small-scale collaborations with the UK and Ireland, and are producing reports in Japanese for each meeting.

24. Japan is currently looking at a socio-economic scheme, co-designed with farmers, around Biochar. This includes options such as using eco-branding on products.

New Zealand – Mike Beare

25. New Zealand has been running projects focused on impacts on soil carbon and nitrogen cycles, in collaboration with Ireland, Germany and Australia. They fund the CLIFF-GRADS programme and LEARN[14] awards. They have co-funded projects in Latin America through FONTAGRO[15].

26. New Zealand's current research programmes are ongoing and have scope for wider collaboration. The CLIFF-GRADS programme continues to be supported and there are opportunities for future scholarships under development.

[12] Scholarships for Foreigners: Short-term scholarships for Bachelor students, Master students and Senior Experts, PhD students and Senior Experts, and Postdocs and Senior Scientists (SPACES)
[13] Intergovernmental Panel on Climate Change (IPCC)
[14] Livestock Emissions Abatement Research Network (LEARN)
[15] The Regional Fund for Agricultural Technology (FONTAGRO)

Republic of Korea – Sun-Il Lee

27. In the past year, the Republic of Korea has contributed to the MAGGnet database, held a biochar utilisation symposium (connected with the potential impact on greenhouse gas emissions in croplands), and continued ongoing projects on nutrient flows, modelling, land use change, and management practices.

28. The Republic of Korea has an upcoming agricultural climate change response project and has new strategies planned to be implemented from 2020. They are seeing incentives to lower emissions and Korea is looking to spend $170 million over eight years on climate change response. The Republic of Korea is working on projects to: understand the effect on greenhouse gases of land use conversion from paddy to cropland, reduce methane emissions through reducing the extent of tillage, and other ongoing projects.

Spain – María Rosa Mosquera Losada

29. Spain is one of the CRG co-Chairs and have worked in a wide range of related areas, from producing an agroforestry handbook and running the EU Thematic Network Project of Agroforesty Innovation Networks (AFINET), to collaborating with the FAO[16] around soil organic carbon guidelines and working with RedNueva (on greenhouse gas emission factors in Spanish agriculture) and GACSA (on climate-smart agriculture).

30. Due to strong expertise in agroforestry; Spain has been invited to write a book related to agroforestry, will continue with the support of the EU GO-GRASS initiative (a circular economy business model initiative) particularly in the policy space, and the REMEDIA[17] conference is now yearly and has 70 members. Ladislau Neto participated in the REMEDIA meeting in Spain.

31. Spain produces the CRG Newsletter, 3 editions so far, with contributions from GRA members all over the world. Spain has committed to continuing this activity in collaboration with other CRG co-chairs. A review of the CRG webpage has also been initiated, to identify ways to improve the information presented.

United States of America – Mark Liebig and Charles Rice

32. USA, one of the CRG co-Chairs, is active in all GRA groups and maintain some of the CRG key projects (e.g. MAGGnet and the CRG Literature Database). They hosted four CLIFF-GRADS students in the past year and intends to host more. The GRACEnet[18] and NUOnet[19] databases collate information on carbon and nutrient use, to generate information for modellers, producers and policy makers.

33. The USA has a central data repository for most of their agricultural research data (Ag Data Commons), where it can be reviewed and tracked. AgCROS[20] is the application that accesses this information across many different research networks.

[16] Food and Agriculture Organization (FAO)
[17] Scientific Network on greenhouse gas mitigation from the agriculture, livestock and forestry sectors in Spain (REMEDIA)
[18] Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GRACEnet)
[19] Nutrient Use and Outcome Network (NUOnet)
[20] Agricultural Collaborative Research Outcomes System (AgCROS)

34. There are a range of funding opportunities for scientists from all stages of their career, both domestic and international (including from USDA-FAS[21], USDA-NIFA[22], US-AID[23] and USDA-ARS[24]). AFRI [25] Sustainable Agricultural Systems has grants for research topics to achieve specific outcomes at $5 million USD each over 10 years. These must include research, teaching and outreach. Eight were granted in the first round and the second round of applications has just closed. Linkages to the GRA have been beneficial for applications.

PROJECT UPDATE REPORTS

MAGGnet – Mark Liebig

35. MAGGnet is continuing to grow and develop, and its profile continues to be shared. However, funding for MAGGnet has ended. The CRG sees value in the connections that can be made and the central hosting of the information. A connection with GRAMP was proposed where 'gold standard' sites with particular metadata attributes would be identified. The attendees were asked to consider potential futures and funding options, and to provide feedback to Mark Liebig. Currently work is carried out on a voluntary basis.

GRAMP – Jagadeesh Yeluripati

36. Funding for GRAMP has officially ended and the platform is seeking new funding sources. Currently other projects are being tapped to keep it running. The opportunity to link it with the MAGGnet database has been identified, which would encourage higher usage for both platforms. Other options for the future include connecting it to Blockchain technology (a paper on which is to be published in 2020).

37. GRAMP is the platform for tracing the genealogy of models to help understand model evolution. It has focused on mapping two families of models, DNDC and ECOSSE[26], with research published outlining the history of DNDC published in 2014[27]. Other model families such as BASFOR[28] and DayCENT are also being mapped. There are currently approximately 800 registered users, including 100 new registrations in the past year.

GRA Croplands Literature Database – Charles Rice

38. The database now contains nearly 5000 pieces of literature. It can be sorted by country, climate zone, or cropping system. The host library (Kansas State University library) is currently migrating to a programme called JournalMap, which gives greater usability to the researcher. The library is also ending its use of RefWorks, so a new citation holder will need to be sourced.

[21] United States Department of Agriculture - Foreign Agricultural Service (USDA-FAS)
[22] United States Department of Agriculture - National Institute of Food and Agriculture (USDA-NIFA)
[23] United States Agency for International Development (US-AID)
[24] United States Department of Agriculture – Agricultural Research Service (USDA-ARS)
[25] Agriculture and Food Initiative (AFRI)
[26] Estimation of Carbon in Organic Soils – Sequestration and Emissions (ECOSSE)
[27] Gilhespy, S., Anthony, S., Cardenas, L., Chadwick, D., del Prado, A., et al, 2014. First 20 years of DNDC (DeNitrification DeComposition): Model evolution. Ecol. Modell. 292.
[28] BASic FORest model (BASFOR)

AFINET Agroforestry Handbook: Javier Francisco Rigueiro-Rodríguez

39. The handbook is currently looking for further contributions. It is a compilation of information pertaining to agroforestry practices covering policy, economy, social, bio-economy, land practices and agroforestry practices. Currently in English and Spanish, it will be translated into more European Union languages. It contains material in several formats: single page abstracts, two paged factsheets (containing a description of the practice, the how, the why and the advantages and disadvantages), up to eight page technical articles, and training videos. CRG Network leaders were encouraged to send contributions to María Rosa Mosquera Losada (mrosa.mosquera.losada@usc.es).

NETWORK UPDATES

40. Three of the seven networks presented updates to the meeting and there was a verbal update from the Nutrient Management Network. Absent were the Peatland Management, Integrated Crop-Livestock Systems, and Irrigation Efficiency Networks.

Conservation Agriculture – Craig Drury

41. The Network currently contains 19 members across seven countries. The key work being undertaken by the Network is a meta-analysis on nitrous oxide emissions and the impacts of cover-cropping and residue management. Suggestions of data contributions for the meta-analysis are being sought, in addition to the 71 peer reviewed publications currently entered. There is a firm deadline of 21 January 2020 for data submissions.

42. The meta-analysis will be published in a special journal issue (Soil Science America and AGEE[29] have expressed interest). The Network seeks additional, unpublished, topically aligned research articles related to the meta-analysis for the special issue. Interested contributors should contact Craig Drury (craig.drury@canada.ca) with abstracts prior to 31 March 2020.

43. Submissions would ideally reflect a wide geographical representation, particularly covering new GRA members, South America and Oceania to extend the connections of CRG. Depending on the level of international engagement, a double issue may be a way to facilitate wider geographical inclusion and a greater number of publications (approximate limit on 15 papers per issue).

44. The following attendees indicated that they would be interested in contributing research articles and/or editing expertise: Charles Rice, Craig Drury, Hero Gollany, Jane Johnson, Lars Munkholm, María Rosa Mosquera Losada, Mark Liebig, and Michel Cavigelli.

Agroforestry Systems - María Rosa Mosquera Losada

45. Regular meetings are held by the nine regional AFINET networks, reaching 300 stakeholders every six months over nine countries. The Network has produced the Agroforestry Handbook and published the book "*Agroforestry for Sustainable Agriculture".*

46. The Network seeks contributions for a Springer book related to Agroforestry and soil management, with the potential also for a review meta-analysis on soil carbon in Agroforestry. Contributions should be sent to María Rosa Mosquera Losada (mrosa.mosquera.losada@usc.es).

[29] Agriculture, Ecosystems and Environment (AGEE)

47. The Network is currently looking for wider involvement in four European Commission projects. Input from developing countries will be fully funded by the European Commission and applications are open until February 2020. The projects relate to Nationally Determined Contributions and emissions strategies (CLA 10), emissions from forest fires (CLA 15), bio-fertilisers from waste streams to decrease the reliance on mineral fertiliser (RUR 08), and forest and open spaces interaction (RUR 11). Input from developing countries, particularly in Latin America, is important, especially for RUR 08.

Landscape Management of Agricultural Systems Network – Xunhua Zheng

48. The Network has been working on developing and extending the CNMM-DNDC model, which focuses on ammonia emissions and aims for universal applicability for various natural and managed terrestrial ecosystems. Various development and validation projects have taken place. Recent testing shows that the model accurately reflects lifetime scenarios of ammonia emissions under tea production cropping and in permafrost soils. More development is planned to further extend the capability of the model.

OTHER UPDATES TO THE GROUP

EJP-SOIL – Lars Munkholm

49. The European Joint Programme Co-fund on Agricultural Soil Management (EJP-SOIL) begins February 2020. There is potential for international collaboration activities within the proposal's structure. It is funded 50% from the European Commission and 50% from the 24 partner countries (for a total of approximately €80 million). More than €9 million will be available for external calls.

50. The 10 year roadmap aims for the co-creation of a framework for soil management and a harmonised soil information system. This is expected to provide more cohesive information about impacts of management on soil, to better guide European Union policy decisions. The target area is the European Union, but external calls could take a more global perspective. The first call will be in 2020 and will be solely internal (for the partner countries and organisations), with an internal and an external call in 2021. More information will be provided at the next CRG meeting.

ALTENA – Rota Wagai

51. The Asian Long-term Experimental Network for Agriculture (ALTENA) was created in 2017. There are 14 members over 8 countries covering a total of 138 sites. By banding together the network strengthens the case for retaining project funding, as it is linked to other international projects. This helps combat the difficulty with maintaining long-term experiments in a changing financial environment.

52. ALTENA is currently focused on Asia as the network knows the people operating in the region and it covers half of the world's population. The network has had a publication entitled *Leveraging drought risk reduction for sustainable food, soil and climate via soil organic carbon sequestration* accepted for print, showing that a small soil organic carbon increase can significantly increase resilience to drought. This will be shared with the soil carbon flagship of the Integrative Research Group once published. There have been issues with navigating the different policies around sharing of information, particularly between countries. ALTENA is

seeking feedback on how other databases/networks (e.g. MAGGnet) managed these and related issues. Feedback should be directed to Rota Wagai (rota@affrc.go.jp).

53. There is a lack of synchronicity between networks of long-term experiments globally. Work is underway, by Dan Richter at Duke University, to catalogue all of the long-term experiments in the USA. There are a number of long-term experiment networks in Europe and the USA, but linkages to Asian networks is lacking. Due to information sharing policies, it has been difficult to get networks to share information. The global reach of the GRA could be utilised as a platform to link these networks.

54. The GRA was proposed as a platform to publish information from a global perspective. It was noted that a stocktake/publication on the pooled outputs from long-term experimental research (similar to ALTENA's soil carbon work) would be useful to encourage participation and funding for the GRA.

CRG PRIORITIES DISCUSSION

Priority outcomes of the CRG

55. Mike Beare proposed that the Group consider publishing a synthesis of existing and emerging 'technologies' that reduce crop greenhouse gas emissions and their potential impacts. Likely in the form of a critical review paper. The idea received widespread support.

56. The result of the discussion is agreement on developing a CRG technical potential emission reduction paper with the following details:
    - **Title (under revision):** "Biophysical Opportunities, Constraints and Caveats of Greenhouse Gas Mitigation Options"
    - **Team (initial commitment):** Mike Beare, Charles Rice, Hero Gollany, Lars Munkholm, María Rosa Mosquera Losada, Mark Liebig and Jane Johnson. Ladislau Neto (Brazil) has also since expressed an interest in being involved.
    - **Deadlines**: Draft outline 14 December 2019, feedback 17 January 2020.

57. Numerous cropland technologies have been explored for greenhouse gas mitigation. A critical review would assess; geographical suitability, the potential scale of their impact, and feasibility of the application (e.g. the potential effects of tillage are vary under different conditions). The CRG product would be a stocktake of potential, beyond where these activities have already been applied and adopted.

58. This review, if well designed and globally inclusive, will have a significant impact and could identify gaps in knowledge of potential greenhouse gas emissions reductions from cropland management activities. The key messages could be translated into member country languages for better reach and the way that they are delivered should consider policy makers.

59. Potential considerations of the review are:
    - The varied environments and system types that need to be represented in a review assessing potential impacts globally.
    - The timeline that the mitigation activities cover. If the purpose of the product is to advise countries on options to meet their 2030 targets, the length of time emission reductions can be achieved for needs to be considered. Also, could the benefit of the activity be achieved in time?
    - The levels of permanence of different activities.
    - The biophysical limits of mitigation strategies, in terms of what can actually be achieved.

- Social and cultural factors that might limit impact of the activities. Connecting with the CLIFF-GRADS students will give wider access to understanding some of these.
- Trade-offs between different mitigation activities.
- Country case studies.

60. This project would need to harness the skills and experiences from across the wider CRG, rather than one particular network. Globally representative involvement from the beginning will be crucial to reflect the varied effects of activities in different environments. Involving new members and developing countries will encourage greater involvement in the CRG and its networks.

61. CLIFF-GRADS alumni network could be a useful resource as they are early career scientists and may be able to promote adoption of mitigation activities in both their home countries and where they are working.

Network re-framing

62. Four of the seven Networks are active (Agroforestry, Conservation Agriculture, Landscape Management, and Peatlands), while three are inactive (Integrated Crop-Livestock, Irrigation, and Nutrient Management).

63. The idea of a cross cutting "synthesis" group was proposed. After discussion, it was agreed that this function is serviced by the CRG itself. However, CRG synthesis action should be added as a specific agenda item for future meetings (i.e. update on Conservation Agriculture special issue/meta-analysis and the '*Biophysical Opportunities, Constraints and Caveats of Greenhouse Gas Mitigation Options*' publication, both of which are synthesis actions).

64. It was suggested that the CRG co-Chairs seek clarity of participation and activity of Networks. The co-Chairs will provide a 'Network Activity Template', by the end of 2019, to be completed by Network leads before the end of January 2020. Gathered input will guide decisions regarding the potential realignment of networks in time for the next biannual CRG report to the GRA Council in April 2020.

CRG EXTERNAL COMMUNICATION ACTIVITIES

Newsletter

65. The CRG newsletter is coordinated by María Rosa Mosquera Losada and Nuria Ferreiro Rodríguez (University of Santiago de Compostela). Attendees were asked to think about what they might be able to contribute. Secretariat to follow up with the croplands related CLIFF-GRADS students for brief summaries of their work, which could be publicised through the newsletter.

Webpage

66. The GRA-CRG webpage content is provided by the CRG co-Chairs and uploaded by the GRA Secretariat. The current web content has not been updated in at least two years. María Rosa Mosquera Losada has prepared a review that is undergoing consultation with the other CRG co-Chairs. An update to the information on the site will be implemented by May 2020.

Webinars

67. A series of webinars was proposed (previously proposed in 2016), following the positive response to the IRG webinar series. Contributions are open and interested parties should contact María Rosa Mosquera Losada (mrosa.mosquera.losada@usc.es). Infrastructure at the University of

Santiago de Compostela is available. Webinars will be approximately 30min long and allow 15min for questions, with topics related to the CRG activities. They would be advertised in advance in the CRG newsletter. Michel Cavigelli, Ayaka Kishimoto-Mo, Mike Beare, Mark Liebig and María Rosa Mosquera Losada offered to be the first set of presenters. Ladislau Neto (Brazil) has also since expressed an interest in being involved.

Podcasts

68. Mark Liebig will explore the feasibility of developing a podcast focused on managing agricultural greenhouse gases.

Facebook Community

69. The Facebook Community is coordinated by Ayaka Kishimoto-Mo and has grown to over 100 followers. Anyone interested in contributing content should contact Ayaka Kishimoto-Mo (mow@affrc.go.jp).

FUTURE PLANNING

2020 CRG Annual meeting

70. Two locations for the 2020 CRG meeting were proposed:
    - Switzerland, alongside the EUROSOIL Conference (24-28 August 2020).
    - Argentina, alongside the AAPRESID Congress (7-9 August 2020).

71. More information about each possibility will need to be gathered before the co-Chairs make a decision. Given the desire to grow the CRG and Networks in developing countries and with new GRA members, varying the destination selected to host the next meeting will need to be considered.

72. The structure for the next meeting was discussed, focussing on:
    - Length of the meeting. It was felt that the meeting was not long enough to have the level of discussion or workshops that some items require. Should the next meeting be 1.5 - 2 days?
    - Organisation of the agenda. The higher energy levels of the earlier sessions might be better spent on topics of more importance, such as the key issues for discussion (e.g. restructuring, project outcomes or cross-cutting issues).
    - The value of country and network updates. Value is seen in the country updates to get an overview of research and potential for collaboration. This could potentially be shared prior to the meeting.
    - Sharing discussion points with the co-Chairs prior to the meeting if a presentation will be seeking input from the group (e.g. ALTENA and meta-analysis presentations).

Growing the CRG

73. Discussions were held throughout the day about how to facilitate and grow CRG engagement. Proposed suggestions included:
    - Targeting invites to new GRA member countries to officially participate in CRG work and attend the meetings.
    - Encourage African and Asian GRA member (particularly less developed members) participation in the CRG.
    - Invite target countries, such as India, as an observer.
    - CRG co-Charis attending workshops organised by other Research Groups to help stimulate interest in CRG by new members.

APPENDIX 1: Participants List

Country	Attendees
Alliance Member Countries	
Canada	- Craig Drury: Agriculture & Agri-Food Canada (craig.drury@canada.ca)
China	- Xunhua Zheng: Institute of Atmospheric Physics, CAS (xunhua.zheng@post.iap.ac.cn)
Denmark	- Lars Munkholm: Aarhus University (lars.munkholm@agro.au.dk)
Germany	- Heinz Flessa: Thünen Institute of Climate-Smart Agriculture (heinz.flessa@thuenen.de)
Japan	- Ayaka Kishimoto-Mo: Institute for Agro-Environmental Sciences, National Agriculture and Food Research Organization (mow@affrc.go.jp) - Rota Wagai: National Agriculture and Food Research Organization Institute for Agro-Environmental Sciences Division of Climate Change (NIAES) (rota@affrc.go.jp)
New Zealand	- Mike Beare: Plant and Food Research (Mike.Beare@plantandfood.co.nz)
Republic of Korea	- Sun-Il Lee: National Institute of Agricultural Sciences, RDA (silee83@korea.kr)
Spain	- María Rosa Mosquera Losada: University of Santiago de Compostela (mrosa.mosquera.losada@usc.es) - Francisco Javier Rodriguez Rigueiro: University of Santiago de Compostela (fjrr1988@gmail.com)
United Kingdom	- Jagadeesh Yeluripati: The James Hutton Institute (jagadeesh.yeluripati@hutton.ac.uk)
United States of America	- Mark Liebig: USDA-ARS (mark.liebig@usda.gov) - Michel Cavigelli: USDA-ARS (michel.cavigelli@usda.gov) - Hero Gollany: USDA-ARS (hero.gollany@ars.usda.gov) - Jane Johnson: USDA-ARS (jane.m.johnson@usda.gov) - Charles Rice: Kansas State University (cwrice@ksu.edu)
GRA Secretariat	secretariat@globalresearchalliance.org - Hazelle Tomlin - William Aitkenhead
Apologies (Brazil)	- Ladislau Neto: Brazilian Agricultural Research Corporation (EMBRAPA) (ladislau.martin@embrapa.br)

APPENDIX 2: Flagship project submission template

Title:

Leader:

GRA Council Champions: *list the names of at least 5 GRA Members and Partners (including at least 3 Member countries)*

1.
2.
3.
4.
5.

Countries involved:

Start date and project length:

Brief description of project:

Key partners and existing resources:

Benefits and outcome from Flagship project:

Further Resourcing needs:

Resourcing mechanisms:

Linkages:

Flagship Criteria

Project Scope

1. Project timeline (defined end date) specified.
2. Project outcome defined.
3. Globally applicable.

Project Participation

4. Benefits from GRA wide collaboration.
5. Provides a range of collaboration opportunities – including low cost e.g. data, sample or knowledge sharing.

Research

6. Will the project generate new knowledge, high scientific impact.
7. Identified community of experts within the GRA Membership (i.e. proposed by a Research Group or Network – or key coordinators identified if cross-cutting).

Resourcing

8. Flagship project lead identified.
9. Funding confirmed for Flagship project lead and core project activities (Minimum 30%, cash or in kind contributions of total project costs).

10. Proposed funding mechanisms for additional activities and contributions identified (i.e. fellowship fund, workshop funding, or research call).

Proposed Process

1. GRA Flagship Project template to be completed by the lead.
2. The GRA Flagship Project must identify at least five Council Champions, Members and Partners, consisting of at least three GRA Member countries.
3. Council representatives to assess proposed Flagship projects using the criteria (below), and agree on the GRA Flagship projects to endorse.
4. GRA Flagship Projects will be profiled on the GRA website, and once complete final outcomes will be presented to the Council.

Example GRA Activity relevant as Flagship Project

Some examples of projects that would meet the GRA Flagship criteria follow.

Global Rumen Census

The GRC is the most extensive exploration of rumen microbial communities to date, representing 742 samples from 32 animal species from 35 countries, and supported by 140 scientists from 73 research institutions worldwide. A key finding of the GRC was that similar bacteria and archaea dominated in nearly all samples, and that diet is a key driver of microbial-community structure. The GRC was a collaboration among members of the Rumen Microbial Genomics Network (www.rmgnetwork.org).

Hungate1000

Building on the results of the GRC, the Hungate1000 project used the culture resources of multiple rumen microbiology laboratories around the world (57 researchers, from 14 research organisations in nine countries) to develop a reference set of 501 rumen-microbial genome sequences and cultures. The Hungate1000 has captured almost all cultured rumen bacterial and archaeal species that have been taxonomically characterized and several as yet uncharacterized strains belonging to novel species and genera. It represents the single largest effort to provide a catalogued and curated culture and genome resource for rumen microbes. The Hungate1000 was a collaboration among members of the Rumen Microbial Genomics Network (www.rmgnetwork.org).

MAGGnet

In 2012, a greenhouse gas research network referred to as MAGGnet was established within the Croplands Research Group of the Global Research Alliance on Agricultural Greenhouse Gases (GRA). With involvement from 46 alliance member countries, MAGGnet seeks to provide a platform for the inventory and analysis of agricultural greenhouse gas mitigation research throughout the world. To date, metadata from 315 experimental studies in 20 countries have been compiled using a standardized spreadsheet.

MAGGnet has served to leverage limited resource investments within individual countries to produce an inclusive, shared meta-database for use by all GRA-member countries. MAGGnet occupies a unique niche among greenhouse gas networks given its geographical domain (global) and intended focus. With time and continued effort, MAGGnet can serve to further greenhouse gas mitigation science through new collaborations among contributing members.
https://www.tandfonline.com/doi/full/10.1080/17583004.2016.1180586

CEDERS

Known as 'CEDERS', this new project aims to: develop databases to evaluate dietary mitigation strategies (including digestion and excretion) and greenhouse gas emissions and undertake experiments to fill high-priority knowledge gaps on dietary effects on ruminant manure emissions. It will evaluate consequences of dietary mitigation measures on emissions on selected farm cases with a modelling platform, improve farm accounting and national inventory methodologies to capture effects of dietary mitigation measures and disseminate the implications of findings to end-users of greenhouse gas accounting and inventory.

CEDERS initially involved scientists from 10 countries and is being expanded to include Post-Docs in Latin America and South East Asia to increase its global relevance. This additional work will help identify region-specific feeds that could feasibly offer the most significant emissions reductions and develop Ym values for specific feeds suitable for inclusion in advanced national greenhouse gas inventories to help better quantify enteric methane emissions and, specifically, capture the impact of local diets and changes in diets on emissions.