Inquiry into soil carbon sequestration in Victoria
Submission no. 33

Gecko CLaN Pasture Cropping Project

Submission to Victorian Parliamentary Enquiry by the Environment & Natural Resources Committee into Soil Carbon Sequestration

Introduction

The Broken Catchment Landcare Network Inc (trading as the Gecko CLaN) represents 23 Landcare groups. We were successful with obtaining Caring for Our Country funding to undertake an investigation into the suitability of pasture cropping (PC) in our area in 2008, and again in 2010. We have found local landholders very receptive to learning about the technique, probably because seasons have been extraordinarily difficult and any technique that enables grazing and cropping to continue, with lower establishment costs and input costs, is very appealing. There is also a realisation that paddocks don't have to be bare and dry over summer, and that there are many species of native and introduced grasses that are summer-active (those with the 'C4' photosynthetic pathway).

Pasture cropping provides a rationale and a framework for moving back to a lower-input approach to agriculture that deals with the paddock and the soil as an ecosystem, rather than a factory.

In conversation with a member of the Committee and the Executive Officer, we have been asked to discuss the following points:

- the pasture cropping technique;
- transitioning to pasture cropping from 'conventional' farming, including any associated costs;
- the benefits of pasture cropping including increased levels of soil carbon storage;
- outcomes from the Pasture Cropping Project trials, particularly in relation to soil carbon content; and
- how the Victorian Government could promote soil carbon sequestration as well as the role of Landcare and CMAs.

The Pasture Cropping technique

Pasture Cropping was evolved by Colin Seis & Darryl Cluff in the 1990s, after a fire had burnt through much of their properties (near Gulgong NSW), leaving them searching for a successful but low-input approach to their farm management.

They define pasture cropping as:

A land management technique that mimics the functions of native grasslands, where perennial and annual species grow symbiotically and each benefit from the other. Pasture Cropping involves:

- *zero tilling crops into perennial pastures, which can be native or introduced, and summer or winter active*
- *pastures can be suppressed but not killed*
- *crops can be managed with or without herbicides or fertiliser*
- *grazing is controlled, with long rest intervals between grazings*
- *soils are kept covered (100% ground cover 100% of the time)*
- *weeds are controlled using plant competition, litter and selective herbicides*
- *diversity in pastures is encouraged, so that various grasses can respond to rains at different times of the year; this makes for a very resilient enterprise*

Pasture cropping involves direct sowing into leaf litter i.e there is no ploughing of paddocks; the only disturbance is with the fine-tipped tynes of the seed drill. Litter, grasses and stubble pass through the drill – for this reason crops are often sown at a wider interval between rows (~30-40 cm). Heavy grazing prior to sowing assists in reducing and trampling existing vegetation so that it can pass through the tynes. Perennial grasses are valued, even if they are only scattered through the paddock – hence the advice *Don't kill what you've already got [by cultivation or herbicides].* Because there is no cultivation of the paddock, zero till crops are slower to develop, and are often sown earlier than usually recommended (including sowing 'dry' before any autumn rains have arrived).

Maintaining green, actively growing plants on the site enables the soil microbiota to be constantly active, increasing root growth, improving soil structure and thereby increasing soil water holding capacity. This is the mechanism by which pasture cropping can increase soil carbon sequestration.

Transitioning to Pasture cropping from conventional farming

Issues relating to transition differ, depending upon whether the farm business is principally a cropping business or principally a grazing business.
100% Cropping businesses may achieve less total yields, and may not obtain the supplementary revenue of extra grazing immediately after harvest. Paddocks will look 'messier', with the perception that there are 'weeds' growing in amongst the crop. In cropping, any other plant is generally regarded as (negative) competition, even though there is evidence that the other species enhance the growth of the cereal crop. Also, sowing into paddocks that have not been burnt, brings issues of 'trash' snagging underneath the seed drill.

Grazing businesses generally seem to be more willing to introduce PC into their farming practice. The main change for these farmers is that, rather than periodically 'renovating' a

paddock by cultivating it and re-sowing the pasture, this process is done incrementally, without killing all of the plants that are there already, and without cultivation.
Generally, most farmers find that they need to modify or replace their seed drill to be able to cope with the additional paddock 'trash' of grasses, weeds, stubble and litter. New drills start at $30-40K. Adaptation or modification of existing equipment costs in the order of $5-10K.
All farming systems moving to zero tillage will reduce the number of passes of the paddock so diesel costs and labour costs are reduced.

The Benefits of PC including increased levels of soil C storage

Pasture Cropping promotes diverse perennial pastures, which rely more on natural competition processes to control weeds and non-desirable pests (such as red-legged earth mites) rather than herbicides and insecticides. As explained by Christine Jones, it is this decrease in herbicides and use of manufactured fertilisers that allows soil mycorrhizae and fungi to really get active, and these allow increased root penetration that can take soil C down to a deeper level where it becomes less vulnerable to emission.
In one year, from Dec 2008 to Nov 2009, Table 1 shows that our two best trial sites went from 2.12% to 2.26% Carbon in the 0-10cm horizon (Ellis), and 2.33% to 2.64% (James). These equate to 7.7t CO2/ha/yr sequestered and 17.1 t CO2/ha/yr sequestered respectively in the 0-10cm horizon. If it is assumed that similar rates of increase occur up to 30cm depth, these figures increase to 23.1 tCO2/ha/yr sequestered and 51.2 t CO2/ha/yr sequestered.

Table 1. of changes in soil C percentage (%) at trial sites (from p.35 of the Pasture Cropping booklet)

ANALYSIS	R 1 DORE	VINEYARD HILL NEARSIDE ELLIS	BORE FALCONER	SMITH'S No 1 JAMES	KANGAROO MITCHELL	No 1 WOOD
Organic Carbon (Dec 08)	2.74	2.12	2.69	2.33	1.69	2.93
Organic Carbon (Dec 09)	2.75	2.26	2.53	2.64	2.01	2.87

We recognise that soils would approach an equilibrium i.e. these rates of sequestration would not be repeated in perpetuity, but the protection and enhancement of perennial grasses in the landscape has the potential to dramatically affect carbon sequestration in the next 20 years – a critical period for the world's climate, when other low carbon emission technologies are being implemented.

In terms of soil carbon sequestration, the results from the trials have been mixed (Table 1). This is to be expected as there was no rigorous intervention in farmers' normal practices and every season and almost every paddock is different. However, over a period of a few years we expect that all paddocks can start to increase their soil carbon levels.

Outcomes of the PC Trials

Attendence at Pasture cropping courses and field days has been outstanding. Numbers attending are listed in Tables 2 & 3. Creating a process where farmers have the opportunity to regularly speak with other farmers is crucial, and leads to both knowledge exchange and equipment exchange. You can't predict when groups will 'click', but you can provide resources for them to come together.

Within our group there is increasing recognition of the advantages of mixed farming systems as opposed to grazing/wool/grain alone; but capital costs and substantial extra knowledge are involved in each element of a mixed business.

As mentioned earlier, Pasture Cropping is providing a rationale for farmers to adopt a low (or lower) input approach to their farming, and providing ways to be able to manage the farm with 100% ground cover, 100% of the time.

Table 2. Attendence at Pasture Cropping Courses

LOCATION	DATE	ATTENDENCE
1. Bungeet	March 2008	25
2. Warrenbayne	2008	15
3. Thoona	April 2008	11
4. Euroa	April 2010	20

Table 3. Attendence at Presentations and Excursions relating to pasture cropping.

EVENT	LOCATION	DATE	ATTENDENCE
1. PC Presentation	Benalla	July 2008	41
2. Presentation PC & Native Grasses	Benalla	August 2008	~40
3. Bus Trip to Colin Seis property	Gulgong	October 2008	33

4. Visit to Ko-Warra grasses	Kerang	February 2009	8
5. Field day with Trial & Course participants	Thoona	February 2009	~20
6. Field Day – Grazing and Soil Health	Bungeet	March 2009	~25
7. Presentation by Christine Jones & Colin Seis	Thoona	November 2009	81
8. Field Day PC & Equipment	Goomalibee	February 2010	80

The current Pasture Cropping trial project is looking in more detail at how we can best operate to increase production and refine our approach to PC, which will in turn increase soil carbon levels. The design of the experiment is summarised in Tables 4 & 5.

Table 4. Questions to be addressed in the current Gecko CLaN Pasture Cropping trials.

Question	What will be measured?	When? How often?
a) PERENNIAL NATIVE GRASSES Does co-sowing of C4's in winter achieve the same survival as spring sowing of summer active perennials? Does grazing /trampling improve recruitment of perennial native species?	Species count /m2 Of these summer-active C4 species only. Use point-to-plant sampling to estimate density.	Initial measurement, then at 12 months. Measure survival in late summer or Autumn 2011.
b) GRAZING MANAGEMENT Does grazing improve recruitment of perennial species?	t/ha of crop t/ha of dry matter & est. of grazed mass Number and type of stock grazing Duration of grazing [Feed cuts]	Initial measurement, then approx. 6 monthly - prior to harvest - prior to sowing -prior to grazing
c) INCREASING GROUND COVER Does grazing increase Soil Carbon relative to the ungrazed site (assuming 100% ground cover, 100% time on both?)	% ground cover #/m2 of crop # /m2 of perennial grasses Standard soil test 0-10 cm % Soil carbon at 0-10, 10-20 and 20-30 cm depth	Monthly 3 months after sowing Initial measurement then at 12 months Annual Annual
d) PADDOCK BIODIVERSITY What measures change in soil biota with addition of summer active species? Does 'active' depth of soil change (sampled to 300 mm depth)?	Soil food web test – 0-10cm	Annual Quarterly shovel test - colour / worms / etc
e) PRODUCTIVITY What are relative returns from the	Fertiliser $/ha	Annual

different treatments in yield, dollars and water use efficiency?	Seed $/ha Sowing & maintenance $/ha Yield (kg/ha) (Not Animal productivity) Rainfall (mm)	Annual Annual Annual and before grazing Daily

Table 5. Paddock design of current Pasture Cropping trials.

GRAZED	Autumn crop plus C4s sown together (Mar-Apr sowing)	Autumn crop (Mar-Apr sowing) cut for hay then a Summer crop and C4 sown (Oct-Nov sowing)	Summer crop plus C4 natives (Sep-Oct sowing)	CONTROL Pasture only
UNGRAZED	As above	As above	As above	As above

How the Victorian Government could promote carbon sequestration as well as the role of landcare and CMAs

Landcare

- Landcare is a trusted 'brand' that is seen to be without vested interest. However, the 'infrastructure' is dangerously close to collapse with volunteer fatigue, lack of career development pathways for staff and uncertain funding year after year. We note with appreciation the efforts of the Goulburn Broken CMA in attempting to preserve Landcare positions in this climate.

Research

- There are fundamental changes occurring in our understanding of soil development and soil ecosystems. In particular the operation of symbiotic relationships between specific fungi, bacteria and grass species, and the contribution that hydraulic redistribution (water taken down into the soil, not just up to the leaves) are areas with enormous ramifications for the management of grasslands. Processes that restore or emulate native grassland ecosystems are only just being identified and developed.

- Understanding the pros and cons of various types of agricultural activities (cultivation, burning, types of fertilisers, liming, establishment of perennials) badly needs some unbiassed and authoritative sources of information.

- It is crucial that a partnership approach to research is adopted, with a landholder majority for the governance of this research.

- Regionally based research teams can greatly assist in ensuring that researchers are accessible to the farming community. DPI Rutherglen is a logical candidate, with laboratory facilities to undertake testing.

Incentives & the CPRS

- Garnaut report recognises the low intensity, low cost contribution that a technique such as PC can make to permanent C sequestration, as opposed to woody biomass sequestration. Most farmers probably still don't aspire to increase the carbon level reported in their soil test – this needs to change.
- One policy approach may be to conduct a soil census with carbon measurement at different depths in the soil horizon (suggestion of 0-10, 10-30, 30-60 cm level) with bulk density testing at each depth.
- It may be possible to identify a minimum soil carbon percentage for broad soil types. Any storage of carbon above this level could then become eligible for a tax rebate.
- An alternative approach may be to include measures of soil carbon in measures of environmental management that entitle landholders to rate rebates in some shires.

David Dore

Chair, Pasture Cropping Committee

19th April 2010