Grains Carbon Accounting Workshop

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"If soil carbon is included in emissions trading, how will it work?"

Workshop Notes

Output from Workshop Sessions

Workshop Convener:

Grains Research & Development Corporation

Australian Government
Grains Research and Development Corporation

GRDC Grains Research & Development Corporation

Grains Carbon Accounting Workshop – Workshop Notes

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Workshop Convener; Martin Blumenthal (*Grains Research & Development Corporation*)

Workshop Facilitator; Peter Day (*Peter R Day Resource Strategies*)

For copies of workshop presentations, contact Tanya Robinson: T.Robinson@grdc.com.au

CARBON ACCOUNTING WORKSHOP NOTES

Summaries

Workshop 1. Purpose

Will the grains industry need to account for carbon, and other greenhouse emissions?

Purpose	**Emissions Trading Scheme**
Yes / No	No – not at present. In the long-term; maybe / probably.

- Agriculture won't be in the Carbon Pollution Reduction Scheme (CPRS); at least until 2015 (with guidelines developed by 2013).
- After that, however, it may do. Numerous factors will influence the outcome, eg Government's view of alternatives to facilitate emissions reductions. Industry may not want to be part of the scheme. Through dialogue industry may influence whether it is "in" or not and, if so, under what "rules".
- Changes may be needed to Kyoto protocols (item 3.4) before a suitable trading scheme could be established to include Australian agriculture.
- Markets don't operate on certainty. Accounting should give sufficient confidence for decisions – use science based estimates rather than attempting to measure everything.

Purpose	**Marketing or Brand Promotion. Industry Credentials.**
Yes / No	Yes – for some markets at least.

- The importance of this may vary between markets (eg EU) and it may not be a huge, or highly priced, market in Australia – but it already exists for off-sets in plantation forestry.
- Involvement will be favoured by some farmers for commercial gain.
- At the industry level, support for a system would promote the credentials of grains and demonstrate their corporate social responsibility.

Purpose	**Regulation**
Yes / No	Not yet. But, could do if there is "market failure" and industry doesn't respond to policy signals.

- Regulations are not proposed at present, but may be considered if alterative measures fail to stimulate a desired response within the industry.
- "Pollution reduction" legislation often includes regulations. In agriculture it could be to ban stubble burning or fallowing; or to institute an accounting (carbon budget) and reporting scheme.

Purpose	**Policy Development**
Yes / No	Yes.

- The industry must better understand and be able to quantify greenhouse emissions (confident estimates based on scientific evidence) in order to contribute to policy debates.
- Accounting must consider whole systems (all inputs and outputs – not just carbon and not just the cropping phase of mixed farming); and recognize it is dealing with biological systems and cycles.
- Soil organic carbon can be used as an indicator of soil health and production capacity. It is a link between greenhouse and production issues.

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Workshop 2. Sequestration

Can grain farmers sequester more carbon?

YES, the Australian grains industry could sequester more carbon, **BUT**;

- The prospects are limited by rainfall (there is more scope in higher rainfall zones - above 500mm in temperate climates and 700mm in subtropical zones),
- The prospects are better in degraded soils and gains taper away as "healthier" levels are reached (ie, there could be perverse outcomes from carbon credits whereby "poor" farmers benefit most),
- Gains in soil carbon can be lost (eg through erosion or cultivation),
- There can be net system "losses" in terms of CO_2 equivalents, even though soil carbon is increasing (eg increased N_2O emission through the use of fertilizers or increased CH_4 emissions from increased livestock numbers), and
- There may be questions about what is "additional" to expected standard practice.

Grower's willingness to be involved in any carbon trading or off-sets scheme will depend upon;

- The specific rules of the scheme (eg exposure to financial loss if carbon stores decrease, the method to be adopted for accounting or any auditing, and the length of commitment required),
- The price paid for any carbon credits (which will be determined across the whole economy), and
- The cost of sequestering additional carbon (eg additional inputs to grow more dry matter).

Carbon sequestration needs to be considered in context;

- Improved levels of soil organic carbon tend to be associated with production benefits and good farm management - soil organic carbon makes sense in its own right, and
- If the goal of carbon sequestration is to combat the greenhouse effect then a whole-system perspective is needed – including consideration of N_2O (nitrous oxide) and CH_4 (methane) emissions.

Carbon credits should be considered like FlyBuys Points; a nice bonus but don't go shopping just to get them.

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Workshop 3. Accounting Methods

How could carbon (greenhouse) accounting work?

Different accounting methods could be applied for different purposes.

- There will be trade-offs between the cost of accounting, the accuracy of accounting/verification and the purpose for which the accounting is being undertaken.
- The level of benefit to growers (eg the price paid for carbon credits in off-sets) will influence their willingness to pay for accounting. The price they receive will be influenced by the certainty and permanence (duration) they can offer to investors.
- Accounting could be undertaken at a farm, regional or industry level.
- Australian accounting methods should be consistent with equivalent international schemes.
- The "point of obligation" – the farm, "downstream" or "upstream" – will influence the accounting method used.

Alternative methods involving farmers range through;

- Farm gate obligations to present a budget of net emissions (all debits and credits, as CO_2 equivalents) including inputs (such as fuel and fertiliser) and outputs (eg grain yields and stock sales),
- Farm gate obligations to present information on the amount of carbon sequestered,
- Farm gate estimates of net emissions or carbon sequestration via a greenhouse gas calculator, incorporating landuse, inputs and outputs, and management practices,
- Farm gate information on land use (eg crop, pasture or trees) and farm management practices (with evidence based correlation to net emission or sequestration information) at a point in time,
- Regional or industry estimates via a stratified random sample and the use of a greenhouse gas calculator,
- Regional or industry reports based on information from the Grains Practices Data-Base fed into a greenhouse gas calculator,
- Regional or industry surveys of land use and farm management practices, or reports via the Grains Practices Data-Base; either with or without spot-check verification inspections.

Farmers should be encouraged to reduce greenhouse gas emissions – perhaps even adopting a goal of being "carbon neutral". However, many farmers may not be able to generate "carbon credits" to sell, and hence (depending on the rules of the scheme) could lose in an emissions trading scheme. Some farmers will have potential to sequester additional carbon and may wish to participate in selling offsets credits (or holding them for their own possible future use).

Any carbon / emissions scheme can have thresholds (eg as does GST reporting or the National Greenhouse Emissions and Reporting Act; NGERs). There could be scope for "opt-in" clauses as well.

A review of the accounting methods and carbon trading options available to farmers could be useful (eg akin to a "Choice" review). However, the rate of change in these topics is such that it could be out-of-date very quickly and the uncertainties involved could make assessment contentious if it did more than present basic summaries.

CARBON ACCOUNTING WORKSHOP NOTES

Workshop 4. Recommendations

What should the grains industry do regarding carbon?

Research & Development

Carbon Metrics:
- Agree on protocols for measuring and analysis; and on common terminology.
- Generate Australian data on greenhouse emissions (sources and sinks), that is compatible with the National Carbon Accounting System (NCAS) and greenhouse gas accounting tools; to provide better estimates of net greenhouse contributions from farming under Australian conditions.
- Undertake sensitivity analysis and make assessments in a "life cycle" context – looking at the full implications of landuse and management practices; pre and post the farm-gate.

Carbon Accounting:
- "Pilot" the application of different accounting frameworks (eg Chicago Climate Exchange) and assess their operation through variable seasons and management.

Carbon Benefits:
- Quantify the relationship between organic carbon and productivity.
- Confirm and promote the benefits of good "carbon-smart" management practices. Promote a message that farming is part of the solution.

Resilient Farming Systems:
- Develop resilient, carbon-neutral mixed farming options. Incorporate learnings from organic production, design options that are profitable with higher cost inputs, and ensure systems are resilient through drought.

Coordination & Collaboration:
- Develop strategic research collaborations to focus scarce research resources upon critical research questions. Consider public / private partnerships and engage the Australian Government – possibly via the Climate Change Research Strategy for Primary Industries (CCRSPI).

Policy

"Green Paper" Response:
- Prepare a submission in response to the Carbon Pollution Reduction Scheme Green Paper. Circulate a draft through industry networks and present a mixed-farming perspective – preferably in collaboration with related commodities (and possibly via CCRSPI). Consider the full gamut of issues and broad economic aspects as well as detail such as threshold levels.

Communication

Carbon Stories:
- Develop clear messages for growers and the industry regarding carbon and greenhouse emissions. Develop consensus on the underlying science, translate that into clear messages and promote them to growers and industry leaders. Deal with topics such as the limitations to sequestration through grains farming.

Group Responses

Workshop 1. Purpose : Group Ideas – Possible Accounting Needs

For emissions trading?

At present, under the CPRS Green Paper, agriculture will not have to formally account for carbon or greenhouse gas emissions. However, in the longer term (after 2015), it may have to (whether it wants to or not). The industry has time to "get this right" and avoid a "political tsunami".

The degree of certainty required in accounting depends on whether it is for a voluntary or regulatory market. Individual farmers may want to be involved in a voluntary scheme akin to the Chicago Climate Futures market.

Accounting could be at the individual farm level or at the industry level – providing information and benchmarks for emissions per tonne of food produced.

For marketing?

It is critical for the industry to be seen to be doing something to reduce greenhouse gas emissions. Supporting farmers wanting to be part of a voluntary (off-sets) scheme would be a good start. A voluntary scheme would not need to be as stringent as a regulated one for emissions trading, but could provide some clues on how a regulatory system might operate.

Some individuals may find commercial benefit in involvement now, and it could provide some product differentiation. Markets in developed countries (eg Europe) may increasingly want information of this nature – there could even be exclusion unless produce is supported by an Environmental Management System.

To meet regulatory requirements?

If Governments don't see progress within industry to mitigate greenhouse emissions, then regulations could be imposed.

Any regulations may be on management practices (eg to force no-till sowing or prohibit stubble burning) because other aspects are too technically difficult to estimate – the emphasis may be on "compliance" than on "accounting". An alternative approach could be to require every farmer (or farms above a threshold size) to lodge an annual carbon budget, including N_2O emissions.

For other purposes?

The grains industry may not want to account for carbon but doing so could help in two ways.

- Environmental Credentials. Voluntary accounting will help show that producers are aware and active (environmentally sound producers) in enhancing food production landscapes; and help populate models. Leadership will also give more confidence to those within the industry.
- Overall Performance. Farming is the management of biological systems and cycles. There are soil health and production benefits to be had from higher soil organic carbon levels; as well as addressing climate change.

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Workshop 2. Sequestration : Group Ideas - Options

Can grain farmers sequester more carbon?

YES. There are lots of ways that grain farmers could sequester more carbon; but they should assess the benefit:cost ratio and prioritize options first. In doing so, they should take a broad view of "carbon neutrality", looking at the whole system (not just soil and carbon) and including all consequences of change – on-farm and off-farm (eg sustainable energy into the grid). Some options to consider for benefit:cost analysis are;

Sequestration Options – their pros and cons.

Increase Productivity.

+ Increase biomass and maximize residue use efficiency, WUE and nutrient use efficiency – and increase potential profit. Increase cropping frequency to increase profit. Increase soil biomass.
− However, it can increase risk and losses. (Query – what impact do pulses have on soil carbon?)

Tillage. No-Till, Minimum Till, Stubble Retention.

+ Increases farm resilience and flexibility. Improves soil health and reduces run-off and erosion. Improves soil water holding capacity and bulk density. Lowers tractor hours and fuel (carbon) consumption. Better timeliness of operation. Avoids losses/pollution from burning stubble.
− Relies on chemical weed control, and still with navigation and stubble (biomass) management issues. Requires high capital investment and a changed mind-set for changed management. Not conducive to high yields in all soil types and climates.

Precision Agriculture.

+ Sows the right things in the right places. More efficient and a better understanding of how to reduce inputs.
− Capital costs to convert – and the soil carbon benefits are uncertain.

Perennial Pasture Phase. Mixed Farming System.

+ Diversified range of farming income and well understood practices (lots of information available). Possible reduction in synthetic N fertilizers via legume pasture rotations. Increases below-ground biomass (sequesters carbon); increases yield; while reducing erosion and stabilizing fragile soils. Capitalizes on out-of-season rainfall and controls salinity.
− Opportunity cost (stock versus grains) and overall cost of production. Need to understand market variability of different commodities to optimize profit. Reduced productivity in first season and reduced management options. Increased total fertilizer input, increased soil acidity and increased greenhouse gas emissions from fertilizers and livestock. Rotation strategies and species selections are not fully understood in terms of their carbon sequestration opportunities.

Perennial (Pasture) Cropping Systems.

+ Sowing winter cereals into perennial grasses will theoretically increase carbon. Suits a holistic system motivation.
− Grains yields compromised and may not be offset by increased grazing productivity.

Soil Amendments.

+ Lifts productivity through the addition of nutrients and correction of acidity and sodicity.
− Costs of amendments and application; and can be difficult to apportion the contribution to marginal benefits.

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Bio-Char.

+ A long term carbon credit (100 years). Soil conditioner and nutrients benefits.
− Uncertain total energy costs and life cycle analysis benefits – if the source material was going to landfill its good but there is no overall gain if its just moving inert carbon; and negative impacts if the original sources (trees) are not regrown. Reduced fertility.

Other Soil Amendment Ideas;

- Silica – not just good yield but also long term carbon fractions. Residue quality, eg sorghum with higher lignin content. Persistence.
- Add other forms of carbon (eg lucerne pellets) at depth.
- Green manuring to increase biomass to soil.

Modified Plant Ideas:

- GM plants with higher lignin components. Sequester carbon for longer – but management issues with high stubble loads; seeding, germination etc.
- Higher root: shoot ratios. Roots buried in soil but carbon benefits may need to off-set production losses. Lower Harvest Index (grain weight: plant weight) with some reward. Better root architecture. Assume lower losses of carbon below ground than above.

Trees / Agroforestry.

+ Woody biomass and greater root growth takes carbon deeper into the soil. Can maintain / sequester carbon for 100 years. Higher water use efficiency / salinity mitigation, and biodiversity gains as well. Could have IPM benefits and be wind-breaks.
− Legacy of having to store carbon in perpetuity. Could be less profitable than other uses of the land.

Waste Management.

+ Recycling feedlot waste etc as composts and manures. Longer lasting form of carbon. Cheaper source of nutrients – and avoids pollution.
− Transport issues (higher net costs in $ and carbon) if not from local sources. May have stock management issues – disease transmission, with-holding periods. Manure versus straw in soils (?).

Second Generation Biofuels.

+ Producing biofuel from plant residues (using enzymes to free sugars from cellulose and lignin for conversion to ethanol) is more energy efficient in a life-cycle context and doesn't require a trade-off between food production and fuel production.
− Converting stubbles and other residues or wastes to ethanol reduces the carbon returned to the soil.

North Australia Option.

+ Change land use from poor production grazing to irrigated cropping for net gain. Drain wetlands to reduce methane (CH_4) and N_2O.
− Increase transport costs and exposure to diverse pests. Ecosystem and wetland impacts.

Invest Overseas.

+ Increase production in Australia and buy carbon credits in the Amazon, Sumatra etc.
− Doesn't increase soil organic carbon in Australia and relies upon involvement in an international carbon trading system.

Workshop 3. Accounting Methods : Group Ideas

Context.

It shouldn't be forgotten that carbon accounting and emissions trading is due to the fundamental driver of trying to reduce greenhouse gas emissions – and reduce climate change. Promoting practice change should not be forgotten in pursuit of carbon accounting for profit.

Tiers of accounting systems could be used for different purposes. Each will need to meet certain criteria;

- All should be compatible with equivalent international (or other national) schemes.
- Each one needs to be subjected to a benefit:cost analysis – is the cost of getting the required information outweighed by the benefit, eg the value of CO_2 equivalents? NB, there will be trade-offs between cost and accuracy – the aim is to provide sufficient information to have influence. The accounting rigour will be determined by the value of the carbon.
- There needs to be clarity about the "point of obligation" – credits or debits should be applied to those entities who have influence over their production.

The degree of certainty (or accuracy / confidence) available ranges from;

- Information on landuse and farm management practices (either with or without audits or back-up surveys),
- Calculators or models (with information ranging from landuse, management practices, inputs (including fuel, fertilizers and electricity) and outputs, soil types and climate), and
- Supporting Measurement (eg surveys of soil organic carbon levels or field trial data on emissions).

Information can be generated at the farm, region or industry level. The accuracy will vary depending on the value (price paid) of the carbon (or the impact of regulations, or consequences of having net emissions) and the "quality" of the carbon – eg form of carbon, additionality and permanence.

Scientific evidence is needed to verify the net emissions / sequestration associated with any "recommended management practices". It (and calculators or models) will be needed to support any accounting (as discussed above), to inform and assist farmers seeking to become "carbon-neutral", and for industry promotion or input to policy debates.

The scientific evidence must also be sound in the way it consolidates and averages information, given the diversity that is likely to occur across farming systems and environments. Nutrient cycling within biological systems is markedly different and more variable than emissions from a controlled manufacturing process and that fact should not be overlooked.

Given the complexity, uncertainty and rapidly changing nature of carbon policy, farmers are likely to want a range of options for how they may engage – from basic or industry level through to high quality individual commercial arrangements.

Voluntary Off-Sets for Marketing

The amount of carbon stored will be the issue for firms wanting to promote their "carbon credentials". Confirmation that accredited practices are being used may meet the requirements – subject to complying with the guidelines of the ACCC (eg, additionality, permanence and quality). Individual contracts (or long term covenants for lifetime payments) between farmers and the benefiting company could legitimize the arrangement, or be via a third-party or group scheme.

Voluntary Off-Sets / Trading Scheme

The amount of carbon stored is the main issue. Calculators or budgets could be used, applying inputs and outputs information and/or be based on yield and management practices. If soil carbon is involved, alternative technical means of generating information on the level of soil organic carbon could be considered, eg rapid in-field surveys using MIR (mid-infrared) applications or NIR (near-infrared) in conjunction with soil moisture probes or penetrometers.

Compliance with "accredited practices" may also suffice – although a level of auditing would probably be required (along with the science to support the "accreditation" of the practices). (A "Choice" magazine styled review of schemes and their pitfalls and advantages could be useful to producers.)

Industry Information – Input to Policy, Regional Group Trading or BMP Benchmarking

Analyzing information on weather, land use (eg revegetation), farming systems, management practices and inputs and outputs via a calculator or model would generate information on carbon sequestration and net greenhouse emissions. The information could come from the Grains Practices Data-Base or from surveying a stratified random sample of farms.

It could be supplemented with information on economics, on-farm gains (eg P/N, soil structure, water infiltration and water holding, and soil microbes), and environmental management (eg area revegetated, and stream lengths fenced).

Remote sensing (penetrating below the soil surface) could be an alternative means of generating information on soil carbon levels, and landuse and management, at a regional scale.

Emissions Trading Scheme – "Downstream" Point of Obligation

This may require less information than a farm-gate point of obligation. Information on the management practices adopted may be sufficient.

Emissions Trading Scheme – Farm-gate Point of Obligation

This purpose could require a full net greenhouse emissions approach – a comprehensive credit / debit account of N_2O, CH_4 and Carbon. Information on management practices alone would be insufficient – but ideally it would be linked in to provide feedback to producers on how they could improve their "balance sheet".

Workshop 4. Recommendations : Group Lists – Top Priority Actions

Research & Development

Think outside the square. What haven't we thought of yet?

Carbon Metrics:

- Ensure all sinks and sources of GHG emissions for the grains industry have been identified and then conduct sensitivity analyses to determine how important it is to get correct emission factor values.
- Develop Australian based estimates of GHG emissions and the capacity to accumulate carbon in the soil, in the main grain growing regions.
- Robust, farm level measurements of the carbon cycle across the entire industry. More science confidence.
- Calibration of existing "tools" to ensure uniformity across the nation.

Carbon Accounting:

- Test the Chicago Climate Exchange approach by developing carbon zones within Australia.
- Go into voluntary emissions trading (ala Chicago Climate Exchange) – but need Australian carbon estimates and research into carbon accounting.
- Information platforms to underpin trading initiatives and encourage market responses.
- An integrated forecast and monitoring system; soil type models / matrix and practice-type comparisons of their potential to sequester carbon.

Carbon Benefits:

- Confirm the management practices that favour carbon accretion in the soil. Vigorously promote these practices with the aim of increasing adoption.
- Basic science on carbon and CO_2-equivalent processes in mixed/grains systems. The associated positive and negative changes eg higher Soil Organic Matter giving improved hydrology but increased Nitrate leaching.

Resilient Farming Systems:

- Economic analysis of current and new management options – whole farm system analysis.
- A resilient farming system to respond in a carbon economy – its not just grains.
- More Life Cycle Assessments (LCA) to identify the strengths and weaknesses of different farming systems (using standardized measurements).

Coordination & Collaboration:

- Facilitate integration in the scientific community. There may be more than one hub, but have consistent approaches and terminology, capture of information and link with other networks.

Policy

"Green Paper" Response:

- GRDC to respond to the Green Paper – eg regarding the "point of obligation".
- Be in a position to influence the 2013 decision regarding agriculture's involvement in the Carbon Pollution Reduction Scheme and emissions trading. Needs a business model to explain things to the politicians (it's not up to the scientists).

Communication

Carbon Stories:

- Synthesize existing knowledge regarding soil carbon and communicate it to industry (eg the potential for sequestration).

Appendix 1. Individual Recommendations – Priority Actions

Research & Development

Carbon Metrics:

- Build accurate estimates for soil carbon levels for an ETS.
- Use the five year window to get the science good enough.
- Develop capacity in LCA. Contribute to the Aus LCI project to develop life cycle database (Developing Agreed LCA Methodologies – RIRDC?). Use LCA information to determine where the major opportunities for emissions reductions lie.
- Do LCAs for N_2O, CO_2 and CH_4.
- Incorporate LCA analysis in all investigations of C sequestration recommendations.
- Ensure all sinks and sources of greenhouse gas emissions have been identified for grains and then; conduct sensitivity analysis to determine how important it is to get correct EF values or carbon sequestration rates – then use LCA if they vary regionally.
- Conduct LCA scenarios to assess whether proposed ETS for agriculture are suitable for the grains industry.
- Life cycle. Improved understanding of the impacts of grains on GHG emissions and sequestration opportunities.
- LCA of common agriculture practices; benchmark regions.
- Develop whole farm GHG emissions modeling capacity.
- Australian situation data on N_2O emissions.
- Quantify C storage potential in soils in different farming zones, by time, by input (tonnes of biomass) and output of farm, and by practice.
- Validate the RothC Soil Carbon Model (for NCAS) into environments where model runs predict upper limit below actual soil measures.
- Need R&D in carbon accounting for management practices zones; and landuse change (pasture, agroforestry) – may be based on soil type.
- Validate CO_2 equivalent increases in different agro-ecological zones with different changes in practice.
- Establish base-line data via a series of focus farms across Australia (for practices etc).
- Provide greater validation of model outputs under local conditions and current farming practices; eg national farmer paired site study.
- Clear measurement tools for soil type, rainfall zone and farming system. Need to define areas where ETS may become viable for farmers.
- Robust Australian data for greenhouse gas emissions from grain production by major growing regions.
- Comprehensive carbon budget and balance sheet for a range of grains based farms.
- C budgets and balance sheets – break practices down to C costs.
- Organisation of “C storage and loss” in agro-ecosystem context.
- Invest in basic science to establish ground rules / baselines / enable effective future management. Areas needed; rainfall limited potential, soil texture, carbon fractions, functionality.
- R&D to understand C turnover in soils – biomass inputs, pools, factors affecting increases and losses, eg water and nutrients.
- Develop C monitoring network across industry.
- R&D for measurement to improve estimates.
- Practical on-ground sampling under newer management regimes to establish soil C changes.
- Ensure industry uses a common data framework and language.
- Simple to understand calculators.
- Use simple C models which are farmer friendly.
- Need more science before having confidence that participating in a market will be beneficial.
- Best bet R&D – that which is needed whatever happens.

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Carbon Accounting:

- Calculate the likely C storage capacity left in soils (landuse change scenarios) and target those areas and growers for inclusion in voluntary trading schemes.
- Combine the outcomes of LCA (to find emission reduction options) with economic analysis to determine appropriate policy response. ie, does it make sense, considering emissions mitigation potential and costs of participation, for agriculture to be included in ETS?
- Voluntary emissions trading – similar to Chicago Climate Exchange (CCX).
- Develop CCX voluntary C scheme in Australia.
- Investigate the US system (CCX) and build an Australian version, using the best of US and Australian models.
- Support development of a voluntary market. Needs research data and models; development of standards / rules; concepts for market mechanisms.
- Revisit N recommendations for full accounting approach.
- Oversee simple accounting methods.
- Assess methods for quickly measuring / auditing C.
- Make sure LCA and GHG emissions calculators are consistent with national inventory data – the basis for ETS values.
- Use Peter Grace's calculators, Jeff Baldock's work, and what is known about practices, soil carbon effects and emissions reduction; to develop best-bet emission factors and soil C factors suitable for use in a future trading scheme.
- Use the Grains Practices DataBase for analysis, based on the science and policy.
- Emissions Intensity Benchmarks. CO_2 equivalents produced per tonne of wheat, barley, lentils etc. Compare with other farmers, regions and nations. Need to produce more food with a low carbon footprint, including getting to market / consumer. Justify our production efficiency and be rewarded – or we will charge! Compare wheat, rice, milk and meat.
- Build market confidence in trading carbon.
- Carbon price will have an enormous impact on the level and detail of accounting used.
- Research the potential impacts of alternative ETS models.
- Economic analysis of potential returns for carbon sequestration versus carbon price.
- Economic analysis based on variable carbon pricing. At what point do alternative strategies become viable?
- Information platforms to underpin trading initiatives and encourage market responses as appropriate.

Carbon Benefits:

- Identify practices for farmers to maximize credits.
- Clarify potential benefits, by location etc, of bio-char (it's the long term C store).
- Cost:Benefit on C sequestration. What's the real value of C?
- More C data. Insufficient information regarding on-farm C change – especially no-till response.
- Linkages between agricultural practices and C sequestration; permanence and additionality.
- Promote the most effective practices to potentially increase the rate of C accretion in soil. Eg improve WUE and hence fixation of C and biomass production / increase C inputs to soil; include legumes for rotational benefits and additional N to allow more Soil Organic Carbon to be stably stored.
- Advise growers of the options (especially win/win) and value of good practice with a view to be prepared for opportunities and obligations. Consider mixed grain / grazing systems.
- Support the identification of best management practices / accredited practices.
- Feet on the ground economic case study at farm level. Truth and better understanding = more confidence to change practice. Good science truth.
- Understand the full range of sequestration options and mitigation and off-set options; and the relative cost breakpoints for each.
- Value of Organic Matter in the production system. Value of practice change.
- Role of organic matter in soil productivity.

- Carbon sequestration potential of soils and crops. Recognition of regions with higher sequestration values.
- Improve our tools for measuring soil health – especially soil carbon. Every farmer says after shifting to "best practice" (no-till, stubble retention, crop husbandry, productive pastures) that soil improves after 5-7 years. But our current soil health tools do not measure this change. Need to fill this gap.
- Better quantify and promote the benefits from soil carbon to production and the environment.

Resilient Farming Systems:

- Innovation in farming systems to sequester carbon. Move on from 1980's solutions to building carbon.
- Grains industry R&D needed for sequestration, mitigation and adaptation; eg varietal development, GMOs etc.
- Plant breeding. Factors which determine more and more stable C in plants. Where do the roots of perennials go? Are the deeper roots more C stable?
- Look at which plant varieties are best at sequestering long term carbon and short term carbon fractions.
- Develop new strategies to manage nutrition, pests, diseases and weeds with less energy demanding inputs; eg reducing chemical use. Ecosystem services.
- Match sequestration options to soil / environmental constraints – eg perenniality in equi-seasonal rainfall zones.
- Root:Shoot Ratio; Harvest Index; perenniality, summer crops and weeds – competition for water in growing season.
- Continued investment in improving soil health and overcoming soil constraints on productivity.
- Develop resilient farming systems that can respond to a carbon economy.
- Continue adaptation work.

Coordination & Collaboration:

- Work via CCRSPI on wider agricultural R&D needs.
- Prioritize investments. Set up science and groups.
- Establish a RD&E Plan over the next 5 years to prepare the industry for the 2013 agriculture deadline. Qualification of practices / carbon footprints; extension of known information / long term campaign; R&D for either carbon sequestration or reduced emissions to aid in making farms more carbon neutral; easy to use farm calculators for grain producers.
- Consortium of Ag industries across all industries. Facilitate development of approaches for ETS that benefit agriculture. Understand Government policy and influence it.
- Work to include a whole-of-industry effort; scientists (CSIRO, Universities, State agencies), policy and farmer organizations, Govt.
- Integrate with other RDCs for a coordinated effort and ensure agricultural industries don't inadvertently undermine each other.
- Fill the leadership void and provide direction. Position the industry to make best use of its good "carbon credentials" – positive story.

Policy

"Green Paper" Response:

- Understand the impacts and implications of the Green Paper proposals for grains and mixed farms.
- Be involved in discussions on what potential regulation and auditing systems are developed.
- Domestic ETS needs to be flexible enough to allow and encourage farm-level practice change. All indications are Kyoto rules will steer legislation toward industry level generic outcomes. This will result in slower practice change and subsequent reduction of emissions.

- Have the option of agriculture either opting out, or being input taxed, if emissions are below a certain point.
- Respond to the Green Paper. Challenge the decision not to allow offsets in agriculture prior to coverage – a missed opportunity for a mitigation incentive. Potential for perverse incentive for landholders to delay (or even reverse) implementation of GHG friendly practices.
- More research on Kyoto Protocol 3.4 and "point of obligation".
- Ensure transparency of emission allocations. The emitter gets the cost and the storer the benefit.
- Ensure the carbon trading scheme is simple and accountable.
- Communicate with policy makers to ensure that science can confirm the parameters used.
- Build a united front for agriculture for sequestration practices.
- Ensure any ETS does not introduce perverse outcomes.
- Develop an "industry" approach and alternative to the Green Paper. Eg Agriculture to remain an "uncovered" sector, offsets allowed, development of a voluntary market approach.
- Work with agricultural industry to develop a framework for other incentives for mitigation. Requires research to fill gaps in existing GHG models, especially soil C change under practice / soil type / environment matrix.
- Link with other agricultural industries for a coordinated approach to Government.
- Risk of being taxed on large emissions to gain (smaller) credits.
- Respond to the Green Paper.
- Should not be involved in policy.

Communication

Carbon Stories:

- Ensure sufficient information is available such that each business can decide its actions for itself.
- Article from scientists to growers, to address the myths in the media. Lets stop the hype.
- Synthesize existing knowledge regarding soil C and communicate it to industry (eg potential for sequestration).
- Ensure Government awareness of the complexities and opportunities – so they're not overly influenced by less science-based "stories."
- Need education of graingrowers of the possibilities around carbon trading. Need "ground rules", eg; low rainfall, sandy soils are unlikely to "bank" carbon; high rainfall, clayey soils may be able to participate in a carbon market – if the system is managed right.
- Detail the risks of agriculture being included in CPRS. Actual carbon cycle in low rainfall, soil carbon cropping areas.
- Tiered communication to growers, NOW; starting at regional level. Clear messages to combat mis-information and ignorance – but also about the positive outcomes from C management outside of C trading.
- Provide informative but simple fact sheets for growers and advisers about the realities of sequestering carbon in terms of CO_2 equivalents – not $. Inform the industry so it can better argue its position regarding greenhouse gas emissions and environmental footprint.
- Myth-busting. Promote debate and share information with industry members.
- Promote confidence in soil carbon; ie very small changes in soil carbon over a large area has important benefits.
- Use positive language and present agriculture as a major part of the solution to global warming due to its direct influence on photosynthesis.
- Agriculture is the key to the solution in dealing with excess CO_2. It captures carbon via photosynthesis.
- Must include extension with the objective of maximizing BMP adoption.