Regenerative Landscape Management Practises to achieve increased sustainable production

Soils for Life Field Day 21st November 2012

A presentation by Greg Chappell

Shannon Vale Station, Glen Innes NSW

GLENRAC
Glen Innes Natural Resources Advisory Committee

CARING FOR OUR COUNTRY

SoilsForLife
AN OUTCOMES AUSTRALIA PROJECT

Where are we?

- *Shannon Vale Station – 12kms ENE of Glen Innes on the Mann River.*
- *Rainfall - 900mm*
- *Soil - grey loam, granite based with some basalt to granite transitional soils.*
- *Pasture – natives, naturalised and improved.*

What is it We Have Set Out to Achieve – Our Goal.

To work more closely with the biological components of the soil and establish long term sustainable pastures capable of:-

- *Growing our heifers to achieve individual live weights of 330kg @ joining – 14months. Continue growing those heifers to achieve liveweights of 460kg @ 2yr old.*
- *Providing sufficient pasture based nutrition to ensure pregnancy rates of 96% plus amongst the cows.*
- *Growing the Angus Sale bulls at 1kg/day – birth to sale @ 2yrs.*

Background comments – The Preceding Years

When we arrived at Shannon Vale from Moree in 2001 we were confronted with the same dilemma as any grazing enterprise when changing geographical regions. Many questions needed addressing such as –

- *What species/combination of species are currently being grown in the district to achieve performance production?*
- *Are the native and naturalised species capable of, with help from fertilizers and legume seed, supporting the cow herd?*
- *What are the "weed" problems and how are they best addressed?*
- *Are there any cash crops suited to the property that can contribute additional income and/or provide valuable winter feed e.g. stubble hay?*

Following a reasonable amount of investigation we embarked on a program of –

- *High performance pasture production to grow the young heifers and bulls*
- *Fertilizing the native and naturalised country with single super for the cows*
- *Spraying weeds with everything from Round Up to Simazine. In 2007 we were applying 2.5 litres of Round Up per hectares and spraying out paddocks as many as three times prior to sowing.*
- *Burning and ploughing out African Love Grass. Interestingly the African Love Grass came back stronger than ever.*

- *Growing cash crops such as corn, millet soy beans and seed oats. The Dolicos lab lab did manage to provide us with the equivalent of 100 units of Nitrogen which has been beneficial in helping establish a permanent perennial pasture of fescue, prairie grass, plantain, red, white and arrow leaf clover.*

The sandy loams simply aren't naturally fertile enough to enable the growth of crops such as corn, millet etc and the numerous cultivations needed to establish a seedbed destroy soil structure and organic matter/soil carbon content (See Appendix table).

Removing valuable organic matter in the form of stubble hays is also extremely degrading to structure. While reading through our diaries in preparing this paper I did come across an interesting comment regarding corn on 7th December 2001 "Not a great fan of the corn, too much fertilizer, too much chemical and too much bare ground".

We didn't grow anymore corn but we did persist with a high performance pasture concept for another six years – see notes for the case studies for Rusden & McMaster regarding the number of workings and sprays to establish 12-18 months of production. I guess you would have to conclude we are slow learners.

Change Needed to Achieve Goals.

In 2007 we became frustrated by the failure of the traditional methods.

- *Cultivation becoming expensive and had resulted in degradation of soil structure through loss of organic matter.*
- *Cultivation also resulted in compaction and erosion.*
- *Synthetic granulated fertilisers were increasing in cost and because of the prolonged drought the benefit from these inputs was questionable.*
- *We started becoming aware that chemicals used 'to spray out' were destroying micro flora/fauna.*
- *The mono culture with annuals particularly rye was adding to the problems of bare exposed soil. The bare ground provided the perfect environment for low order plants to multiply.*

So in October 2007 with our first application of Solid Start Compost from Bruce Picone at Tallawanta Moree we commenced our 'revised approach' aimed at improving the soil to promote better pasture growth to achieve our animal production goals. Bart Davidson from Moree was extremely helpful in mapping our program. Bart continues as our Consulting Agronomist.

The Shannon Vale Methodology

By the Autumn of 2008 we'd become convinced of the positives of the first application of the Compost and so set about devising our biological approach to promote pasture growth.

This approach can be summarised as follows:-

1. *No cultivation – some pasture renovation using direct drill machines with no chemical spray. Cultivation destroys S.O.C % and organic matter content.*
2. *No herbicides.*
3. *Apply compost at 300kg/ha.*

The exclusion of cultivation and herbicide did result in the explosive growth of many 'undesirable' low order plant species. Most would call these undesirable species weeds, their performance being greatly enhanced by the addition of compost at 300kg/ha. We didn't have a problem with these undesirables e.g. Windmill grass, Red grass, Wheat grass, Sorrel, Rats tail fescue and African Love grass. They've become a valuable resource.

How?

- *They've indicated the fact that our soils aren't healthy.*
- *They've become a source of nutrients for re-cycling. The undesirables tap root bringing many of the micro-nutrients to the surface e.g. zinc and boron etc. If conditions are right and the saprophytes are active they digest this plant material releasing the nutrients into the root zone of the more favourable grasses.*
- *The succession indicates to us the change in soil fertility. For example once we see the species such as Prairie grass, Yorkshire Fog etc. appearing we then know it is time to start applying our preferred perennials e.g. Cocksfoot, Fescue the herbs e.g. Plantain and the legumes e.g. Red and White clover.*
- *When we apply the Compost we will almost always include additional soil nutrients e.g. Gypsum, Boron, Zinc, Magnesium and Copper. Seed is also included to either bolster existing stands or introduce diversity.*

Remember that compost is not manure or rotting vegetable material. Compost is a stable product and is defined as 'The process whereby Organic Materials (in our case, straw, feedlot manure, rock phosphate) are microbiologically transformed under aerobic conditions for a period of not less than six weeks which includes a 'pasteurisation phase' (Australian Standard 4454 (2003)).

In an effort to hasten the decay of these lower order plants and so improve the base soil fertility we have now commenced applying Compost Extract. This extract contains populations of first order saprophytes. Included in the mix with the extract are products such

as Calpac and Easy-N. These aren't applied just as plant feeds but rather as feeds for microbial decomposition as well microbes as well. Our goal is to re-build that A horizon through increasing the organic matter decay - re-building the soil.

4. *Promote Dung Beetle activity – cycle the nutrients.*
5. *Restrict use of chemicals – drenches.*
6. *Promote animal impact.* ⎫ *Grazing Management*
7. *Maintain ground cover.* ⎭
8. *Mulch to cycle the carbon. This mulched material provides the substrate for the Fungi in the Compost and the Extract to convert stubble to organic matter. Must use a mulcher not a slasher don't leave thatch in windrows must get even distribution of thatch. Where possible mulch 2 – 3 days prior to removing stock as the animal impact helps get thatch in contact with ground surface.*

Case Study Paddock – Rusden ~ 35ha

During the 1950's and 1960's Rusden was used to grow potatoes and corn. N.B. The soil isn't strong enough for either crop. During the 1970's, 80's, 90's and up to 2007 is was cropped (Oats and Rye) and grazed. Granulated synthetic fertilisers used to promote oats and rye.

Overview of program for pasture establishment in 2007

Date	***Treatment***
28 January	*2.5 litres/ha of Round Up Power Max*
20 February	*Multi disc plough*
13 March	*Compost application, ground spread*
14 March	*Scarified*
15 March	*Paddock rolled using tyre roller*
17 March	*Seed spread, 20kg/ha Sungrazer T rye grass, 0.75kg.ha New Zealand white and hafia clover*
17 & 18 March	*Harrowed*

The result from the above treatment was oh so disappointing. No measurable output to graze. In October 2007 we started using Solid Start Compost with Boron and Zinc at the rate of 300kg/ha. The vegetative response was interesting; lots of Rats tail Fescue, Sorrel, Cud weed and Wheat grass. Virtually no Love grass grew. We applied Compost in April 2008 and again in October 2008. With the October 2008 application we included Gypsum at the rate of 200kg/ha.

In October 2009 we again applied Solid Start plus Gypsum and with it 9kg of Greenly Cocksfoot, 4kg Festival Fescue, 1.5kg/ha Trophy White Clover and 1kg/ha Plantain.

In early October 2010 we applied Solid Start at 300kg/ha and started to see some White clover and the odd Fescue plant. Again in October 2011 we applied Solid Start at 300kg/ha and during the summer of 2011/2012 the paddock was covered in Trophy and Haifa Whit clover. The Greenly Fescue came up very prolifically in rows as it had been broadcast. Interestingly the seed is lighter than the compost so there is about 2 metres of gap between the rows.

During the Spring of 2011 we couldn't find any Sorrel and there was hardly any evidence of the Rats tail fescue. Why? The soil had become healthy enough to support the higher order plants and these higher order plants have out-competed the so called weeds. Plants such as Sorrel and Rats tail in particular tell us our pH and Calcium levels in the soil are too low to support the types of plants we need to get the 1kg/day gain.

It did take 3 years from seed application to achieve a worthwhile establishment and it took 2 years (Oct 07 to Oct 09) of compost application prior to us feeling confident enough to attempt seeding with fescue, cocksfoot, plantain and clover. However we were able to achieve 90% ground cover and were able to use the paddock to AI cows from during 2008, 2009 and 2010. The paddock is now in our rotation program.

Case Study Paddock – McMaster 1 ~ 33ha, McMaster 2 ~ 32ha

Pasture Establishment 2007

Date	***Treatment***
13 & 14 September	*Cultivated*
19-21 September	*Multi disc ploughed*
7-9 September	*Scarified*
20-21 September	*Sprayed 2.5 litres Round Up Power Max*
7 November	*Ground spread 600kg/ha compost*
10 November	*Seed spread Winfred rape 2kg/ha, Crusader rye 8.5kg/ha, Arrow leaf clover 2kg/ha, Plantain 1.5kg/ha with 100kg/ha of single super and 30kg/ha of Muriate of Potash*
11 November	*Paddock rolled*

Consider the organic matter loss from these four workings. In addition to the loss of soil biology brought about by both the high rate of herbicide and the fact that there was no stubble/thatch for the favourable soil microbes to live on while the soil is the fallow state.

Treatments since starting our new approach

Date	***Treatment***
11 October2008	*300kg/ha compost*
18 May 2009	*20 litres/ha CALPAC*
9 October 2009	*300kg/ha compost*

At the beginning of Spring 2009 it was obvious that the Rye & Arrow leaf clover had run their race. During the Winter of 2010 we fed 116hd cross bred weaner bulls from 5th May to the 1st September their corn silage supplement in this paddock. The intention was to bash the rubbish so we could seed the paddock without having to spray it.

On the 2nd September we direct drilled the following pasture mix – Greenly cocksfoot 12kg/ha, Astred red clover 2.5kg/ha, Trophy white clover 2.0kg/ha, Haifa white clover 1.0kg/ha.

Soil tests revealed calcium, sulphur, zinc and boron were still very much limiting factors. We sought out the following brew which was applied in liquid form on the 16th December 2010.

Ingredient	***kg/ha***	***Trace Ingredients***	***kg/ha***
Super fine lime	*50*	*Super fine Zinc*	*8*
Super fine dolomite	*80*	*Super fine boron*	*4*
Super fine sulphur	*10*	*Super fine Copper*	*2*
		Cobalt	*60 grams/ha*

A mycorrhiza stimulant to promote nitrogen fixation was included in this mixture at the rate of 1.5 litres/ha. During April & May 2011 the McMaster paddock was subdivided into two paddocks of 32 and 33 hectares respectively. The frontage to the Mann River was fenced out and a reticulated water system installed. This subdivision has greatly enhanced our ability to manage grazing and our ability to fully utilise the improved response.

In its first season of grazing the McMaster aggregation produced the following outcomes.

McMaster 1 ~ 33ha	***McMaster 2 ~ 32ha***
100 days grazing by the bulls	*94 days grazing*
110 days rest	*106 days rest*
6774 grazing days	*5993 grazing days*

On the 22nd October 2012 liquid lime was applied plus the liquid formulation as listed above at the same rates.

Case Study Paddock – Middle Gully 1 ~ 40ha

The African Love Grass on Black Gully, a 445ha block located 4km east- south east of the homestead block, was extremely well established upon our arrival in 2001. We did receive plenty of advice as to how to control this expansive low digestible grass. We did attempt to control it in Colonels (the paddock to the immediate south) by-

1. *Burning,*
2. *Cultivating/harrowing it four times*
3. *Seeding*

The result was very disappointing; the love grass out-competed the improved species. We simply did not have the funds (thankfully) to cultivate Middle Gully. As a result we decided to top dress it with single super (2002-03); SF45 (2004-2006) and guano in 2007.

In the Autumn/Winter of 2002-2004 we ran 150 dry cows on the block with Prolix. The result was encouraging; the cows did knock down much of the love grass allowing light through to the ground surface. During the late Autumn/Winter of 2005-2007 we ran our weaner bulls in the paddock with Prolix.

The grazing pressure was reducing the love grass monoculture, we started to see sorrel, cud weed etc indicating a lack of calcium prompting the guano application in Spring of 2007. Accompanying the emergence of the lower order weeds was the arrival of, albeit a couple years later in the Spring of 2006, some white clover.

The following succession occurred-

Spring 2007	*The white clover was prolific*
Spring 2008	*In addition to the white clover we also noticed some fescue*
Spring 2009	*The fescue was very dominant and it seeded prolifically. We invited David Miller out for an inspection. David was surprised; he'd jokingly been telling us we'd never grow fescue on this second grade sand pit. To Dave's credit he went back to his office sorted through his records and discovered in March 1996 he had sold the previous owners, Snaith's Triumph Fescue, NZ White clover and Haifa white clover.*

Snaith's had reported little or no sign of establishment. What had happened to promote the establishment of the more desirable fescue and clover? The addition of the fertilizer, the impact of the cattle and the great result achieved by the dung beetles in burying the dung

created a favourable germination, emergence and establishment environment for our preferred grasses and legumes.

The Prolix is a great tool in improving the digestibility of these lowly digestible fibrous plants as a result the dung is much softer and so able to be properly buried by the dung beetles. These less desirable species are as a result being cycled and so are helping to rebuild our soil.

The treatments applied to Middle Gully since we commenced our new approach:-

Date	***Treatment per hectare***
11 Oct 2009	*300kg compost*
6 Oct 2009	*300kg compost + 200kg gypsum to 1/3 of the paddock;*
	300kg compost + 200kg gypsum + 6kg zinc + 7kg boron to 1/3;
	300kg compost only to the remaining 1/3 of the paddock
14 Oct 2010	*Paddock mulched*
29 Oct 2010	*Paddock subdivided into 3 paddocks, new paddocks sizes are 40, 40 and 20 hectares respectively*
16 Nov 2011	*300kg compost*
16 & 17 Nov 2011	*Paddock mulched*
23 Nov 2011	*16 litres CALPAC, 12 litres UAN /ha applied*
24 Sept 2012	*300kg compost + 200kg gypsum*

In October 2010 Bart Davidson and Rohan Berecry conducted a trial to compare production, digestibility, ME and protein contents of the three treatments outlined in the 2009 applications to Middle Gully. Bart will discuss the results. We are conscious of the fact that there is more to growing grass than purely dry matter production. Quality is hugely important to achieve the goals we must achieve.

Many would argue it's been a slow process reducing this love grass domination. That may be true. However, during the process we have maintained ground cover; we have provided dry cow type nutrition and have commenced the process of rebuilding the soil.

There is no doubt in our mind that had we have started with the mulcher in 2001 we would have hastened the process. The mulching is a great tool, it recycles nutrients, it provides the basis for additional organic matter breakdown that in turn strengthens the structure and fertility of the A horizon of the soil profile.

APPENDIX

Monitoring is an important component of our process. It has been strongly endorsed by our consultant agronomist, Bart Davidson. Every Autumn since 2008 we have taken soil samples from 11 monitoring sites. Each Spring we take plant sap samples from 6 sites and in Autumn leaf tissue analysis.

The results of the soil and plant tissue analysis are presented below. Please feel free to discuss these results with Bart.

SOIL FERTILITY AND FEED QUALITY ON THE IMPROVE

Year	*Nitrate Nitrogen mg/kg*	*Colwell P mg/kg*	*K mg/kg*	*S mg/kg*	*Ca mg/kg*	*pH range*	*Organic Matter %*	*S.O.C %*
2002- 06	*14.7*	*31*	*100*	*8.6*	*312*	*4.70 - 5.30*	*2.2*	*1.00*
2008	*3.3*	*34.5*	*73*	*6.2*	*248*	*5.10 – 5.70*	*2.3*	*1.46*
2011	*6.9*	*32.2*	*73*	*9.1*	*318*	*5.85 – 6.43*	*2.3*	*1.44*
2012	*7.6*	*40*	*133*	*14.7*	*415*	*5.84 – 7.16*	*2.6*	*1.47*

Points to Note

- *The 2002 -2006 data an average from 5 sites.*
- *The 2008 data an average from 8 sites*
- *The 2011 and 2012 an average from 11 sites.*
- *Nitrate Nitrogen high during the period we refer to as our hydroponic era (2002 -2006) due to urea applications. We also used Dolichos Lab Lab and Soya Beans in rotation – Lab Lab is a high nitrogen fixation plant.*
- *Soil Organic Carbon low due to cultivation, it is on the improve as we cycle decaying plant material. The loam structure with low C.E.C makes it difficult for us to rebuild and store carbon.*
- *Phosphorus levels have increased from 34.5ppm (2008) to 40ppm (2012) with no addition of single super phosphate.*

Plant Tissue Analysis

Year	*Nitrogen%*		*Phosphorus%*		*Potassium%*		*Sulphur%*		*Calcium%*	
	Av.	*Target*	*Av.*	*Target*	*Av.*	*Target*	*Av.*	*Target*	*Av.*	*Target*
2011	*3.7*	*4.7*	*0.34*	*0.43*	*2.40*	*4.0*	*0.24*	*0.38*	*0.99*	*0.85*
2012	*3.8*	*4.7*	*0.36*	*0.43*	*2.91*	*4.0*	*0.22*	*0.38*	*0.85*	*0.85*

Points to Note

- *The data for both years averaged across six sites.*
- *The sites comprised pastures consisting of Cocksfoot, Fescue, ryes (volunteer) clovers, Prairie grass, Plantain, Yorkshire Fog.*
- *The Calcium levels given the low C.E.C. of the sandy loams are very encouraging.*

In Closing

The most frequently asked question of us regarding this methodology has been "How much does it cost"? Some observers have been quick to point out that because of the bull stud enterprise the funds are available to innovate. Our response is quite categorical, the approach we have adopted has saved us in the order of 30 to 35% when compared to high performance, high input regimes. These funds are systematically re-invested into fencing and water distribution which is helping our grazing management and improving stocking rates.

Notes