

# Soil Carbon Workshop for Research, Industry, Policy and Market Stakeholders – Sydney, 5<sup>th</sup> May 2010

## Workshop Report

### Background

There has been considerable discussion regarding the role of soil carbon sequestration in mitigating greenhouse gas (GHG) emissions. However, in exploring soil carbon issues with various stakeholders, it has become clear that many issues related to: (a) science; (b) industry; (c) policy; and (d) markets must be resolved before the potential for mitigation through soil carbon management can be understood and, if possible, achieved.

Preliminary research also indicates that there is currently limited interaction between these groups of stakeholders. The groups have very different backgrounds, drivers and perceptions of the issues, yet share a common goal of promoting soil carbon management to mitigate human-induced climate change.

In response to this, [The National Centre for Rural Greenhouse Gas Research](#) (NCRGGR) in collaboration with [E3 International](#) embarked on a process to support informed discussion and identification of key issues related to soil carbon sequestration.

The result of these efforts was an intensive one-day workshop which aimed to:

- **Achieve a common understanding of soil carbon issues from the policy, science and industry/market perspectives**
- **Discuss the requirement/options for any follow up process to address these issues and to maintain dialogue between the stakeholders.**

The workshop was sponsored by NCRGGR and the [National Climate Change Research Strategy for Primary Industries](#) (CCRSPI), facilitated by E3 International and hosted by [PricewaterhouseCoopers](#).

As a means to seed discussion a Background Paper, including contributions from the majority of participants, was prepared by E3 International and circulated prior to the workshop.

The workshop agenda, shown in [Appendix 1](#), included twelve short presentations on different aspects of soil carbon. The Background Paper and the presentations cover the agronomic and environmental benefits of soil carbon, as well as its potential to reduce atmospheric CO<sub>2</sub>. They also illustrate the range of perspectives on the readiness to include soil carbon in markets. No attempt has been made in this report to include or summarise the presentations made during the workshop, but these are available online at <http://www.e3international.com>.

## Contents

This document summarises the response of participants in relation to the stated workshop objectives above. It has been compiled from:

- Responses and input to the background paper.
- Questions and comments made during the event, in the context of twelve presentations covering a variety of perspectives on soil carbon.
- Input and discussion during the identification of key soil carbon issues.
- Small group discussions and voting on which issues most need multiple stakeholders involved
- Discussions on options for maintaining/building the necessary dialogue
- Evaluation forms

It is not a record of all discussion on the day, but aims to summarise the participants' input as captured from the working sessions and present it in an orderly and neutral form, avoiding commentary. It is intended to form a basis for further input and commentary by participants and other interested parties. The report contains the following sections:

- [The value of combining perspectives](#)
- [Soil Carbon Issues](#)
- [Continued Stakeholder Interaction](#)
- [Appendices](#)

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## The value of combining perspectives

Participants 'take home' messages were captured via evaluation forms (refer [Appendix 2](#)). These provide a picture of the value of drawing together people with a broad range of perspectives on soil carbon:

- There was strong support for the concept of bringing the different perspectives together. Several participants with significant experience in soil carbon commented that the workshop had provided valuable insights. Written feedback included:
  - *"Linking Science, Policy, Industry and Market on soil carbon a good idea indeed"*
  - *"The whole market chain is important"*
  - *"This group represents a powerful set of skills and knowledge"*
- Following on from this was a strong sense that this interaction needs to continue in order to make progress....
  - *"Need to get all players engaged to move forward"*
  - *"Bridging the silos is needed"*
  - *"Need to interact more broadly across disciplines"*
- However, there was also some recognition of the challenges in achieving this...
  - *"Still a long way to go, but important step along the way"*
  - *"Until there is a significant input of "energy/dollars/regulation" nothing will change rapidly in either direction or speed"*
  - *"Lack of understanding of fundamental issues"*

## Soil Carbon Issues

[Appendix 3](#) includes the issues identified by workshop participants, as well as a revised version by E3 identifying emerging themes. Based on this, E3's interpretation of the issues can be summarised as follows.

- **Potential of soil carbon and factors impacting on soil carbon**

The extent of our understanding of the potential to increase soil carbon under different practices, and sequestration rates; consideration of the role of other nutrients and water as well as the role of innovation and new technologies
- **Measurement & modelling**

The ability to measure soil carbon effectively, given uncertainty. The options for measuring soil carbon directly, or to model it, or to pursue a hybrid approach.
- **Industry issues**

The importance of taking a systems approach to soil carbon in holistic farm management; leveraging wins to date; acknowledging the danger of farm businesses being locked into inflexible systems but recognising that a boutique market could be of value; applying geosequestration-like ambition levels.

- **Policy issues**

Recognising the multiple dimensions of soil carbon (consideration of productivity/food security/ profitability, environmental sustainability and social resilience) and tradeoffs in optimising soil carbon; the need for robust economic analysis; balancing market mechanisms with complementary measures including consideration of direct investment in soil carbon.

- **Framework for trading**

The need for a low cost yet credible Monitoring, Reporting and Verification (MRV) regime; treatment of boundaries, additionality, leakage and permanence; accommodating sequestration vs a reduction in GHG emissions; and which soil carbon pools should be included.

- **Investor and market perceptions**

The ability of the voluntary market to support investor participation. Customer preferences and level of confidence in the product (including product integrity)

- **Legal and institutional issues**

National harmonisation of property rights for soil carbon; exclusion of natural variability through force majeure provisions; understanding the costs, and risks of contracting in soil carbon; the role of any regulator, and market education

## Continued stakeholder interaction

### Part 1

Groups were asked to consider which issues would benefit the most from further interaction between different stakeholder groups. This recognised that many of the issues identified in relation to a particular perspective, such as “science” or industry”, have much broader impacts. Opinions were captured through a voting process, whereby each person placed dots against up to four issues considered most amenable to collective input.

The focus was on the scope for collaboration, not on whether one issue was more or less important than another. The collective scores are summarised in [Appendix 4](#). Those issues attracting more support *as being amenable to collaborative approaches* are noted below and linked where possible, in order to highlight some high-level areas that merit further interaction:

- ***Understanding and measurement of soil carbon***

Several issues related to this scored highly, including “Is the potential to increase soil carbon under different practices sufficiently understood?”, “Is current research adequate to define potential?”, particularly in relation to “innovation and new technologies”? “Do we need to measure soil carbon directly or is it adequate to model it?”, or could a hybrid be developed; “Can we measure soil carbon cost-effectively?”

This recognises wider stakeholder interest in the scientific work required to understand the behaviour of soil carbon, including refinement of measurement and modelling techniques. Interaction with market and policy stakeholders may facilitate a better understanding of basic technical issues such as the different forms of soil carbon.

Participants agreed on other related issues that would benefit from broader stakeholder input such as “leverage current wins”, where changed practices appear to have carbon benefits, and “applying geosequestration-like level of ambition”.

- ***Systems approach***

The issue of “Systems approach to soil carbon in holistic farm management” rated highly as needing to be recognised and addressed by multiple parties. Soil carbon interacts with other production and conservation objectives and soil management practices may also impact on other greenhouse gases, such as nitrous oxide and methane. A holistic approach would also consider indirect emissions, interactions of soil carbon management with water and nutrient supply, and socio-economic impacts. The high rating for this issue appears to recognise the importance of market and policy sectors also taking these factors into account.

Another highly rated issue, “Need for cost benefit analysis and comparative analysis relative to other initiatives”, might enable all parties to understand these various elements of the system.

This point is reflected in another issue: “What are we trying to achieve? Policy outcome for climate change; consider productivity/ food security/ profitability/ environmental sustainability (what is the net ecosystem spatial and temporal benefit?) and social resilience”. This indicates the potential value of policy makers engaging in a systems approach.

- ***Mechanisms to support a tradeable instrument***

Another area that was identified in terms of the potential benefits for collaborating across stakeholder groups was related to mechanisms to support a tradeable soil carbon instrument. This encompasses issues such as: “Voluntary market is a low value market, therefore has to be low cost – need for a low cost yet credible MRV” and “What level of confidence will the market demand? – how big does the buffer need to be?” This suggests that technical input and an understanding of carbon market dynamics will be required to guide the development of a Monitoring, Reporting and Verification system.

## **Part 2**

Groups were asked to consider what needs to happen next to enable interaction between different stakeholder groups, and in particular, to consider what mechanisms might enable stakeholders to maintain their understanding of, and engagement with, these issues over time. (For example, online working groups, newsletters, ongoing forum, further meetings – general or issue-specific, face-to-face or online interaction).

Some of the discussion centred on approaches to transferring information to farmers through various means such as farmer circles and demonstration plots. Other suggestions had a broader focus. Catchment-level projects were seen as one way to drive interaction, as has occurred with the Lachlan MBI project (refer session 1 in agenda [Appendix 1](#)). This is seen as providing a clear structure, timeline and objective, providing a focus for commitment and collaboration between stakeholders.

One group noted the role of The Climate Change Research Strategy for Primary Industries (CCRSPI) in coordinating research projects across a wide range of industries. The potential for a Cooperative Research Centre (CRC) to encompass industry and other partners as well as research groups was also raised.

Another group sketched out a concept plan for a “Reserve Bank of Carbon” as a coordinating entity with roles in managing buffer stocks, as well as research and community education. This would be linked to a think tank and/or community cluster designed to incubate soil carbon ideas. Another group proposed coordination at the international level through a “Global Soil Carbon Sequestration Institute”. Time did not allow for these concepts to be discussed with all participants.

## Appendix 1: Workshop Agenda

0900 – 0915	Welcome and Introduction
0915 – 1015	<p><b><u>Session 1: Science</u></b></p> <p><b>Chair – Annette Cowie, National Centre for Rural Greenhouse Gas Research</b></p> <ol style="list-style-type: none"> <li>1. <b><i>Soil carbon in a carbon accounting framework</i></b> - Jeff Baldock, CSIRO (10mins)           <ul style="list-style-type: none"> <li>• <i>The multiple benefits of soil carbon</i></li> <li>• <i>Soil carbon cycle, fractions &amp; profiles</i></li> <li>• <i>Potential for increasing soil carbon; practices that increase soil carbon</i></li> <li>• <i>Pitfalls – saturation, permanence</i></li> <li>• <i>R&amp;D needs - DAFF funded Soil Carbon Research Program</i></li> </ul> </li> <li>2. <b><i>Towards more efficient soil carbon measurement and monitoring</i></b>  <b>– Alex McBratney, University of Sydney (10 mins)</b> <ul style="list-style-type: none"> <li>• <i>Existing and developing soil carbon estimation methods, fractionation, modelling. Costs of measuring soil carbon. Precision vs cost</i></li> <li>• <i>Need for whole property approach</i></li> <li>• <i>Resource costs/benefits of soil carbon sequestration eg water, N, P</i></li> <li>• <i>Other soil management impacts on greenhouse gases – Nitrous Oxide</i></li> </ul> </li> <li>3. <b><i>Estimating soil carbon change, for Market Based Instruments, Lachlan Pilot Program</i></b> – Andrew Rawson/Brian Murphy, NSW DECCW (10 mins)           <ul style="list-style-type: none"> <li>• <i>Multiple benefits of soil carbon. Soil carbon in land management context</i></li> <li>• <i>Lachlan MBI project – Concepts for a practical MBI for soil carbon: trialling cost-effective estimation of soil carbon - matrix approach</i></li> </ul> </li> </ol> <p><b>Audience contributions</b> (approx 10 mins after each presentation)</p>
1015 – 1030	Break (Morning Tea)
1030 - 1130	<p><b><u>Session 2: Industry</u></b></p> <p><b>Chair – Mick Keogh, Australian Farm Institute</b></p> <ol style="list-style-type: none"> <li>1. <b><i>Key elements of an ideal system for wool producers</i></b> – Louisa Kiely, Carbon Farmers of Australia (10 mins)           <ul style="list-style-type: none"> <li>• <i>Market differentiation through products backed by carbon sequestration practices eg Carbon neutral wool</i></li> <li>• <i>User-friendly &amp; confidential auditing options, eg through Catchment Management Authority. Whole of farm system approach</i></li> <li>• <i>Carbon Smart (forestry) model to enable participation by smaller enterprises</i></li> </ul> </li> <li>2. <b><i>Current practices and new approaches to broad-acre cropping – role of regulators, markets and economics</i></b> – Bryan Clark, Grain Growers Association Limited (10 mins)           <ul style="list-style-type: none"> <li>• <i>Trends in cropping practices (includes minimum till, precision agriculture and Controlled Traffic Farming (CTF), Pasture cropping</i></li> <li>• <i>Market experience of grain growers</i></li> <li>• <i>International models – pros and cons, potential application to Australia – growers perspective</i></li> <li>• <i>Conserving existing stocks vs increasing soil carbon?</i></li> </ul> </li> </ol>

	<p>3. <b>Drivers of, and barriers to, the changes required to sequester soil carbon</b> -  <b>David Eyre, NSW Farmers Association (10 mins)</b></p> <ul style="list-style-type: none"> <li>• <i>Differential impacts on producers – structural issues</i></li> <li>• <i>A mandated or voluntary market?</i></li> <li>• <i>Practical cost/benefit issues for farmers</i></li> <li>• <i>Who bears liability for natural losses?</i></li> </ul> <p><b>Audience contributions</b> (approx 10 mins after each presentation)</p>
<p><b>1130 – 1230</b></p>	<p><b><u>Session 3: Policy and Economics</u></b></p> <p><b>Chair – Michael Robinson, University of Melbourne and Victorian Department of Primary Industries</b></p> <p>1. <b>Soil carbon in the carbon market – National policy settings</b> - Kath Rowley, Department of Climate Change and Energy Efficiency (10mins)</p> <ul style="list-style-type: none"> <li>• <i>Australia’s mitigation policy framework</i></li> <li>• <i>Where does soil carbon fit?</i></li> <li>• <i>Carbon markets and carbon offsets</i></li> <li>• <i>Offsets for soil carbon – key policy issues</i></li> </ul> <p>2. <b>Current status of the economics of soil carbon</b> – Anna Skarbek, ClimateWorks Australia (10 mins)</p> <ul style="list-style-type: none"> <li>• <i>Approaches for assessing marginal abatement costs</i></li> <li>• <i>Current knowledge on marginal abatement costs</i></li> <li>• <i>Knowledge gaps and how they might be closed</i></li> </ul> <p>3. <b>Changing land management practices through the use of market-based instruments (MBIs)</b> - Jason Crean, Industry and Investment NSW (10 mins)</p> <ul style="list-style-type: none"> <li>• <i>Economic theory and MBIs</i></li> <li>• <i>Lessons from MBIs in Australia - implications for soil carbon markets</i></li> <li>• <i>Possible interactions between carbon, water and biodiversity markets</i></li> </ul> <p><b>Audience contributions</b> (approx 10 mins after each presentation)</p>
<p><b>1230 - 1315</b></p>	<p>Break (Lunch)</p>
<p><b>1315 - 1415</b></p>	<p><b><u>Session 4: Market</u></b></p> <p><b>Chair – Andrew Petersen - PricewaterhouseCoopers</b></p> <p>1. <b>International policy context and market requirements</b>, Ilona Millar, Baker &amp; McKenzie (10 mins)</p> <ul style="list-style-type: none"> <li>• <i>International policy developments including reference to UNFCCC</i></li> <li>• <i>Market precedents including treatment in mandatory and voluntary carbon markets</i></li> <li>• <i>What is required for a tradeable instrument</i></li> </ul> <p>2. <b>Lessons from forest carbon sequestration</b> – Penny Baalman, GHG offset Services/Nick O’Brien, New Forests (10 mins)</p> <ul style="list-style-type: none"> <li>• <i>Experience in forest offsets in GGAS/GF/CDM – what works, what doesn’t</i></li> <li>• <i>What is common/different for soil carbon, suggestions on how to manage the challenges</i></li> <li>• <i>Monitoring Reporting and Verification (MRV) of offset projects</i></li> <li>• <i>Monitoring vs estimation</i></li> <li>• <i>Challenges of MRV for soil carbon: precision vs cost</i></li> </ul>

	<p>3. <b><i>The Prime Carbon Experience - a legal and practical framework for turning a change in land management practices into tradeable “carbon credits” – Ian Conrad, Boulton Cleary &amp; Kern Lawyers (10 mins)</i></b></p> <ul style="list-style-type: none"> <li>• <i>Rationale for Prime Carbon’s choice of voluntary framework model</i></li> <li>• <i>Prime Carbon Landholders Agreement &amp; trading mechanism</i></li> <li>• <i>Incorporating into the National Carbon Offset Standard – some key issues</i></li> <li>• <i>Incorporating into the CPRS – some key issues</i></li> </ul> <p><b>Audience contributions</b> (approx 10 mins after each presentation)</p>
<b>1415 - 1515</b>	Identification and refinement of issues
<b>1515 - 1615</b>	Small group assessment of issues, including consideration of next steps
<b>1615 - 1700</b>	Discussion on follow up process and next steps
<b>1700</b>	Workshop ends

## Appendix 2: 'Take-home' Messages from Attendees

- Lots of enthusiasm to make it work. Good collaboration. Need common understanding of different needs
- Linking science, policy, industry and market on soil carbon a good idea indeed
- The issue is complex; there are opportunities, motivation, vision and understanding, [which] will drive changes.
- Much lack of understanding of fundamental issues in operating as a project mechanism under a GHG Program, with stakeholders
- Still need to understand soil carbon potential; why are management options not resulting in increased soil carbon? Still need to understand grower motivations
- The system approach is critical in terms of understanding all the components and fitting them together
- Still don't see a clear way forward. Have a much improved overview of the sector
- Need to interact more broadly across disciplines and involve more people in research projects
- While there are a number of issues associated with soil carbon, this group represents a powerful set of skills and knowledge. The future for soil carbon seems positive
- Still a long way to go, but important step along the way. Great opportunity to get this broad group together
- We need to get all the players engaged if we want to move forward on this issue
- Inertia rules. Until there is a significant input of "energy/dollars/regulation" nothing will change rapidly in either direction or speed. Self interest [is] a substantial barrier to some cross discipline sharing
- There is enthusiasm for soil carbon projects. Some will be submitted under NCOS
- Ignorance of practical issues is rife
- We seem to be at the "pointy end"
- Need for good basic communications material on policy settings. Despite negativity of peak bodies, there are innovative farmers keen to take up market opportunities
- Need to develop systems to measure soil carbon cheaply and the levels of soil carbon under different land management systems
- Soil carbon sequestration is a win for everyone
- The whole market chain is important – need to consider buyers, sellers, government and community
- Collaboration is good
- "Bridging" – reducing the silos of science, markets, banking , farming, food, agriculture, carbon are intrinsically unified – so too must be any solutions to issues surrounding
- More to be done and achieved to make soil carbon elevate from voluntary market to mandatory market
- The knowledge exists and the will exists – a combined voice will work well for this
- Productivity benefits are likely to far outweigh the carbon price as an incentive for practice change
- The soil carbon sequestration agenda is continuing along well; it is heading in the right direction
- Lots of smart people are working on soil carbon; need to move from "talking" to "doing"; bring in the capital providers and risk takers
- The key issue remains international agreement on LULUCF issues that would enable Australia to include soil carbon in the mandated trading system
- We are still all over the place on this issue, and more effort is needed to bring us closer together

## Appendix 3: Soil Carbon Issues

### As recorded at workshop

#### Science

- Is the potential to increase soil C under different practices sufficiently understood?
  - Is current research adequate to define potential
  - What is the rate of sequestration
- Role of innovation and new technologies
- Do we need to measure soil C directly or is it adequate to model it? What is the balance between both? What does the hybrid look like?
- Can we measure soil C cost effectively?
- Soil C is potentially vulnerable – do we need to distinguish the separate pools? Should vulnerable carbon be traded?
- Uncertainty is high for soil C estimate – is it a killer for emissions trading? Can science address this?
- Science capturing non-CO<sub>2</sub> emission and leakage
- Impact of climate change on sequestration rate and permanence
- Role of other nutrients and water
- Consolidation of experimental data and research as a precursor to markets

#### Industry

- Understanding the applications of Life Cycle Analysis (LCA) vs Kyoto Protocol Accounting
- Danger of farm businesses being locking into inflexible systems.
- A boutique market can still be valuable to industry
- Additionality (if for avoided offsets) on a time limited basis
- Modelling of risk and variability vs measurement
- Market integrity - “Greenwashing” and separation of offsets from “carbon neutral”
- KP accounting – soil carbon not currently recognised
- Potential sequestration also means potential emissions
- Consumer preferences
- Industry requirements for funding for both research and governance
- Leveraging the current wins
- GeoCCS type of opportunity ambition needs to be applied

#### Policy

- What are we trying to achieve?
  - Policy outcome for climate change
  - Consider productivity / food security/ profitability, environmental sustainability (what is the net ecosystem spatial and temporal benefit?) and social resilience
- Trade-offs in optimising for soil carbon
- Markets are most efficient mechanism? – need to manage tension between policy targets and effective markets
  - Offsets must be real!
- Balancing the complementary measures (unknown) with market mechanisms (both voluntary and regulatory)
- How far away are we from enough good data, good MRV, good models, and good testing and design of markets?
- Need for cost benefit analysis and comparative analysis relative to other initiatives
- Force majeure – need to acknowledge that carbon can both increase and decrease due to natural variability
- Lack of JI is a significant barrier

#### Market

- Boundaries - What is in vs what is out?
- What is the size of the market – Boutique only?
- Carbon property rights – relevance, role and national harmonisation
- Project type (sequestration / reduction) – challenges
- What level of confidence will the market demand? – How big does the buffer need to be?
- Roles, costs, and risks of contracting carbon
- Should a short term approach include direct investment in soil carbon? Consider the urgency of the issue
- Role of regulator and education
- What are the requirements for additionality specifically for soil carbon?
- What are the thresholds for investor uptake in soil C
- Voluntary market is a low value market, therefore has to be low cost – need for a low cost yet credible MRV
- Systems approach to soil carbon in holistic farm management

## **Soil carbon issues - E3 Revision to clarify and consolidate above list**

### **Potential of soil carbon and factors impacting on soil carbon**

- What is the rate of sequestration? Is current research adequate to define potential?
- Is the potential to increase soil carbon under different practices sufficiently understood?
- Impact of climate change on sequestration rate and permanence
- Role of other nutrients and water
- Role of innovation and new technologies
- Consolidation of experimental data and research as a precursor to markets

### **Measurement & modelling**

- Modelling of risk and variability vs measurement
- Do we need to measure soil carbon directly or is it adequate to model it? Can we develop a hybrid approach that includes both measurement and modelling? Can we measure soil carbon cost effectively?
- Uncertainty is high for soil carbon estimate – is it a killer for emissions trading? Can science address this?

### **Industry issues**

- Danger of farm businesses being locked into inflexible systems
- A boutique market can still be valuable to industry
- Geosequestration level of ambition needs to be applied
- Potential sequestration also means potential emissions
- Industry requirements for funding for both research and governance
- Leveraging the current wins
- Systems approach to soil carbon in holistic farm management

### **Policy issues**

- What are we trying to achieve? [Policy outcome for climate change; Consider productivity/ food security/ profitability, environmental sustainability (what is the net ecosystem spatial and temporal benefit?) and social resilience]
- Trade-offs in optimising for soil carbon
- Need for cost benefit analysis and comparative analysis relative to other initiatives
- KP accounting – soil carbon not currently recognised
- Lack of support under JI (Joint Implementation)
- Need to manage tension between policy targets and effective markets
- Balancing the complementary measures (unknown) with market mechanisms (both voluntary and regulatory)

- Should a short term approach include direct investment in soil carbon? Consider the urgency of the issue

### **Framework for trading**

- How far away are we from enough good data, good MRV, good models, and good testing and design of markets?
- Voluntary market is a low value market, therefore has to be low cost – need for a low cost yet credible MRV
- Boundaries - What is in vs what is out? What are the requirements for additionality specifically for soil carbon? Additionality (if for avoided offsets) on a time limited basis
- Do we need to distinguish the separate pools? Should vulnerable carbon be traded?
- How big does the buffer need to be?
- Capturing non-CO2 emission and leakage; understanding the applications of LCA vs KP Accounting
- Offsets must be real!
- Treatment of project type (sequestration vs reduction in GHG emissions)

### **Investor and market perceptions**

- Consumer preferences
- What is the size of the market – Boutique only?
- What level of confidence will the market demand?
- Market integrity - “Greenwashing” and separation of offsets from “carbon neutral”
- What are the thresholds for investor uptake in soil carbon

### **Legal and institutional issues**

- Carbon property rights – relevance, role and national harmonisation
- Roles, costs, and risks of contracting carbon.
- Role of regulator and education
- Force majeure – need to acknowledge that carbon can both increase and decrease due to natural variability

## Appendix 4: Issues that would benefit from stakeholder interaction

Issues that would benefit from continued stakeholder interaction	Total	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
<b>Science</b>							
Is the potential to increase soil C under different practices sufficiently understood? Is current research adequate to define potential?	28	3	5	4	5	3	8
Role of innovation and new technologies	7	1	4		1	1	
Do we need to measure soil C directly or is it adequate to model it? What is the balance between both? What does the hybrid look like?	6			1		3	2
Can we measure soil C cost effectively?	5					1	4
Soil C is potentially vulnerable – do we need to distinguish the separate pools? Should vulnerable carbon be traded?	2				1	1	
Uncertainty is high for soil C estimate – is it a killer for emissions trading? – Can science address this?	2				2		
Science capturing non-CO2 emission and leakage	1						1
Impact of climate change on sequestration rate and permanence	3	2					1
Role of other nutrients and water	2	1			1		
Consolidation of experimental data and research as a precursor to markets	1			1			
<b>Industry</b>							
Understanding the applications of LCA vs KP Accounting	2			2			
Danger of farm businesses being locking into inflexible systems.	3	2			1		
A boutique market can still be valuable to industry	3				2	1	
Additionality (if for avoided offsets) on a time limited basis	0						
Modelling of risk and variability vs measurement	3			3			
Market integrity - "Greenwashing" and separation of offsets from "carbon neutral"	0						
KP accounting – soil carbon not currently recognised	1					1	
Potential sequestration also means potential emissions	0						
Consumer preferences	3	1					2
Industry requirements for funding for both research and governance	0						
Leveraging the current wins	4	1		3			
GeoCCS type of opportunity ambition needs to be applied	6	3	3				
<b>Policy</b>							
What are we trying to achieve? Policy outcome for climate change; Consider productivity / food security/ profitability, environmental sustainability (what is the net ecosystem spatial and temporal benefit?) and social resilience	11	2	5	3	1		
Trade-offs in optimising for soil carbon	2				1	1	
Markets are most efficient mechanism? – need to manage tension between policy targets and effective markets. Offsets must be real!	1						1
Balancing the complementary measures (unknown) with market mechanisms (both voluntary and regulatory)	2			1	1		
How far away are we from enough good data, good MRV, good models, and good testing and design of markets?	1			1			
Need for cost benefit analysis and comparative analysis relative to other initiatives	7	1	4	1		1	
Force majeure – need to acknowledge that carbon can both increase and decrease due to natural variability	1	1					
Lack of JI is a significant barrier	1	1					
<b>Market</b>							
Boundaries - What is in vs what is out?	0						
What is the size of the market – Boutique only?	1			1			
Carbon property rights – relevance role and national harmonisation	3			1	2		
Project type (sequestration / reduction) – challenges	0						
What level of confidence will the market demand? – How big does the buffer need to be?	7				1		6
Roles, costs, and risks of contracting carbon	4			1	2	1	
Should a short term approach include direct investment in soil carbon? – Consider the urgency of the issue	4	3			1		
Role of regulator and education	3					1	2
What are the requirements for additionality specifically for soil carbon?	3	1		1	1		
What are the thresholds for investor uptake in soil C?	2			2			
Voluntary market is a low value market, therefore has to be low cost – Need for a low cost yet credible MRV	17	2	13		1	1	
Systems approach to soil carbon in holistic farm management	12	4		2	4	2	