SOIL CARBON & NITROGEN CROSS-CUTTING GROUP MEETING REPORT

Impulse Building, Wageningen University Campus, the Netherlands

Saturday 14 June 2014

Meeting Report

OVERVIEW

Members of the Soil Carbon and Nitrogen Cycling Cross-Cutting (SCN) Group met on Saturday 14 June 2014 at Wageningen University, Wageningen, the Netherlands. The one day meeting included presentations and identified opportunities for further collaboration and coordination of modelling efforts in discussion with the Co-Chairs from the other Alliance Research Groups. Other presentations covered an overview of the outcomes from the SCN Group to date and future activities. The Group Co-Chair from France Jean-François Soussana chaired the meeting and discussions as the Co-Chair from Australia was unable to attend.

This report is a summary of the key discussions and outcomes from the meeting.

PARTICIPANTS

The meeting was attended by 16 representatives from 8 member countries:

- **Alliance Members attending:** Canada, France, Japan, The Netherlands, New Zealand, Norway, Spain, USA.

Refer to Appendix 1 for a full participants' list.

KEY OUTCOMES OF MEETING AND ACTION POINTS

The meeting achieved the following outcomes:

- Updates from the Research Groups of the Alliance and opportunities for collaboration.

- Increasing coordination of activities with the Inventories and Measurement Cross- Cutting Group.

- Presentations on future activities on farm calculators and modelling interactions between livestock and grasslands.

- Discussion on how to share results of the Groups model comparisons and outputs more widely.
- Identify future products and ways for the Group to add value.

SUMMARY OF DISCUSSIONS

WELCOME

1.   Martin Scholten (Wageningen University, the Netherlands) welcomed all participants attending the Soil Carbon and Nitrogen Cycling Cross-Cutting Groups meeting to the Netherlands and Wageningen University. Wageningen University is the only agricultural university in the Netherlands covering all aspects of agriculture and food production including social science aspects. The current structure of the university has been built around the idea that knowledge sciences are the backbone of success and this success will be achieved through partnerships between science, business, and government.

GROUP OVERVIEW

2.   Co-Chair of the Soil Carbon and Nitrogen Cross-Cutting Groups (SCN) Jean-Francois Susanna provided an overview of the Alliance and the action plan of the SCN. This meeting of the Group includes presentations for the Co-Chairs of the other Alliance Research Groups and discussions on how to improve the collaborations and links between the Cross-Cutting Groups and the Research Groups.

3.   The SCN workplan focuses on testing mitigation actions through models, and needs to include stakeholders especially other Research Groups. The group will do this by:

- Identifying the needs of a range of stakeholders;
- Developing capacity building tools to support these needs;
- Exploring the use of process based tools in developing national inventories;
- Benchmarking and comparing models by testing the models against a wide range of diverse datasets;
- Identifying additional datasets from long term experiments, flux data, enteric methane measurements and;
- Evaluating specific models, for example DAYCENT, RothC and simple statistical models.

4.   To undertake the intercomparison activity the Group needed high quality data sets to test the models against. The main criteria for selection of the sites were that all three agricultural greenhouse gases were measured, and the data was collected from long term experiments on grasslands or wheat.

5.   The SCN have tested various mitigation options across all the models to compare the performance of the models. Initial comparisons using the default N2O emission factor (EF1) give different results from each model tested and is an example of why default are not always applicable.

Data from experiments using nitrification inhibitors was also checked against the models and this found that not all models have the sensitivity to calculate the changes in nitrogen or ability to model the process. Models developed to simulate carbon cycling in soil and the overall greenhouse gas balance were not successfully able to predict changes to the soil and harvest dates that may occur over time due to climate change.

6.   The Group is working to extend the datasets used in the model comparison, as at this stage the models are tested against data from three grassland sites and three croplands sites. With the exception of two croplands sites in Brazil in India all long term experiments are located in temperate climates. To date 24 models have been tested against all of these datasets.

7.   The SCN is looking to improve capability among the modelling community through the development of web-based tools and platforms. Three existing platforms have been identified and will be explored further to identify if the SCN could collaborate with these projects.

- INRA, France has a platform (RECORD) which is able to link models together and will complete the data analysis on the platform once data from a site or experiment is provided.
- MDE is a US database developed from ecology experiments which links the literature and the measurements provided in these experiments with modelled outputs.
- GRAMP is the Global Research Alliance Modelling Platform comparing models and their different management system. GRAMP is a UK developed platform that supports the Alliance under the Croplands Research Group. Although DNDC is the only model covered in detail at this time there is the opportunity to expand to other models and the platform has been developed with a strong training component.

8.   The SCN aims to identify widespread mitigation options through comparisons across the models but needs to ensure the model can calculate the mitigation option that has been applied. Models are developed with particular datasets or to meet specific requirements. Therefore the SCN needs to identify the optimum range of the models they are using and understand the situations where they will not be applicable. The SCN should group models by the major principles and objectives that they were developed for as this will bring added value to members and a better understanding of each model applicability, robustness and global use. It is also important that the Group consider a wide range of models so that all countries have options available for modelling data from their experimental sites.

INTERACTIONS WITH OTHER RESEARCH GROUPS

9.   The Co-Chairs were then invited to present an overview of the other Alliance Research Groups noting additional collaborative opportunities; and support that the SCN needs to provide back to each Group such as data provision, reporting on model outputs and addressing mitigation options.

Croplands Research Group

10.   Co-Chair of the Croplands Research Group (CRG), Alan Franzluebbers (USDA-ARS) provided an overview of the existing collaborations between the two Groups, and ideas for future activities.

11.   Currently the modelling data used is taken from sites with long term wheat experiments only and is not testing data from a range of crops. The model intercomparison does not account for crop rotation with only the wheat phase of rotation tested, although these may include residue from other crops. To be of use to the CRG the models would need to be tested against a range of crops and have the ability to recognise management practices common across croplands.

12.   The SCN and the I&M Cross-Cutting Groups need to communicate their activities and outcomes to the other Groups, establishing a flow of information that all Research Groups and members can expand on. There would be benefit in combining information from the Cross-Cutting Groups and presenting this to the Research Groups revealing knowledge gaps and additional areas where the Alliance could add value or improve on information.   The database activity underdevelopment by the SCN may be one of the ways of providing information to member countries and the Research Groups.

13.   The four FACCE- JPI projects that form the basis of the SCN activities were funded with the recommendation that they improve the connections and knowledge sharing of modelling components among the projects. The project group may also identify ways that these projects could provide support to countries with specific question on modelling and how these answers could be shared and applied more widely.

14.   The SCN will look into developing a matrix that can report the key weakness and strengths identified for the models they are testing. This would note the conditions under which models work best and which processes the model is not able to consider e.g. will note if the model includes a component for soil water modelling or can predict increased soil carbon or yield. This could be compared with regional data to identify instances where it will be safe to use each type of model.

Livestock Research Group

15.   The Livestock Research Group (LRG) has participation from all member countries and has a clear path of activities working from stocktakes to supporting policies, farmers and partners. The Group looks for activities that demonstrate achievements for the Alliance, and go beyond research alone. The LRG works actively with Partners and considers partner requirements when determining the scope of activities.

16.   Opportunities for the SCN to support LRG activities include communicating the outcomes from the model analysis and benchmarking activities which can help to underpin the development of mitigation measures for countries. Modelling of soil carbon and nitrogen processes in pasture with grazed livestock is an area of particular importance for the LRG with one of the six networks, the Grasslands Network established to include management practices for rangelands and pasture with potential benefits to store carbon and understand the functioning of the system to prevent the degradation of grasslands.

17.   The Grasslands Network would be interested in collaborating with the SCN to discuss models that can integrate livestock processes with grasslands and models that can show the effect of changing stock density on soil carbon sequestration. Soil carbon storage in grasslands is an area with

high potential to mitigate greenhouse gas emissions, but options which are able to measure and quantify soil carbon changes over time are needed. Developing collaborations between the Groups including the CRG, Networks of the LRG and partners in this area of work could attract additional funding to the Alliance.

18. Countries are increasingly looking to place a financial value on agricultural management practices (e.g. NAMAs), although limited measurements mean that the real affect on greenhouse gas emissions are not able to be verified. Countries need good modelling to gain verification and credit for changing practices and the SCN may have a role to play in this.

Paddy Rice Research Group

19. An overview of the Paddy Rice Research Groups and Japan's activities of modelling greenhouse gas emissions from rice was provided by Yasushito Shirato (NIAES, Japan). The Paddy Rice Research Group is focussed on standardising measurements, developing databases and partnerships and regional collaborations. The Group is not yet considering modelling, although this is an important cross-cutting issue, and the inclusion of models specific to paddy rice processes in SCN activities would be of benefit to members.

20. Japan has calibrated the DNDC-rice model so that it is able to calculate rice emissions for Japanese management practices. Soil carbon changes in paddy soils and andosols are modelled using RothC which was calibrated using data from several long term (more than 30 years) experiments in Japan on different soil types. Taking the model outputs and experimental data, spatial mapping is being used to scale up the levels of soil carbon available across Japan and evaluate global warming potential (GWP) and trade-offs nationally. This has lead to the development of a web- based decision support tool for farmers which automatically populates weather and soil information once the farm site is selected and then the farmers are able to add their management issues to have a range of mitigation options suggested.

21. Japan has developed joint research activities with Thailand, China and Vietnam to test the model under different conditions and develop decision support tools and joint research. The Japanese Co-Chair of the PRRG has been in contact with the SCN to discuss model comparisons across paddy rice sites and ways to share experiences with other countries.

Inventories and Measurement Cross-Cutting Group

22. The Inventories and Measurement Cross-Cutting Group spans a large area of work, and goes beyond national greenhouse gas inventories, including scaling up of sites for quantification. The two Cross-Cutting Groups have an interest in developing the soil carbon measurement guidelines and coordinating this activity across all Research Groups.

23. Two presentations identified possible collaborations between the SCN and the I&M to be discussed further including a survey of soil carbon methodologies and reporting across countries and two EU projects identifying management practices to increase soil carbon, one at the farm level and one providing information to policy makers.

Qualitative Assessment of Methodologies

24.	Jan Peter Lesschen (Wageningen University) presented an analysis of soil carbon methodologies developed by several countries for use in their national inventories. Currently national inventories have a high level of uncertainty around soil carbon reporting and there is scope for the I&M Group to identify some best practices and share experiences across members.

25.	The objective of the analysis was to identify a few countries that have developed relevant measurement schemes and consider details of each programme including how the sites are selected, the specific measurements taken and the frequency of re-sampling which could show the change in soil carbon stocks over time.

26.	The measurement schemes (the examples were UK, US, Denmark and EU) were assessed against several criteria; sampling density, frequency, soil depth, bulk density, land use cover, statistical underpinning and land management links. The survey acknowledged that there are differing approaches across countries and that limited funds available to do this work may mean many countries will use the information made available through other survey programmes which may not include measurements specific to soil carbon.

27.	The Alliance could develop this work further and access detail around the schemes developed by Alliance members and their underpinning data. The analysis would help countries understand where they are at and would provide recommendations from the literature and comparison with other schemes to show where improvements could be made and how this might be done, including the costs required for each approach.

EU Projects: Catch-C and SMARTSOIL

28.	Jan Verhagen (Wageningen University) Co-Chair of the I&M Group presented two European Union funded projects considering soil carbon management options to achieve reduction of agricultural greenhouse gases and other impacts on the environment while also increasing production.

29.	SMARTSOIL is a project mapping carbon stocks and scaling up carbon flows based on long term experiments across Europe with examples from regional case studies. The project hypothesis is that increasing soil carbon stocks will lead to an increase in productivity.

30.	The SMARTSOIL project classifies typical farm sites with similar soil types and crop management practices then compares their soil carbon activity and overall productivity. The modelled changes are based on information from farmer surveys and EU soil survey data (LUCAS). The project will developed a box of tools - farmer case studies, cost effective processes, soil management processes, communication to farmers and policy makers, provide best practice knowledge, and simple information explaining the importance of soil carbon to farmers.

31.	The CatchC project takes a farm systems approach based on agri-environmental zones and simplified land use characteristics. The project identifies the most important classes for each country by developing simple categories for management practices and then mapping the farms types to the country. Once the mapping is complete several indicators of environmental quality (soil chemicals,

GHGs etc) are overlayed to build a data database of environmental indicators and land management where the overall effect on soil carbon can be mapped based on long term data.

32.   The CatchC project has also surveyed farmers on 1000 farms of each type in each country. These surveys were used to identify management practices, barriers to uptake and sources for new practices.

Future interaction between the I&M Group and SCN could include:

1. Improvement of monitoring, reporting and verification systems. This could be achieved through Alliance produced desk studies and reports which identify how to create an improved design for monitoring.

2. Farm systems and farmer tools. There are many online calculators available for farmers, what role can the Alliance play to review these calculators and the situation each is best suited for.

FUTURE ACTIVITIES

Farm Tools and Farmer Perception

33.   Peter Kuikman provided lessons learnt when reviewing an EU wide farm calculator (JRC) that had been developed. The calculator was similar in its approach to many others considering both carbon and nitrogen balances and scaling up the data to the national level. The JRC tool was evaluated to see if farmers were able to provide the data required and if the data produced was in a form that could be used by policy makers.

34.   The review surveyed farmers to see if they could complete the tool and had easy access to the data requested. Survey outcomes showed that the tool was too complex for farmers use taking 6 or more hours to complete and would need to be linked to a payment or provide a clear benefit to farmers to have them use the tool. Not all of the data required by the tool was immediately available to farmers, on farm management decisions could be easily reported, but information on renewable energy and carbon storage for example was less likely to be accurately completed.

35.   The review found that the tool would only be filled out by farmers or advisors if it was linked with current farm subsidy tools. Carbon calculators work best when linked to other farm calculators or databases so that farmers are not required to enter the same information in multiple tools.

Modelling Livestock-Grassland Interactions

36.   To support the LRG the SCN is considering how to model emissions from combined grasslands and livestock systems and how to couple models both directly and indirectly. Models developed specifically for grasslands modelling or livestock modelling have different focuses and weaknesses which increase the need to identify the use and scope of the modelled outputs.

37.   interactions. Attempts to improve this coupled model by increasing the livestock species/ production systems and allowing for different feeds, and stages of animal growth did not produce a

change in the overall greenhouse gas emissions estimate when model output was compared with actual measurements but The PASIM model is a pasture simulation that considers limited livestock-grasslands did show increased sensitivity to systems and annual changes.

38.   LRG partner AnimalChange has a component to considering integrated farm-scale models which includes management systems, manure, exported product and input. There is an opportunity to create an interface between the SCN and the LRG Networks on Feed and Nutrition and Grasslands which compares the coupled and uncoupled models available and shares this information.The coupled models would need to be at the farm scale meaning only the most important management actions would be considered. The Feed and Nutrition Network is developing a database of how feed effects greenhouse gas emissions as modelled by a simplified conceptual model.

CLIMATE CHANGE IMPACTS AND ADAPTATION – LINKS TO AGMIP

39.   Fiona Ehrhardt presented the collaborative activities between the SCN and the AgMIP project. AgMIP is an international programme to evaluate agricultural models which are used for projections of climate change impacts and adaptation as well as regional assessments. The objective for the collaboration between SCN and AgMIP is to improve the ability to model climate change impacts on grasslands.

40.   The team have recently published a paper on the process of applying scenarios to climate data and testing the sensitivity of the models and are now hoping to include additional experimental sites. A minimum requirement before new sites can be registered for this experiment is that climate data taken over at least 31 years is available. Once the climate data is entered the results are derived from emulation calculations.

41.   The models are calibrated using data from specific site, which is currently limited to temperate systems. The next steps for the programme will be to include information from grasslands and tropical sites and improve the protocol used in the analysis.

CONCLUSIONS

42.   The Group then agreed the identified outcomes from the days meeting especially future work activities for the SCN and ways to improve links and collaborations to modelling projects or components across the other Alliance Research Groups.
- Identify model requirements from the Croplands and Livestock Research Groups, coordinate questions from members regarding modelling of key sites and specific issue.
- Communicate the expected outputs of the model benchmarking project to Members including the categorisation of models with regards to model type greenhouse gases calculated, applicability and specific recommendations.
- Explore opportunities to provide SCN outputs and results on a web based platform with options to coordinate across existing platforms.
- Initiate activities with the Paddy Rice Research Group, Japan's modelling of rice data and calibration of DNDC rice will be a good basis to begin this collaboration.
- Coordinate activities with the I&M Group such as an MRV scheme review and combining skills across groups

- Continue work on assessment of farm scale calculators; data requirements, time to complete, approximate cost and transparency of calculations.
- Develop work on coupled and uncoupled methane models with LRG Grasslands and Feed and Nutrition Networks.
- Identify the best models for coupled soil carbon modelling with the Grasslands Network and how to upscale these.

APPENDIX 1: Participants List

Country	Attendees
Alliance Member Countries	
Canada	Brian McConkey: Agriculture and Agri-Food Canada (brian.mcconkey@agr.gc.ca)
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