Submission in response to Issues Paper 1
Climate Change: Land use - Agriculture and Forestry
Garnaut Climate Change Review

Submitted by

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Executive summary

Aims

1 To detail how the cell-grazing management system in agriculture has the potential to generate in the long-term, enhanced levels of soil carbon.

2 To outline how cell-grazing can be used to generate verifiable carbon credits, able to be included in an emissions trading scheme (ETS).

3 To outline how carbon credits generated from agriculture can offer the land owner an additional avenue of financial return.

4 To indicate why carbon credits arising from agriculture should be included in an ETS as soon as possible.

These aims address the following questions raised in the Issues Paper 1;

Section 3.2 Mitigation options for agriculture and forestry

- *What potential is there for mitigation in the agriculture sector in the short term? What practical options for mitigation are likely to become commercially viable in the near future?*
- *What are the opportunities available to the agriculture and forestry sectors as a result of mitigation policies?*

Section 3.3 Practical considerations for including agriculture and forestry in an emissions trading scheme

- *What systems are available that would allow for efficient and accurate monitoring of emissions at the operator level?*

3.4 Recognition of carbon sinks and offsets

- *What types of carbon sink and mitigation measures should be included as offsets or within an ETS? Are there practical and cost effective monitoring solutions available for these measures?*

Major points made in submission

Major points section 1

a) Cell-grazing is based on the practice of strategic short grazing periods to minimum specified plant height with high stock densities and long periods of rest that allow plants to recover.
b) Cell-grazing is a land management practice that enhances the SOC levels
c) A cell-grazing style management of grasslands has been estimated to increase soil C storage by 0.22%C/yr (~7.9 tonne C/ha/yr, ~ 29 tonne CO_2/ha/yr)

Major points section 2

a) Carbon Link Pty Ltd is set up to participate in the trading of carbon credits generated from agricultural practices.
b) The Carbon Link protocol is to be verified by an internationally recognised organisation, approved by the AGO.
c) In some States the ownership of soil carbon rights on Crown Land is unclear. A change in legislation is required to allow land owners in those states to take advantage of the agricultural ETS scheme.
d) The costs associated with the Carbon Link development project are extensive and a submission is to be made to the AGO for assistance in covering these.

Major points section 3

a) It would be beneficial to the uptake of the proposed agricultural ETS scheme if the management of soil analyses (including the database used for the NIR analysis) was transferred from the CSIRO to the AGO.
b) The net income potential from participation in an ETS scheme (based on an increase in SOC of 0.22%C/yr) increases from $13/ha/yr at year 1 to $800/ha/yr after 20 years.
c) The establishment of an agricultural based ETS scheme would significantly increase the awareness of land owners to the additional benefits of a more sustainable approach to land management.

Major points section 4

a) The inclusion of carbon credits arising from agricultural practices such as cell-grazing can be used to offset carbon emissions arising from other sectors of agriculture
b) Setting up an ETS system will be a benefit in a number of ways;
   i. It will act as a showcase for other land owners interested in converting to cell-grazing from less sustainable practices.
   ii. It will demonstrate to land owners that participation in the scheme has on going environmental benefits as well as indirect land productivity benefits
   iii. It will act as a stimulant to other sub sectors of agriculture to investigate ways that those sectors may possibly be included in an ETS an economically feasible scheme

Recommendations

1. **The development of an agricultural ETS scheme should be encouraged and promoted by the Federal government.**

2. **The AGO should be encouraged to take over the management of the analytical services that are required to obtain the necessary data used as input into the RothC model, to ensure the ETS scheme is economically viable in the long term.**

Table of Contents

CarbonLink

1 Cell-grazing is a sub-sector of agriculture which has the potential to generate, in the long term, enhanced levels of soil carbon

1.1 *Outline of cell-grazing*

Much of Australian agricultural is conducted using systems that cause loss of the soil organic carbon (SOC) (Lal 2002). These systems include “set stocking and short rest periods” for grazed paddocks and extensive tillage under cropping regimes.

Cell-grazing is based on the practice of strategic short grazing periods to minimum specified plant height, with high stock densities and long periods of rest that allow plants to recover. This approach maintains above ground biomass at a level that maximizes the root growth (Mapfumo *et al.,* 2002). This type of grazing practice may also be referred to as *planned, strategic, mob, management intensive or Techno-grazing*.

The major impetus for a land owner to set-up a cell-grazing regime is to increase the productivity of the land in a sustainable manner (Earl and Jones 1996, Kahn *et al.,* 2005). Additional indirect benefits of cell grazing include increasing the soil organic carbon (SOC) levels (Reeder and Schuman 2002), which often leads to improved water-holding capacity (Conant and Paustian 2002).

1.1.1 *Effect of cell-grazing on pasture characteristics*

The process of maintaining the vegetation cover between minimum and maximum levels, achieved by employing controlled grazing rates by stock, is used to maximize the growth and competitiveness of species palatable to stock (Earl and Jones 1996).

- A low stocking rate leads to patches of short and long pasture as a result of animals looking for the more palatable pasture plants and ignoring less palatable plants (due to species and age/digestibility) (Earl and Jones 1996). This leads to;
  - reduced light access above ground for the more palatable plants due to the dominance of the less palatable plants, and
  - reduced root structure of the more palatable plants in response to the selected over grazing (Richards 1993) and hence reduced nutrient access below ground
  - the overall height and abundance of the more palatable plants decreases with time as a deleterious cycle is set up from which the plant may not recover.
- A high stocking rate leads to all the plants in the pasture being evenly short and hence the plants have equally short roots (Mapfumo *et al*., 2002; Lodge and King 2006). As plants are killed by overgrazing, areas of bare ground begin to appear (Earl and Jones 1996) which can lead to;
  - Invasion by annual grasses which generally have shorter root systems (Hansen *et al.,* 2004; Bolinder *et al.,* 2002)..
  - Erosion of topsoil from wind and/or water action

- No grazing at all leads to high dense swards of largely dead material shading the green leaves in plants and the area around it. This may lead to (Reeder and Schuman 2002; McNaughton 1979);
    - The dead material not being tramped back onto the soil surface reducing the potential for it to be incorporated into the soil profile.
    - Less plant growth and an increase in the ratio of above/below grown biomass

1.1.2 *Effect of cell-grazing on soil organic carbon levels*

- As plants grow, the developing root biomass and organic components exuded by these roots, both contribute to enhancing the level of SOC.
- Perennial grasses tend to have deeper roots systems relative to that of annual grasses (Hansen *et al.,* 2004; Bolinder *et al.,* 2002).
- Additionally, the activity of the microbial biomass decreases with increase in soil depth, largely due to the increased concentrations of CO_2 (Fierer *et al.*, 2005; Potthof *et al.*, 2005).
- Hence, increasing the relative coverage of perennial grasses has the potential to significantly increase the total level of SOC at a specific time.

Conventional grazing management of grasslands has been estimated to increase soil C storage on rangelands from 0.1 to 0.3 tonne C /ha/year and new grasslands have been shown to store from 0.6 to 1 tonne C /ha/year (Post and Kwon 2000; Lal 2002). Cell-grazing management has the potential to significantly enhance that rate of C storage in soils.

1.2 *Land areas suitable for instigation of cell-grazing*

More than 75% of Australia is included in the area defined as rangelands: relatively undisturbed areas of land ranging from tropical savannas, woodlands, and shrublands to grasslands. (ANRA 2007). The climate in rangelands may vary from low rainfall, arid regions to semi-arid and seasonally high rainfall areas. Around 80% of the rangeland area (60 % Australian land) is presently used for grazing (ANRA 2001).

Rangelands (and hence grazing lands) are important to Australia in terms of carbon storage, and contribute to meeting Australia's international obligations for climate change and greenhouse gas emissions. (ANRA 2007).

A 10 year study in the arid rangelands of WA by Japanese scientists led by Prof Koichi Yamada of the University of Tokyo, has shown that arid regions do have carbon sequestration potential (Alchin, 2007). This result was given further credence in a report on a grazing property in the Western Australian Pilbara region where an increase of 0.51 tonne/ha in the top 10 cm of the soil was indicated over a 6 year period although some caution was expressed in the use of the results due to the limited nature of the trial (Wiley, 2007).

All but the most delicate of the ecosystems included in the area of defined rangelands would benefit from cell-grazing practices. Exceptions might include high alpine regions and deserts.

2 Potential of cell-grazing to generate verifiable carbon credits, able to be included in an emissions trading scheme (ETS).

2.1 *Overview of proposed agricultural ETS scheme*

2.1.1 *National and global acceptability requirements*

It is critical that in an ETS scheme, all carbon offsets are verified in a transparent manner to the highest standard. The Voluntary Carbon Standard (VCS) program provides an international framework for that to happen in a range of areas, including agriculture.

The VCS Program was set up in 2005, by The Climate Group, the International Emissions Trading Association and the World Economic Forum, to provide "*a robust, new global standard and program for approval of credible voluntary offsets"* and to *"Standardize and provide transparency and credibility to the voluntary offset market".*

The "Voluntary Carbon Standard – Guidance for Agriculture, Forestry and Other Land Use Projects", published in November 2007 (VCS Program 2007) provides guidance for soil carbon projects as well as other land uses. It is expected that this international standard will be operational in the first quarter of 2008.

Carbon Link Pty Ltd is a company set up to participate in the trading of verified carbon credits generated from agricultural practices. Carbon Link has been incorporated to act as an aggregator and broker of soil carbon credits, initially in Australian markets, and eventually in several international markets.

2.1.2 *Role of aggregators*

The major roles of aggregators in the ETS scheme are;

- To market to land owners, the benefits of soil carbon sequestration,
- To arrange legally binding contracts,
- To assure carbon is sequestered and maintained for the permanence period (70 to 100 yrs),
- To arrange for soils to be baselined and monitored by verified protocols,
- To aggregate groups of properties into projects that will then be verified by an internationally approved verifier, and
- To find markets for the resultant credits using recognised registries and trading platforms.

2.1.3 *Land owner contracts*

Once a selected area of land has been base-lined the land owner will be able to enter into a contract to trade the increased soil carbon in 10 year periods for a defined area. The land owner may do this again in 10 years time for the same land area if the level of SOC has further increased, and continue this process until the soil reaches its storage capacity for organic carbon. The carbon can be sold in vintages e.g. 2008, 2009, 2010 etc.

In some States the ownership of soil carbon rights on Crown Land is unclear. This particularly applies to Queensland, NSW and the Northern Territory. A change in legislation in those states is required to allow land owners, who make the change to agricultural practices which have a long term positive impact on the levels of SOC, to take advantage of the agricultural ETS scheme.

2.1.4 Inclusion of buffers to account for loss of soil carbon

The formation of projects is an internationally accepted practice for managing the verification process and for managing permanence risk. The VCS has a well developed protocol for managing permanence risk based on project buffer pools which can be accessed to cover losses, both measured and assumed.

2.2 Assessing the SOC in a project land area

2.2.1 Development of the protocol for SOC assessment

Organic carbon levels in most soils can be highly variable even across relatively short distances. In addition, even though average levels might be rising over time, annual fluctuations can occur due mainly to variation in climate.

With the assistance of a number of Australian soil scientists, soil surveyors and statisticians, Carbon Link has developed a sampling protocol designed to measure the total SOC in a specified area of land, taking into account short and long range spatial variability.

The protocol can be used to measure;

- The baseline state of a land area with respect to the level of SOC
- The acquisition of SOC in an on-going cell-grazing land area, for monitoring purposes
- The retrospective acquisition of SOC associated with an existing cell-grazing land area (using paired sites), in compliance with the *additionality* rules defined by the Kyoto Protocol (AGO 2007)

The protocol is rigorous and incorporates best-practice procedures;

- The major aspects of the methodology are based on procedures outlined in the National Carbon Accounting System (NCAS) Technical Reports (AGO 2000, 2002, 2003)
- The methodology has received favourable comments during informal discussions with CSIRO and State Government scientists.
- The protocol complies with the requirements for measuring soil carbon, outlined in the publication "Sourcebook for Land Use, Land Use Change and Forestry Projects" by Winrock International (Pearson 2005)

2.2.2 Estimating SOC in years intervening assessment years

The level of the SOC in a project area will be measured once every 5 years. Hence, there is a need to employ modelling in the intervening years to estimate the amount of carbon that is available for sale in those years. This will enable the land owner to obtain cash flow from the ETS scheme on an annual basis.

It is essential that the model used is internationally recognised as a reputable model The Australian Greenhouse Office (AGO) has selected the RothC model for this purpose.

2.2.3 *Adaption of the RothC model for cell-grazing style agricultural*

At present the RothC model has not been adapted to account for the soil carbon processes associated with agricultural practices in the style of cell-grazing. To address this issue, Carbon Link has undertaken to provide data to the Australian Greenhouse Office to calibrate the RothC Model for this purpose.

- Carbon Link has set up a development project in which a number of existing cell-grazing properties are to be assessed for retrospective carbon using the Carbon Link protocol.
- The data collected from this development project will be analysed according to the requirements of the AGO for input into the RothC model.

2.3 ***Verifiable carbon credits***

2.3.1 *Need for verification of carbon credits*

Discerning buyers demand high quality credits where they do not have to assess the quality on a product-by-product basis. Hence, the need for projects to be verified to a market recognized standard. This need is all the more apparent in the case of soil carbon. The VCS is highly likely to fulfil that role on an international scale.

The Carbon Link protocol is to be verified by an internationally recognised organisation. The following information will be submitted to the verifier;

- The Carbon Link protocol
- The data collected during the development project
- The output from the development project, which will include
  - The major characteristics of the project sites
  - The estimation of total level of the SOC accumulated as a result of cell-grazing
  - the statistical analysis of the SOC assessment
  - the input and output data associated with the adaptation of the RothC model

2.3.2 *Initial verification costs*

The verification costs include both the verifier’s project verification fee plus the soil sampling and monitoring costs leading up to the verification process. Since the verification of a soil carbon project has not yet been attempted in Australia the actual cost is unknown. At this stage the costs are estimated as follows;

- Verifier’s fee will be in the range of $30,000 to $50,000 per project.

- Assessment of a land area, $18 and $25 per hectare (average value).
- Soil analysis for calibration of the RothC model, $10+ per hectare
    - This cost is for the Near Infrared (NIR) analyses required to extend the calibration curves and provide data for verification of the RothC model

The costs associated with this development project are extensive and a submission is to be made to the AGO for assistance in covering these, as it is believed that the information obtained from the project will be useful to a range of groups including the AGO, scientists, other aggregators and land managers.

As stated above Carbon Link has undertaken to provide its data to the AGO as it is collected to ensure that the RothC model is able to account for the role that cell-grazing has to play in green house gas (GHG) mitigation. The cost of running the RothC model has not been included in the calculations.

2.3.3 *Ongoing verification costs*

Under the VCS standard, verification needs to occur every 5 years. This ongoing cost is not likely to be as onerous as the initial verification of a project. For example, the mapping will not need to be repeated and the site characteristics will already be known to the surveyors. However, the frequent sampling adds significantly to the cost of a project to the land owner over a 70 year period. Check sampling every 10 to 15 years, with monitoring by satellite images in the interim, would be more economically palatable.

3 Financial aspects of trading carbon credits generated from agriculture.

Once a contract, to be involved in the ETS scheme, has been signed by the land owner, the *carbon trading area*[1] proposed by the land owner is assessed. The costs associated with this will vary depending on the variability of the land area and whether retrospective carbon is to be included in the assessment. Please note that at this stage the costs are approximations only. Soil mapping and GPS data is collected as part of the process.

In addition, the carbon trading area is reassessed for SOC every 5 years as part of the monitoring program for the ETS scheme. The costs for these reassessments will be lower than the initial baselining costs, as much of the original mapping and GPS work will not need to be repeated.

In measuring soil carbon, all other energetic costs must also be counted. In a cell grazing system, external energy costs such as fuel for mechanised seeding are generally reduced. However methane production may increase if stocking rate is increased. On the other hand, even methane is reduced if stocking rates do not increase.

- Methane production is a function of feed quality. The higher the feed quality, the lower the methane emissions will be from livestock.
- Research in the US (DeRamus *et al*., 2003) has shown that average methane emissions are reduced by 22% in a cell grazing system compared to a continuously grazed system. This reduction is due to an improvement in diet quality caused by the movement of stock onto fresh feed on a regular basis.
- This research demonstrated a significant reduction in methane production per kg of beef produced under a cell grazing system

3.1 *Financial costs to the land owner*

- Setup costs
  - SOC baseline assessment $18-$25* /ha
  - If retrospective carbon is required then an additional cost of approximately $10/ha would apply
- Ongoing costs
  - SOC monitoring program assessment *$18-$25 /ha every 5 years

These costs are expected to reduce over time as new technologies such as in-field automated sampling and analysis are commercialised.

* A significant proportion of these assessment costs relate to analysis of the soil samples carried out by CSIRO Land and Water in Urrbrae, SA;

- the analysis of soil samples using the ^{13}C- Nuclear Magnetic Resonance (C-NMR) to determine the charcoal content of the soil,

[1] *Carbon trading area* -A defined area that is sampled with the objective of determining the carbon content for a defined area.

- the analysis of soil samples using Near Infrared Spectroscopy (NIR)

There is some concern with the inferred need to use these facilities of the CSIRO for the purposes of gaining the necessary soil data for input into the RothC model;

- the CSIRO have a requirement that their services are offered on a commercial basis
- That service may not exist in the long term.

Hence, it would be beneficial to the uptake of the proposed agricultural ETS scheme if the management of these analyses (including the database used for the NIR analysis) was transferred to the AGO. In this way there is the possibility that the costs of the analysis could be significantly reduced (increasing the potential for growth of the ETS scheme), and the availability of the service would be more assured in the long term.

3.2 *Financial Returns to the landowner*

The factor that most affects the returns of the land owner is the amount of carbon sequestered. While anecdotal stories abound about increases that have been achieved by cell-graziers across Australia, initial research by Carbon Link indicates that a conservative estimate of the increase achieved by good practitioners is approximately 0.22 % C/ha/yr..

Using an increase of 0.42%C/yr in soil organic carbon in the top 10 cms and an increase of 0.12%C/yr in the next 20 cms Carbon Link's financial modeling suggests the following returns to a grazier after costs (all data is in today's dollars).

Table 1 Yearly net income potential from participation in an ETS scheme based on an increase in SOC of 0.22%/yr.

$/ha	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yrs 10-20	Yrs 20-30
Yearly	$13	$32	$35	$45	$57	$31	$90	$100	$100	$100	$62	$810	$668
Cum[v] yrs	$13	$46	$80	$126	$183	$214	$304	$403	$503	$603	$665	$1,475	$2,143

These returns provide considerable incentive for land owners to make a fundamental shift in the manner in which they manage their land. The total amount of carbon dioxide sequestered under the abovementioned scenario (assuming the bulk density is 1.2 g/cm) is approximately 29 tonne CO_2/ha/yr, or 870 tonne CO_2/ha over 30 years.

3.3 *Indirect returns*

3.3.1 *Improved productivity*

Earl and Kahn (2006) reported in their workshop notes accompanying their course "Pasture & Grazing Management on the Northern Tablelands", that the annual dry matter production on 6 New England properties showed approximate variations of;

- 4 tonne/ha to 7.8 tonne/ha in 2000
- 3.8 tonne/ha to 6.5 tonne/ha in 2001
- 6.0 tonne/ha to 10.1 tonne/ha in 2003

The range from year to year represents seasonal conditions while the range within years is largely a reflection of grazing management practices with cell-grazing practitioners at the upper end of each range.

A land manager at Guyra, NSW, reported that he increased his pasture growth rate by 36% and the stocking rate by 47% under Techno-Grazing (a cell grazing variant) (Kahn *et al*., 2005).

Many cell graziers report a decrease in input costs especially in relation to animal health (parasite management) and feed supplementation bills during drought. It is not uncommon for cell graziers not to have fed stock during the recent drought while their neighbours who used set stocking denuded their equity.

The establishment of an agricultural based ETS scheme would significantly increase the awareness of land owners to the additional benefits of a more sustainable approach to land management.

4 Reasons for immediate inclusion of carbon credits arising from agriculture to be included in an ETS.

4.1 Potential reduction in national carbon emissions

Grazing lands are estimated to contain 10–30% of the world's soil organic carbon. In Australia the area of land that is suitable for grazing is approximately 470 million ha (ABS 2007), which is 60% of the total land area.

The amount of carbon in soils typically used for grazing can vary from 0.1 to 5% C with around 44% of the area containing between 1-2% C in the soil (ANRA 2001). Given the size of the C pool associated grazing lands, even a small loss of carbon as a result of over- or under-grazing equates to large losses of carbon from the soil. Enhanced land management practices such as cell-grazing have the potential to reverse this loss of C from the soil, and in addition, significantly increase the level of SOC over vast areas of land.

The inclusion of carbon credits arising from agricultural practices such as cell-grazing can be used to offset carbon emissions such as those arising from other sectors of agriculture

In excess of 6,000 Australian graziers have been trained in cell-grazing management practices. These graziers now have the knowledge to manage their land holdings in a way that would allow them to generate increased levels of SOC associated with their land, and so participate in an agricultural ETS scheme.

It is estimated that approximately 75% of the graziers trained in cell-grazing management practices, have yet to implement the system into the management regime on their properties. The initialization of an agricultural ETS scheme would provide a strong incentive for these graziers to make the change to cell grazing as there would be additional financial benefits in doing so, gained from trading the newly sequestered SOC in their soils.

4.2 Increase in economic viability of agriculture in some localities

The additional income that may be derived by the land owner as a result of selling carbon credits will vary largely with climate from region to region, and over time due to fluctuations in the market price of carbon and the five yearly monitoring costs. Table 1, in section 3.2 above outlines what is considered possible for much of temperate Australia based on preliminary soil sampling.

Over one 10 year sequestration period in temperate Australia the return may be of the order of $600/ha. If we assume an average land holding size of 500ha and 60% of Australia's total holdings of some 130,000 units lie in this then the total additional income able to be derived as a result of cell-grazing in this area over the first 10 year sequestration period could be of the order of $23.4 billion or $2.34 billion per year. The CO2 sequestered in this example on the 39 million hectares is approximately 716 million tonnes over 10 years or

71.6 millions tonnes per year. For the whole of Australia the total is much higher when other climatic regions are included.

4.3 *Provide a showcase of the feasibility of an agriculturally based ETS*

Setting up an ETS system will be a benefit as it will;

- act as a showcase for other land owners interested in converting to cell-grazing from less sustainable practices. E.g. set-stocking or slow rotations.
- demonstrate to land owners that participation in the scheme has on going environmental benefits as well as indirect land productivity benefits
- confirm the costs and returns involved to interested participants
- assist in streamlining and debugging the process of participation in the ETS by land owners
- act as a stimulant to other sub sectors of agriculture to investigate ways that those sectors may possibly be included in an ETS an economically feasible scheme

Some of the other sub-sectors that have the potential to sell carbon credits are:

- *Pasture-cropping* is the land management practice of sowing crops using minimum or no tillage into existing pastures
- Intensive cropping practices that include the addition of large amounts of organic inputs such as cover crops, manures, composts and bio-chars.
- Irrigated pastures
- Municipal parks and gardens

5 Summary

5.1 *Major points section 1*

a) Cell-grazing is based on the practice of strategic short grazing periods to minimum specified plant height with high stock densities and long periods of rest that allow plants to recover.

b) Cell-grazing is a land management practice that enhances the SOC levels

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5.5 *Recommendations*

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2. The AGO should be encouraged to take over the management of the analytical services that are required to obtain the necessary data used as input into the RothC model, to ensure the ETS scheme is economically viable in the long term.

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