



# INNOVATIONS FOR REGENERATIVE LANDSCAPE MANAGEMENT

## Case Studies of Regenerative Landscape Management in Practice





CARING  
FOR  
OUR  
COUNTRY



### ***Innovations for Regenerative Landscape Management***

*Case studies of regenerative land management in practice*

A Soils for Life Report

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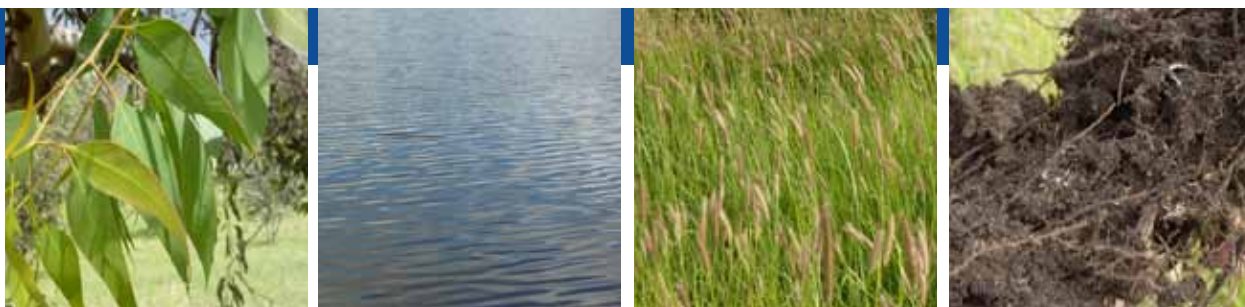
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## Foreword

It is clear to me that the challenges we face in dealing with land degradation, a changing climate, food and water security, energy demands and the needs of increasing populations are unprecedented. With a diminishing global natural resource base, including some estimates of only about 50 years of top soils remaining and with severe aquifer depletion in China, India, Africa and the Middle East, it seems obvious that we can't continue to mismanage the landscape as we have done.

It is well documented that the environment in Australia is also under increasing stress from human activity and will suffer further from the effects of climate change. Agriculture, which relies on nature for managed output is also under stress. Despite good practices of many of our land managers and farmers linked to some good science, the realities of an increasingly arid and degraded landscape with severe salinity and erosion, diminishing river flows, high evaporation rates, decreasing availability of groundwater, declining soil health and rising input costs for fuel and non organic fertilisers, will impact significantly not only on the productivity and viability of agricultural enterprises, but also on the health of our environment and the well being of every Australian.

Change is required now.

The good news is that solutions do exist in Australia. In my travels I have seen wonderful examples of individuals regenerating the landscape through various 'innovative' practices. Through good soil and water management, they shine like beacons as stunning examples of what can be, and to my mind, must be done to meet the challenges of the future. But, for all sorts of reasons, their work in successfully managing the paddock is not being widely adopted nor quickly enough.

The *Soils for Life* Program intends to give these leaders a strong, persistent voice, to show us all the compelling advantages of adopting proven high performance in landscape management. This document is the beginning of our work to encourage change in how the Australian landscape can be regenerated and enhanced to realise sustainable productivity, with consequent social, environmental and global benefits.

Our initial set of case studies cover a range of regions and land use types across Australia, developed as independent and objective evaluations. They are written to tell a story in sufficient detail of how our landscape management leaders have made the change to sustainable, triple bottom line practices. Whilst common themes are recognisable throughout their stories, each of them is different and provides a range of ideas that the next generation of early adopters can embrace.

This is a first but critically important step.

At the strategic level, we must support the example of land management leaders, with sound national policy, incentives and research, to ensure that Australia can play a leading role in providing these solutions both regionally and globally. A national, integrated mechanism appropriately supported and managed at the highest political level, must be established to facilitate the required cooperation between national, state and regional authorities.

To save the planet we must save the soils and there is not much time to do it.

**Michael Jeffery** AC AO(Mil) CVO MC  
Major General (Retd)  
Chairman, Soils for Life  
September 2012







# Contents

<b>Foreword</b>	3
ACKNOWLEDGEMENTS	6
ABOUT SOILS FOR LIFE	7
<b>1. LANDSCAPE REGENERATION FOR OUR FUTURE</b>	9
THE NEED FOR CHANGE	9
KEY PROCESS DRIVERS FOR LANDSCAPE REGENERATION	12
LEADING CHANGE	17
<b>2. LANDSCAPE REGENERATION IN ACTION</b>	19
SOIL	20
WATER	25
SUPPORTING BIODIVERSITY	34
WEED REDUCTION	34
REDUCED INPUTS	35
PRODUCTION AND ECONOMICS	36
MAKING THE CHANGE TO REGENERATIVE LANDSCAPE MANAGEMENT PRACTICES	39
COORDINATED SUPPORT	40
PRINCIPLES FOR REGENERATIVE LANDSCAPE MANAGEMENT	41
RECOMMENDATIONS	43
<b>3. CASE STUDIES OF LANDSCAPE REGENERATION IN PRACTICE</b>	45
1. <i>Dukes Plain, QLD</i> - Delivering continuous improvement of the farming resource	48
2. <i>Bokhara Plains, NSW</i> - Reaching the real potential of the NSW rangelands	60
3. <i>Shannon Vale Station, NSW</i> - Weed control without herbicide is not a load of bull	68
4. <i>Beetaloo Station, NT</i> - First add water	76
5. <i>Three Rivers Station, WA</i> - Restoring the Gascoyne rangeland – commitment, cooperation and hard work	84
6. <i>Clover Estate, SA</i> - Turning sand into fertile soil with applied soil science	96
7. <i>Jillamatong, NSW</i> - Don't measure success by the size of your herd	102
8. <i>Gunninggrah, NSW</i> - Shifting mindset from animals to the land	112
9. <i>Lana, NSW</i> - Partnering farm animals to regenerate the land	120
10. <i>Tallawang, NSW</i> - Productive greener pastures through restoring landscape hydrology	128
11. <i>Talaheni, NSW</i> - Reducing dryland salinity and achieving resilience by design	136
12. <i>Winona, NSW</i> - Pasture cropping the way to health	144
13. <i>Milgadara, NSW</i> - Putting life back into the soil - humus compost	152
14. <i>Inveraray Downs, NSW</i> - Higher quality food through regenerated soils and reduced inputs	160
15. <i>Briandra, VIC</i> - Using raised beds and beneficial fungi to restore soil health	166
16. <i>Prospect Pastoral Company, WA</i> - Against all odds: turning sand into profit	172
17. <i>Pine Lodge, VIC</i> - The influence of effluent - the power to do good	180
18. <i>North East CMA, VIC</i> - Empowering farmers to meet the soil carbon challenge	188
19. <i>NRM South, TAS</i> - Working with the willing	198
<b>Endnotes</b>	208
<b>Glossary and Acronyms</b>	210



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This report is based on the differing and varied experiences of the Soils for Life Phase 1 case study participants in their individual approaches to high performance regenerative landscape management. The narrative presented in the report is a tribute to the work of the Soils for Life research and interview team in researching and telling the inspiring stories of these capable and committed people.

The Soils for Life team is extremely grateful for the openness and hospitality shown by each of the case study participants visited and their generosity in providing photographs and data included in this report.

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## ABOUT SOILS FOR LIFE

### Purpose

Outcomes Australia's Soils for Life Program is an environmental organisation with the principal purpose of *enhancing the natural environment through the provision of information and education on innovative leading performance in managing Australia's natural environment, with a particular focus on the Australian rural landscape.*

### Objective

To facilitate positive and sustained change in how the Australian landscape is managed to ensure a thriving natural environment for the benefit of all Australians.

This objective will be achieved through three phases.

- 💧 **Phase 1:** Identify leading practice in landscape management through documenting, demonstrating and promoting those practices.
- 💧 **Phase 2:** Address the impediments to the wider adoption of these leading practices.
- 💧 **Phase 3:** Encourage the adoption of these leading practices as the norm across the agricultural landscape in Australia, setting a positive example for others.

The Program is expected to take up to 15 years to complete. This document contributes to the achievement of Phase 1.









# LANDSCAPE REGENERATION FOR OUR FUTURE

## THE NEED FOR CHANGE

Landscape degradation is an issue of national and global concern. Landscape management practices including, but not limited to agriculture, forestry and fire have caused significant damage and in the process have altered the earth's natural biosystem. Consequently the precious resources of soil and water necessary to sustain life are being lost at unsustainable rates.

Unprecedented global challenges are arising in the face of this massive degradation of the landscape. These challenges are interrelated and, if left to evolve, will risk manifesting themselves in social instability crises.

Soil erosion due to traditional agriculture is occurring at a rate between 10 and 100 times faster than the soil's natural formation process (*pedogenesis*)<sup>1,2</sup>. Although the lack of good data makes predictions highly uncertain, at the current rate of topsoil loss, indications are that the earth may only have 48 years of topsoil left<sup>3</sup>. Estimates also suggest a reduction in global food production of 30% in the next 25-50 years due to soil degradation alone<sup>4</sup>. Healthy soils are necessary to provide sufficient amounts of food with quality nutrition to meet global food requirements.

Three billion people globally already have inadequate water and sanitation. It is assessed that 80% more water will need to be accessed by 2050 to feed the potential global population of more than nine billion<sup>5</sup>. This requirement is in the face of declining water availability, primarily through severe aquifer reduction in China, India, Africa and the Middle East. Unless all limited fresh water resources are understood and wisely managed, its decreasing accessibility and our absolute dependence on it, will risk escalating social disruption and regional instability.

Even with its significant land area, Australia is not immune to the consequences of landscape degradation and increasing future needs. The repercussions of our past environmental and heritage management are highlighted in *Australia: State of the Environment 2011*. This document describes a number of environmental issues that continue to cause concern and exert pressures on our environment, reducing our ability to deal with current and future challenges<sup>6</sup>.

Despite good practices of a number of land managers and farmers allied to some good science, the realities of an increasingly arid and degraded landscape are being experienced across the country. These include:

- ◆ increasing acidification, particularly in the south-east;
- ◆ declining soil health, caused by the loss of soil organic carbon (SOC);
- ◆ erosion;
- ◆ severe salinity;
- ◆ diminishing river flows;
- ◆ high evaporation and runoff rates;
- ◆ decreasing availability of groundwater; and
- ◆ reduced resilience to impacts of extreme and variable weather events such as drought, flood and fire.

The current state of the Australian natural landscape is further challenged by stresses from our changing climate, unsustainable management practices, increased mining activity and urban expansion. These will impact significantly not only on the productivity and viability of agricultural enterprises but also on the health of our environment and the wellbeing of every Australian.



The national and global challenges being faced, as detailed in this chapter, are interrelated and can be best met through a comprehensive coordinated approach focused on improved regenerative environmental management practices. Also outlined, are the current status and pivotal roles of the three key process drivers for landscape regeneration – soil, water and vegetation. Restoring the biosystem, through effective landscape management focusing on these three interrelated components, and becoming more efficient in the use of natural resources is fundamental to the provision of sufficient food, fibre and water for a growing population.

Chapter Two discusses how action already being taken by innovative farmers is successfully and profitably regenerating the landscape.

Chapter Three provides their stories.



*By supporting innovative farmers undertaking regenerative landscape management practices, we can restore the Australian landscape*

## FEEDING A GROWING POPULATION

By 2050, the global population is projected to be in excess of nine billion. With the current dependency on and demand for increasingly scarce fossil fuels and other resources, the pressure being placed on the earth's natural resources will compound exponentially.

The future world demand for food risks placing huge pressure on global food production systems<sup>7</sup>. The world will require around a 70% increase in global agricultural production to cope with population growth to 2050<sup>8</sup> with decreasing availability of agricultural land and water and reduced fertility of soil. Further, agriculture is heavily dependent on fossil-fuel-based inputs and, in the process, vulnerable to increasing resource prices. Water is often used inefficiently, to the extent that agriculture now accounts for 70% of global freshwater use. Groundwater extraction for irrigation is estimated to have contributed nearly half of the observed rise in sea level between 1961 and 2003<sup>9</sup>. As production outputs must continue to grow, inputs must be reduced and efficiency improved as global capacities and thresholds are being reached. Continuation of current usage patterns is not viable.

The situation is no different in Australia. Current government policy emphasises the importance of lifting agricultural productivity through agricultural research and development<sup>10</sup>. Whilst this is important, the more urgent requirement is to change how we manage the paddock, including clearly understanding the essential interconnectivity of soil, water and vegetation. Without so doing and despite some good farming and scientific practices, the realities of an increasingly degraded landscape, less reliable access to water, and increasing input costs for fuel and non-organic fertilisers, will further impact on the productivity and viability of agricultural enterprises.

Food quality, as well as food quantity, is of vital importance to meet the needs of the population. Nutritious food is fundamental to good health and disease prevention. The integrity of food is suffering due to the breakdown in the nutrient cycle. Farmland soils have been stripped of nutrients in a one-way flow of minerals and nutrients from the soil, to food, to consumption, to waste. The health and nutrient dynamic of soils must be regenerated to increase mineral and nutritional densities of our food to ensure proper nourishment requirements.

**The world will face around a 70% increase in global agricultural production to cope with population growth requirements...**



*Over-reliance on chemical inputs and non-regenerative practices have contributed to degradation of Australian agricultural land*

Alternatives to such input dependencies need to be found, due to the increasing prices and doubts over future availability of fossil fuels, extracted minerals and water.

Efficiency gains can often come from modifying existing farming and processing practices at little or no cost. These can include the use of more energy efficient engines, the use of compost and precision fertilisers, irrigation monitoring and targeted water delivery, adoption of no-till farming practices, the use of less-input-dependent crop varieties and adaptive animal breeds.

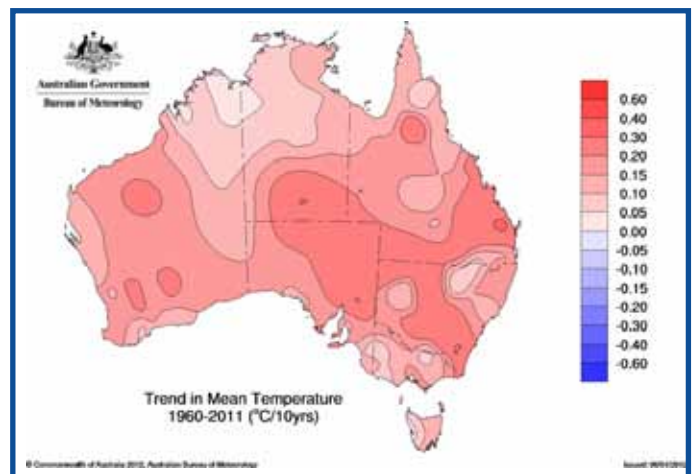
## VULNERABILITY TO A CHANGING CLIMATE

The impacts of climate change are global in scope and unprecedented in scale. Whilst the predicted effects of a changing climate continue to be debated, it is clear that a more resilient landscape will be imperative if we are to adapt and respond to the challenges of the future. Robust ecosystems underpin resilience in landscape function. To achieve these, healthy soils, better use and conservation of available rainfall, pragmatic use of vegetation and groundcover, and increasing biodiversity are key.

## RELiance ON HIGH ENERGY INPUTS

Current land management practices place a heavy reliance on increasingly scarce and expensive inputs: fossil fuel, extracted minerals, chemicals and water. As oil prices increase through scarcity and demand, the viability of maintaining many oil based agricultural inputs will decline. The United Nations Food and Agriculture Organization (FAO) has highlighted concern of the global food industry's dependence on fossil fuels, saying that excessive reliance on that form of energy is likely to undermine efforts to produce enough food for the world's growing population<sup>11</sup>. By 2050, it is estimated that 2% of global energy consumption will be devoted to production of nitrogen fertiliser<sup>12</sup>.

Through the practice of specialised monocultures, soil has lost its natural inputs in not only carbon, but also nitrogen and phosphate, relying instead on costly artificial fertilisers. Increasing input of these fertilisers, together with herbicides and pesticides, has contributed to the depletion of the health of soils and its capacity to produce food sustainably.



## KEY PROCESS DRIVERS FOR LANDSCAPE REGENERATION

Many of the challenges being experienced are not isolated events, but are related to landscape degradation, loss of biodiversity and resultant impact on what should be a naturally balanced system.

Soil, water and vegetation, supported by a constant flow of solar energy, are the fundamental and interrelated process drivers necessary to provide essential natural ecosystem services.

### ESSENTIAL ECOSYSTEM SERVICES

**SUPPORT:** nutrient cycling, water release and retention, soil formation, habitat for biodiversity, exchange of gases with the atmosphere, degradation of complex materials;

**REGULATION:** carbon sequestration, greenhouse gas emissions, water purification, natural attenuation of pollutants;

**PROVISION:** food and fibre production, water availability, platforms for construction;

**CULTURAL:** protection of archaeological remains, outdoor recreational pursuits, landscapes, supporting habitats<sup>13</sup>.

Increasing landscape degradation and inefficient resource use are clearly evident within our current management of soil, water and vegetation. These areas are strongly interdependent and damage to one causes detriment to another. Equally, however, regeneration in one area can also bring positive results to the others as part of natural biosystem cycles, as discussed further in Chapter Two.

## SOIL

Pedogenesis processes over the past 420 million years helped transform arid bare rock into the healthy soils that still underpin our biosystems, hydrology, climate, water, food security and survival. Microbial ecologies governed these pedogenesis processes through the bio-sequestration of carbon to build soil structures, water holding capacities, nutrient availabilities, bio-productivity and resilience to stress.

Today, the dramatic loss of SOC from soils, and related implications, is one of the two issues featured by the *UNEP Year Book 2012*. This flagship publication highlights the imperative to sustain and enhance soil carbon stocks in order to manage serious consequences which are already being experienced in terms of climate change, food security and the health of ecosystems. The earth's ability to provide the interrelated ecosystem services, of which soil carbon quantity is a major determinant, has also declined.

For example, around 60% of the carbon in the world's soils and vegetation has been lost as a result of land uses since the 19th century<sup>14</sup>. As a result of soil carbon losses, one-quarter of the global land area has suffered a reduction in productivity during the past 25 years<sup>15</sup>.

*Australia: State of the Environment 2011* confirms that SOC stocks are low in many Australian agricultural systems. On average, Australia's current SOC content is around 1%. By comparison, when the explorer and geologist Sir Paul Edmund Strzelecki collected 41 soil samples around south eastern Australia between 1839 and 1843, average soil organic matter in the top ten most productive farm samples was 20%, with levels of organic matter up to 37.75% – equating to SOC content of 10% to nearly 20%<sup>16</sup>.

Current landscape management practices are contributing to poor health of our soils through the loss of carbon and topsoil, acidification, erosion, mineral deficiencies and chemical dependencies. Nutrients are being chemically locked-up and made unavailable to plants, or being lost through waste in urban areas which is not returned to the soils for use by plants and animals.

Threats to the soil will increasingly affect Australia's agriculture unless carefully managed. In 2001 soil acidity was estimated to be costing around \$1.585 billion per year in lost agricultural production<sup>17</sup>.

Due to the current structure of Australian soils, extreme weather events, such as flooding or high winds, continue to degrade the landscape, washing or blowing away valuable topsoil and further reducing remaining carbon content.





*Soil organic matter forms through the breakdown of organic materials on the soil surface and below the ground. It comprises approximately 50% carbon*

Every gram of soil organic carbon can hold up to 8 grams of water.

Soil health must be built; depletion cannot be rectified by adding chemical elements to address identified symptoms. Carbon is a master variable within soil that controls many processes, such as development of soil structure, water storage and nutrient cycling. Every extra gram of carbon in soil can retain and make available up to eight extra grams of water. Without carbon in the soil, the resilience of the landscape is weakened, water losses to the effects of wind and extreme temperatures continue and the capacity to respond and adapt to a changing climate declines. It is vital that carbon is returned to Australian soils through increased biodiversity of vegetation to facilitate carbon sequestration and restore hydrology, bio-productivity and resilience.

## WATER

Securing an adequate supply of safe, reliable water is likely to become a strategic determinant for communities, regions and nations within the coming years. It is estimated that the global community will require access to an *additional* 14,000 cubic kilometres of water – the equivalent of 11,000 Sydney Harbours – to meet our future water demands in feeding a global population of nine billion<sup>18</sup>.

50% of Australia's typical rainfall is lost to evaporation.

Australia is the driest inhabited continent with variable rainfalls. Whilst many regions in Australia received very healthy rainfalls in 2010, the 2010 CSIRO/BOM *State of the Climate* report highlighted that reduced rainfall in eastern and southern Australia, together with more intense rain events are likely to be the norm in the future<sup>19</sup>. Drastic flood events have already been experienced in northern Australia for consecutive years with devastating results.



*Slowing the flow of water across the landscape helps to restore riparian areas*





Australia's landscape used to be characterised by 'in-soil' reservoirs. Complex microbial ecologies maintained soft deep soils which allowed for infiltration and retention of rainfall into well-structured subsoils. These in-soil reservoirs then leached any salt to depth and slowly recharged and sustained what were typical reed covered billabongs, meandering waterways and fully functioning floodplains. As a result, most of Australia's inland rivers did not discharge rainfalls to the sea, but recharged aquifers or created highly productive inland deltas and extensive wetlands and intermittent lakes.

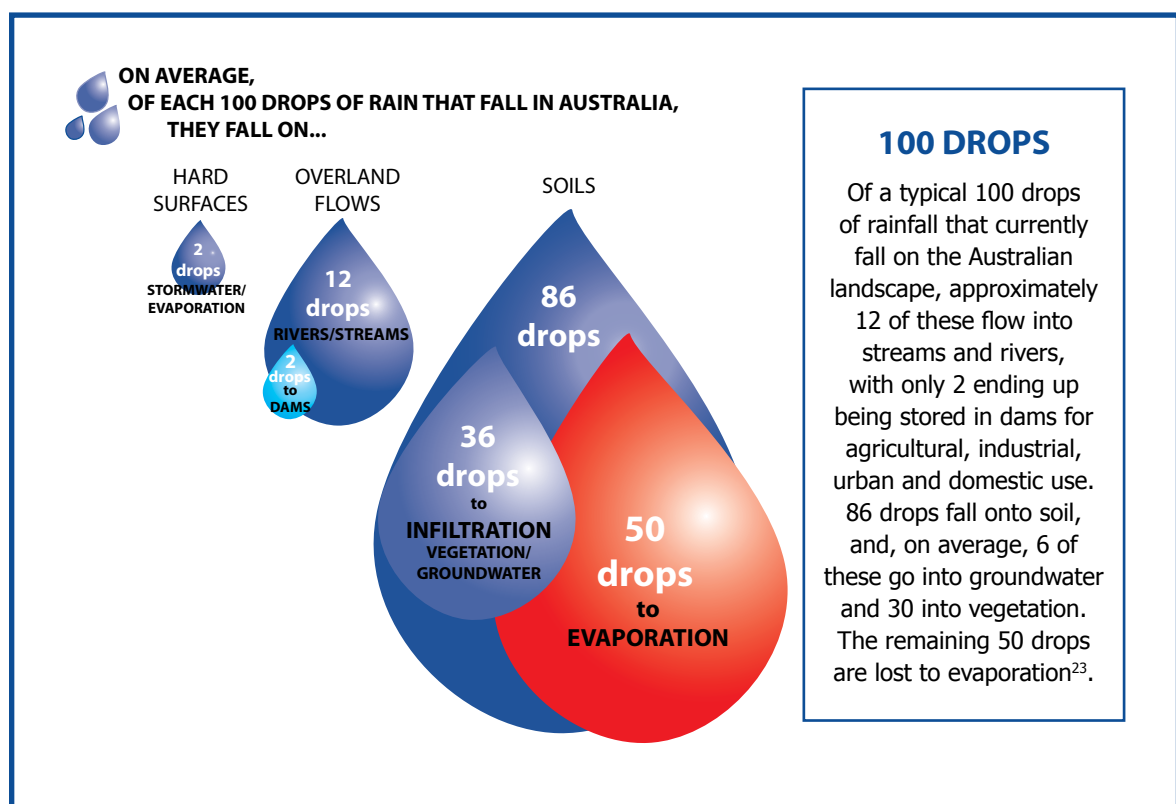
It is assessed now that over a quarter of Australia's river systems are close to unsustainable extraction and groundwater is being over extracted by almost 15%<sup>20</sup>. Furthermore, 94% of wetlands have been destroyed and over one million kilometres of Australia's rivers have been incised<sup>21</sup>.

Australians are also some of the highest per capita consumers of water. We need to secure many times the actual water that is projected to be available under current practice. With rainfall patterns changing, how each drop received is conserved and used is critical. The structure

of soil is imperative to maximise efficient infiltration and capture of water.

What happens to water when it falls on the landscape as rain has to be managed in such a way that every drop is utilised to the maximum advantage; whether in maximising its capacity to hydrate the soil; to replenish relevant aquifers or when saved through capture from rooftops, roads and storm water drains or recycled from waste; it all has to be properly managed. Water is only a renewable resource if the water cycle is functional<sup>22</sup>.

The greatest potential for improvements in conserving water and using it intelligently can be found in reducing the high evaporation rates. Current approaches to water management, such as policies related to the Murray Darling Basin and Snowy River, are focused mainly on the average 12% of rainfall that ends up in streams, rivers and eventually into dam storage – the 'end of pipe'. However, the greater potential for efficiency lies in making better use and conservation of rain where it falls - the 'front of pipe'. Eighty-six per cent of rainfall initially falls on Australian soils, but around 50% - 25 times the quantity held in all dams - is currently being lost to evaporation.



## VEGETATION

World deforestation is estimated as 13.7 million hectares a year<sup>24</sup>. Current rates, extents and intensities of land use and land-cover change are greater than ever in history, causing significant loss of vegetation<sup>25</sup>.

### Healthy soils support vegetation regeneration and healthy nutrient cycles.

Australia has some 770 million hectares of land. Although former policies of active land clearing are no longer extant, around one million hectares of native vegetation

was cleared annually in Australia in the decade to 2010. The most significant loss of vegetation has been in the over 470 million hectares of rural managed land that has been farmed at various intensities, with around half of this being variably degraded. The land use of greatest extent is livestock grazing, accounting for use of 55% of Australia's land area (428 million hectares)<sup>26</sup>. Land health is at further risk from changing land use, changed water and fire regimes and overgrazing<sup>27</sup>.

As remnant vegetation continues to deteriorate, the land and soil degrades as topsoil is lost and erosion occurs<sup>28</sup>. Poorer soils are then unable to support regeneration of healthy vegetation and nutrient cycles break down.

Nutrients are necessary for healthy soil and vegetation functioning. These are also being lost to production systems through disruption to the natural waste cycle as a result of urbanisation and consumption habits. Cities are producing increasing volumes of waste, including significant organic matter, which is no longer being returned to the soils.

Nutrient deficient soils lead to nutrient deficient plants, ultimately the food source on which we survive. Massive mineral depletions in fruit and vegetables were identified over a research period 1940 to 1991. The food we eat today is less nutritious than it was before World War II<sup>29</sup>.



*Vegetation of all types contributes to carbon sequestration and restoration of hydrological cycles*

## A REGENERATIVE CYCLE

Together in a natural system, soil, water and vegetation provide a regenerative cycle. This regenerative cycle is possible because of the solar energy that bathes the earth each day. This light energy is converted by plants into food energy that flows through biota. It is this constant flow of energy through the biosphere that makes life possible.

Restoration of fundamental natural systems will regenerate the health and resilience of our landscape so it can bio-sequester and draw down current and past carbon emissions to safe levels into stable sinks; secure and restore the essential rainfall and natural water ecology on which our biosystem, economy, communities and life fundamentally depends; and regenerate the vegetation that also supports the biodiversity essential to maintaining the cycle.

Improving landscape management practices will maximise water use efficiency, improve soil health and nutrient cycling. In turn, this will also improve Australia's biodiversity, reduce weed invasion and improve production to help meet the needs of the global community, environmentally, economically and socially.



A properly structured soil will re-create effective in-soil reservoirs, through greater infiltration and retention of rainfall. Sequestering carbon is the safest, most practical and relatively quickest way of restoring the natural organic status of the soil to increase its water holding capacity. Carbon can be returned to the soil through establishing a biodiversity of vegetation cover.

In-soil reservoirs also allow water to slowly recharge waterways, particularly during times of limited rainfall. In times of increased rainfall, healthily structured soils can slow the flow of water across the landscape. Slowing down water rushing through the landscape by installing interventions that mimic nature also assists in the build up of sediment and the capture of water in the soil.

Returning to such natural hydrological processes can restore riparian areas, recharge flood plains and make water available for uptake by plants and animals over longer periods of time.



*Installing interventions that mimic nature assist in the build up of sediment and the capture of water in the soil*

Revegetation will improve ground cover, and subsequently the quality of the soil, enhancing water infiltration. In turn, improved soil health and efficiency in water use will contribute directly to the ability to further regenerate forests and vegetative cover in our landscape, expanding biodiversity of species and support agricultural food and fibre production. Vegetation also has the ability to draw down CO<sub>2</sub> and fix nitrogen in the soil, and plants with deep roots have the ability to recycle nutrients up to five metres in depth – improving both the soil and the nutrition of food grown.

Trees and other plants also have a profound influence on climate through their ability to moderate temperature. Vegetation protects the ground from overheating and drying out. It also optimises the amount of evaporation by transpiration through the many pores (*stomata*) on the leaves. Vegetation influences the transformation of solar radiation, in its ability to bind up solar energy in transpired water vapour which is then carried away and released upon condensation in cooler locations. This cooling effect from transpiring plants, especially trees, is the perfect air conditioning for the earth, as well as a key component of the small water cycle for moderating precipitation<sup>30</sup>.

Returning carbon to the soil and restoring the biosystem will recreate the unique natural processes that govern productivity and resilience of our soils. This can heal the damage that has been done to the landscape and enable it to tolerate, adapt and even influence climate extremes. Increased soil carbon also enhances the essential biological activity of fungi and microbes, facilitating the availability of minerals and nutrients to plants. Healthy soils and plants lead to healthy food and animals and by extrapolation, healthier people<sup>31</sup>.

## LEADING CHANGE

The challenges facing a growing population in a gradually degrading landscape – exacerbated by a changing climate – together with continuation of our current behaviours will increasingly manifest themselves in water, food and social instability crises. The wellbeing of people, in terms of health, lifestyle and the future for the next generations, both here in Australia and around the world must be of strategic concern to leadership.

The recent United Nations report *Resilient People, Resilient Planet: A Future Worth Choosing* includes in its recommendations, “Governments and international organisations should work to create a new green revolution – an “ever-green revolution” – for the twenty-first century that aims to at least double productivity while drastically reducing resource use and avoiding further loss of biodiversity, topsoil loss and water depletion and contamination, including through the scaling-up of investment in agricultural research and development, to ensure that cutting-edge research is rapidly moved from laboratory to field...”<sup>32</sup>

Current Australian investment in management of the land environment, in research and development programs and knowledge and information systems that underpin good land management, has been assessed as inadequate. Per hectare of agricultural land, Australia invests less in natural resource management than in Europe and the United States, and this is generally regarded as insufficient to meet Australia’s environmental management needs<sup>33</sup>. *Australia: State of the Environment 2011* emphasises the need to choose our approaches to environmental sustainability to continually and intelligently mitigate or adapt to the ongoing drivers of climate change and population growth<sup>34</sup>.

In Australia we continue to treat the symptoms of the degraded system through controls on stored water, massive expenditure on weed control and reliance on chemical interventions, rather than address the cause. This needs to change. Effective practical policies and actions are needed now. Indeed, it is imperative that there is a better connection between innovative farm practice and peer-reviewed science to learn more about these approaches and to help support the generation of new reliable knowledge that can be translated to other properties. Business as usual is neither viable nor sustainable.

The earth’s natural biosystem is balanced so that no element leaves the planet, and stores are contained in the right place in the right volumes. However this balance has

been disrupted and storage thresholds have been reached. We need to be more effective at recycling the elements and restoring them to where they belong in the natural system.

The solution to the many and varied, yet interrelated problems, lies in the regeneration of the landscape, particularly our soil. This undervalued component of the earth’s highly complex natural biosystem is only just beginning to receive attention outside the realm of soil scientists<sup>35</sup>. By adopting a practice of high performance regenerative landscape management, the natural balance will be restored, returning carbon to the soil, effectively capturing water, ensuring plant and animal biodiversity, providing resilience to the landscape and ultimately contributing to sustainable production outputs and better human health.

As discussed in Chapter Two and presented in Chapter Three, innovative farmers are using high performance regenerative landscape management methods and fighting the trend of continued degradation of the landscape with its heavy reliance on external inputs. They are demonstrating sustainable, regenerative practices on their land.

These innovative farmers are small in number now – probably less than 5000 – however with relevant policies and incentives these practices could be extended successfully and quickly to involve at least 30,000 of Australia’s 135,000 farmers.

Whilst there are always opportunities to learn more, enough is already known to take action now.









## LANDSCAPE REGENERATION IN ACTION

The challenges outlined in Chapter One can be best met through the wider adoption of high performance regenerative landscape and water management, facilitated by comprehensive strategic coordination. Such landscape management is already taking place through a small number of innovative farmers across Australia and around the world, but these efforts are not yet being sufficiently supported or coordinated to maximise results.

Outcomes from a comprehensive approach to regenerative management have the potential to heal landscape degradation, support the sustainable provision of sufficient quality food and fibre for the growing population, improve the environment and restore the earth's natural biosystem.

This chapter discusses how these outcomes are already being achieved by participants in the *Soils for Life* case studies. These farmers, and others taking similar approaches, must be recognised not just as producers of food, but for the positive work they are performing in regenerating the Australian landscape and achieving sustainable outcomes.

Experiences shared by the 17 innovative farmers and two community organisations in the *Soils for Life* case studies in Chapter Three demonstrate successful action being taken to restore the landscape. The case studies describe a range of techniques being used to obtain positive, regenerative outcomes.

These techniques and their relation to the key process drivers are discussed through selected examples in this chapter and include:

- ◆ Applying organic composts, fertilisers and bio-amendments;
- ◆ Encouraging natural biological cycles and nutrient transfer;
- ◆ Implementing time-controlled planned grazing;
- ◆ Using grazing management and animal impact as farm and ecosystem development tools;
- ◆ Retaining stubble or performing biological stubble breakdown;
- ◆ Constructing interventions in the landscape or waterways to slow or capture the flow of water;
- ◆ Fencing off water ways and implementing water reticulation for stock;

- ◆ Investing in revegetation;
- ◆ Pasture cropping;
- ◆ Direct-drill cropping and pasture sowing;
- ◆ Changing crop rotations;
- ◆ Incorporating green manure or under-sowing of legumes;
- ◆ Managing for increasing species diversity;
- ◆ Reducing or ceasing synthetic chemical inputs; and
- ◆ Integrating enterprises.

Healthy soil is fundamental to landscape regeneration and sustainable food production. Restoring soil physical, mineral and biological qualities is essential in order to maximise biosystem functioning. Healthy soil can only be achieved through a good understanding of the inter-linkage of sound water management with a biodiversity of functional vegetation. Together, supported by the constant flow of solar energy, soil, water and vegetation management are the process drivers to a healthy regenerative landscape.

As illustrated in the case studies, due to their interrelated nature, benefits can be experienced across all process drivers regardless of the particular area of focus.



Changing from conventional to regenerative landscape management practices involves making a commitment and constantly challenging and testing decisions made to ensure that they are economically, environmentally and socially sustainable. Case study participants' experiences in undertaking change and how adoption of change can be supported are also summarised in this chapter.

Policies and actions required for a comprehensive, coordinated approach to high performance regenerative landscape management are recommended at the conclusion of the chapter. These efforts will contribute to delivering process outcomes of restored landscape function, that include increased production, an improved natural resource base, healthy nutrient cycling, increased biodiversity and enhanced resilience. These will benefit not only the primary producers, but also the community - economically, environmentally and socially - and will significantly contribute to addressing the national and global challenges outlined in Chapter One.



*Innovative farmers, such as those in the Soils for Life case studies, should be recognised for their work*

## SOIL

As presented in Chapter One, a healthy soil is fundamental for the functioning of the natural biosystem.

Soil health refers to the condition of the soil and its potential to sustain biological functioning, absorb water and promote plant and animal nutrition and health. Such resilient soils are better able to retain function during, and recover after, stress or disturbance, such as too much or too little rain.

Many of the case study participants address soil health directly, identifying its causal role in successful production.

Of many examples, the experience of Bill and Rhonda Daly of *Milgadara* in the NSW South West Slopes (CS13, pg. 152) demonstrates the broad positive outcomes achievable from focussing primarily on soil health. The Dalys place great emphasis on the importance of balancing and restoring the physical, mineral and biological qualities of soil. This perspective moves from the conventional agricultural view of soil which focuses primarily on the mineral qualities, in particular, increasing the levels of phosphorus (P), nitrogen (N) and potassium (K).

The Dalys restore soil structure, chemistry and biology through applying specially formulated humus compost. As a result, they have increased soil organic carbon (SOC) levels, improved cation exchange capacity (CEC), their pastures are more diverse and prolific and their crops are producing greater yields. The Dalys have also experienced an improvement in the quality of the wool their sheep are producing and lambing percentages have increased. This could potentially be linked to the improved nutrition in their pastures.

## Soil Chemistry and Structure

The carbon content of soil plays a primary role in the soil's physical qualities and its structure. It is a key indicator of its health. Carbon content is fundamental to its water-holding capacity and ability to cycle nutrients. The amount of SOC can reduce rapidly through oxidation as a result of unsustainable management and changing land use<sup>1</sup>. Regenerative practices however, are demonstrating how this loss can be reversed.

SOC is the main constituent of soil organic matter (SOM). SOM is formed by the biological, chemical and physical decay of organic materials on the soil surface and below the ground. On average, SOM is composed of 50% carbon, 40% oxygen, 3% nitrogen and smaller amounts of other elements as micronutrients. SOM varies in its stability. Some is labile, relatively quickly biodegradable, and other components are more stable (non-labile). The ratio of labile to non-labile depends on microbial conditions.

Generating SOM was revealed as a primary step for many case study participants in addressing their soil health.

The carbon sequestration potential under conventional farming practices should not be seen as the maximum possible or be the drivers of policy, when there is evidence that numerous innovators have been achieving greater bio-sequestration outcomes by some orders of magnitude.

Colin Seis of *Winona* in the NSW Central Highlands (CS12, pg. 144) has developed and implemented a cropping technique - 'pasture cropping' - which has led to dramatic increases in soil and soil minerals, including SOC. Pasture cropping involves direct-drilling crops into dormant native perennial grasses. Time-controlled planned grazing is integrated with the cropping, with sheep being employed prior to sowing, during growth before seed-set, and after harvesting. This technique promotes ongoing groundcover and minimal soil disturbance, supporting high biological functioning and constant formation of fertile soil.

Extensive soil testing on *Winona*, including paired-site analyses by the University of Sydney through the *Communities in Landscape* project, has shown that this technique has increased SOC by 203% in ten years. SOC has been measured up to depths of 500mm. In total, this equates to around 45 tonnes of SOC a hectare, or per hectare storage of around 170 tonnes of CO<sub>2</sub> (equivalent).

Importantly, 78% of the newly sequestered carbon on *Winona* is in the non-labile (humic) fraction of the soil. This is therefore much more stable and significantly less subject to degradation.



*Samples from a paired-site analysis showing the healthy and carbon-rich soils on Winona (left) achieved through Colin Seis' 'pasture cropping' technique, compared with a neighbouring paddock (right) which is farmed conventionally*

In a very different environment in the NSW North West, Graham and Cathy Finlayson of *Bokhara Plains* (CS2, pg. 60) are restoring the soil structure to claypans in the rangelands, seeking to reach the previous potential of this landscape. Through planned grazing practices, stock are being used to break up the surface of the claypan, which formerly comprised 50% of their land, turning it into productive pasture.

The herd impact from high density stock levels triggers soil disturbance, exposing seed already present or carried in from manure, stock hooves and/or hide to a germination opportunity. The stock density used by the Finlaysons also ensures nutrient deposit from urine and manure that has been carried from other areas of higher natural fertility. By allowing water and seeds to penetrate and also leaving manure fertiliser deposits, the claypan and degraded areas of *Bokhara Plains* are becoming revegetated. Plant succession is possible because the first plant species create groundcover, which allows moisture retention, pushes roots down to create SOM in the claypan and in turn

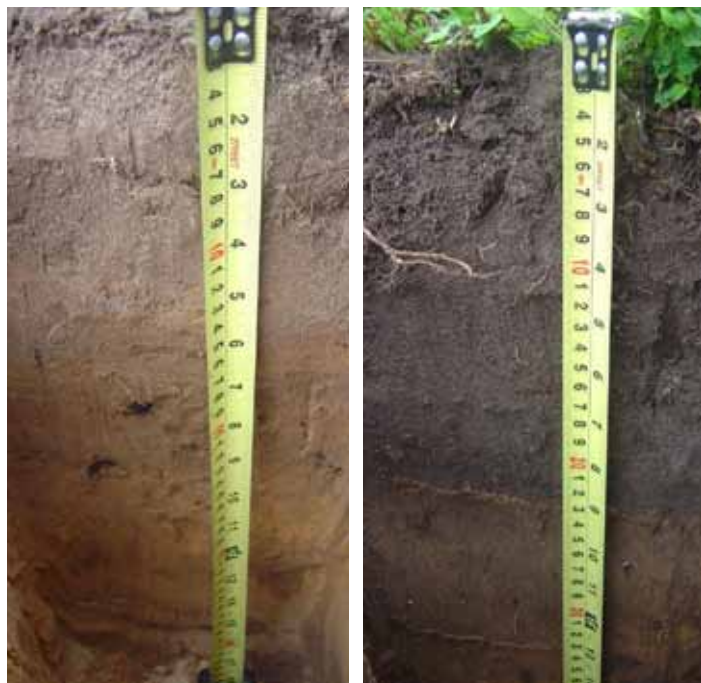




provide a pathway for carbon from leaf photosynthesis to feed soil micro-organisms around the roots. This then initiates the nutrient cycle where previously it would not have been sustained due to the absence of plant life and an energy source.

As a result of these regenerative land management practices, which commenced in the early 2000s, the soil structure on *Bokhara Plains* is continuing to improve and SOC levels are increasing from the greater plant biomass and root systems in soil. By regenerating the soil and increasing groundcover, the Finlaysons have significantly increased productive land on their property and improved their sustainable carrying capacity. Through addressing the health of the soil, the Finlaysons are creating a viable business and are moving towards drought-proofing their property.

Whilst *Bokhara Plains* has not yet been subject to scientific soil testing, a number of other case studies have recorded measured increases in SOC since the implementation of their regenerative practices. For example, Martin Royds and his partner, Trish Solomon, on *Jillamatong* in South-Eastern NSW (CS7, pg. 102) have seen available SOC increase from a low of 0.8%-2.4% in various paddocks ten years ago, to best sites now measuring close to 7.0% SOC.



On Clover Estate, David Clayfield has converted nutrient-poor sandy soils (left), to rich and fertile soils (right) through supporting soil biology

## Soil Biology

Within healthy soil, trillions of micro-organisms recycle and release nutrients to drive plant growth. Mycorrhizal fungi are central to this process enhancing the ability of plant roots to access soil moisture and nutrients, and form stable organic matter. Use of chemical fertilisers and bio-cides (herbicides, pesticides, etc.) within modern conventional farming practices can decrease soil microbial life and destroy the balance between soil microbes and plants, negatively impacting production and sustainability.

In both Western and South Australia, case study participants have demonstrated that by supporting the biological activity in their soil, they have been able to convert nutrient-poor sands into productive and resilient soils. Ian and Dianne Haggerty of the *Prospect Pastoral Company* (CS16, pg. 172) are producing consistent crops and 'boutique' fat lambs on very limited rainfall and David Clayfield of *Clover Estate* (CS6, pg. 96) is now 'growing' calves for export as dairy heifers at a rate of 600-700 a year on 100 hectares.

Conversely, on the heavy, boggy soils of the Victorian Western Plains, Brian and Sandra Wilson of *Briandra* (CS15, pg. 166) have combined raising crop beds to improve drainage with the application of beneficial fungi to break down crop stubble and the application of bio-amendments to improve soil structure. Both their cropping and sheep production outputs have increased and their soil is visibly improved.

Limiting soil disturbance through the practice of direct-drilling or no-till cropping is also important to maintain biological functioning of micro-organisms and fungi. This technique has been applied successfully in both cropping enterprises, such as on *Prospect Pastoral Company* and *Winona*, and with grazing, for example on *Jillamatong* and Greg and Sally Chappell's *Shannon Vale Station* on the NSW Northern Tablelands (CS3, pg. 68).

Each of the case study participants in these examples believe they would not be able to produce what they do without investing in the soil; in these instances through the application of organic composts, worm juice and biological amendments comprising beneficial bacteria and fungi. Combined with stock management practices to control grazing and distribute nutrient, direct-drilling of seed and reducing or ceasing chemical inputs, the biological functioning and overall health of the soils on these properties have greatly improved. Consequently, as have sustainable and nutrient-rich production.

## Supporting Natural Nutrient Cycling

Producing sufficient nutritional food is essential for future wellbeing, and healthy nutrient cycling underlies this production.

Nutrient cycling refers to the movement and exchange of organic and inorganic matter back into the production of living matter. Bacteria, fungi, insects, earthworms, and other organisms release nutrients from various sources, enhancing the fertility of the soil. The minerals and nutrients in the soil are then made available for uptake for the production of crops or fodder for stock. This natural process is regenerative and functions most effectively when naturally balanced. A healthy cycle produces more nutritious crops and animal protein than one in which nutrients are imbalanced or not cycling effectively.

Many of the case study participants are supporting healthy nutrient cycling through making better use of nutrients available on-farm, rather than introducing supplements from external sources.

On their property, *Lana*, on the NSW Northern Tablelands (CS9, pg. 120), Tim and Karen Wright have been applying Holistic Management practices for almost 20 years, optimising natural nutrient cycling processes and achieving significant production increases.

The Wrights are using their grazing management as a farm tool, redistributing soil nutrients from areas of high to low fertility through controlled stock movement. Due to the time it takes for animals to digest the nutrients and turn them into waste, the use of high density rotational grazing practices (discussed in greater detail later), relocates the livestock before this cycle has occurred. Nutrients are thus deposited in a different part of the property from where they are taken. This process achieves increased biological activity as a result of the more even spreading of nutrient from manure and urine as a result of greater density of stock grazing over each hectare of grass.

A greater level of above ground plant litter, combined with root exudates (which come from the short periods of intense grazing), soil food sources from greater root biomass, as well as above-ground trampling of unpalatable mature plant matter (containing nutrient), in effect, equate to the application of fertiliser - though internal to the farm and not from external sources. Such processes support microbial links in the chain needed to make previously applied nutrient into a plant-available food source. These actions explain an increase in the availability of key nutrients to pasture production.



*Mycorrhizal fungi forms symbiotic relationships in and on the roots of host plants, enhancing the nutrition of both the host plant and the fungi*

By maximising the use of nutrients already available on the property, the Wrights have been able to reduce their reliance on chemical fertilisers.

Improved fertility without fertiliser through spreading on-farm nutrients may not happen indefinitely, however. Whilst there is a great deal of cycling of nutrient through the animal while it is on the farm, there is still export of nutrient off farm in the form of the harvested product, such as beef, milk, lamb or wool. Whilst nitrogen can be replaced *ad infinitum* from legumes, phosphorus and calcium, amongst others, cannot be. As such, these holistically managed systems should expect to reach a plateau where minerals may need to be imported again to maintain production levels. As healthier systems however, these will be able to make use of forms of nutrient that are not immediately plant available, as opposed to granular fertilisers, as the soil/biological system is better placed to degrade the more insoluble forms over time. Through good monitoring and measurement, these farms are able to respond to such situations.

The Dalys of *Milgadara* and Cam and Roxane McKellar of *Inveraray Downs* in the NSW North West Plains (CS14, pg. 160) are already responding to any loss of nutrients from harvested products, by the regular application of organic compost. This allows for recycling of off-farm nutrients by re-introducing composted materials back on to the property.

Greg and Sally Chappell of *Shannon Vale Station* undertake comprehensive chemical analysis of plant tissue and sap in order to apply organic fertilisers targeting specific deficiencies in nutrient availability. Balancing soil and plant nutrients enable effective cycling. By combining specific grazing management practices with the use





of solid organic fertiliser tailored to their soil and liquid foliar fertiliser to address plant nutrient deficiencies, the Chappells have rejuvenated once weed-infested pastures. SOC and fertility have increased and pasture quantity and quality have improved. The Chappells believe that these improvements to the nutritional value of their pastures have directly lead to increased growth in their Angus bulls.

With 300 dairy cows and a 60 bail shed, Ian and Wendy Klein of *Pine Lodge* in the Victorian Central North (CS17, pg. 180) were producing more 'nutrient' than they could manage – in the form of dairy effluent. Too rich to use as fertiliser, it was when the Kleins adopted natural methods across their farm that they identified an option to treat the effluent. Now, by adding aerobic and beneficial bacteria to add oxygen and convert the ammonia into amino acid, those nutrients can be returned to the soil as an economically valuable fertiliser, re-establishing the nutrient cycle.



Top: Livestock contribute to nutrient transfer and cycling;  
Below: Crop stubble on Milgadara is now retained to break down and return nutrient to the soil

In cropping situations, crop production, in terms of higher test weights, is also known to occur when plant nutrition improves. As a result of improved soil structure, nutrient cycling and water holding, it is possible to achieve the same yield with lower applied nitrogen. Improved translocation and allocation of other nutrients to the grain, as well as improved water and carbohydrate transfer occur when plants are less moisture stressed.

On *Inveraray Downs* on the Liverpool Plains, the McKellars are regenerating what used to be some of Australia's best soils, which had become degraded through cultivation and use of inorganic fertilisers and bio-cides. The McKellars have re-designed ecological cropping practices by altering crop rotation, applying compost and introducing stock into production – all of which are contributing to restoring essential biological processes, nutrient cycling and healthy soils. As a result, they now produce better quality and more healthy and nutritious food – more sustainably and with lower input costs.

Cam and Roxane are capturing increased nutrients such as carbon and nitrogen from plant growth through incorporating green manure legume crops, and through the retention of crop stubble. Consequently, greater soil microbial population response is promoted, which in turn feeds improved cycling of the other nutrients needed for plant growth. Under the previous conventional management system, this would have been lost to burning and oxidation.

By moving from synthetic to compost-based minerals for nutrient replacement, the McKellars are now also adding trace elements, organic matter and biological by-products of the compost process that contribute to soil fertility over and above simple nutrient replacement. Short term responses in crops are also being promoted through the use of organic liquid fertiliser stimulants. As a result of changing his practices, Cam has reduced production costs, increased crop yields and nutritional value and restored soil structure and fertility.

As on *Inveraray Downs*, the Wilsons of *Briandra*, and the Dalys of *Milgadara*, have also adopted the practice of stubble retention on their properties, using stock or cellulose-digesting fungi to break down stubble, better hold water and return nutrients to the soil for uptake by plants.

## WATER

### Capturing Rain Where and When it Falls

Ninety-eight per cent of Australia's rainfall initially falls on soils, and case study participants who have improved their soil's structure are demonstrating that most of this rain can be captured where it falls, infiltrate deeply and be retained within the soil. It can then be available to slowly recharge floodplains, wetlands, streams and dams and not be lost to runoff and evaporation, as is common where soil structure is poor.

Soil structure is the key property that governs the effective infiltration, retention and availability of rainfall due to the increased water-holding capacity of SOC. The previous section discussed how soil structures can be improved, practically, rapidly and even profitably by simply restoring their natural SOM content. This aids the:

- infiltration, retention, availability and sustained supply of water from such soils;
- aeration and capacity of roots to proliferate and penetrate deep into soils;
- capacity for water to recharge and irrigate soils from below to limit loss due to evaporation; and
- restoration of in-soil reservoirs and aquifer recharge.

On grazing properties, the beneficial outcomes of time-controlled planned grazing are evidenced in facilitating capture, infiltration and retention of rainfall. This is what gives Shane and Shan Joyce of *Dukes Plain* in the Southern QLD Brigalow Belt (CS1, pg 48) and Charlie and Anne Maslin of *Gunningrah* on the NSW Southern Tablelands (CS8, pg. 112), amongst others, the capacity to manage production in periods of low rainfall. As discussed later in the Planned Grazing section, adjusting stocking rates in accordance with the feed resource available is also essential in maintaining resilient plant communities and thus production, long-term.

A number of the case studies were located in areas of low rainfall, and all areas had experienced inconsistent rainfall over the years. Traditionally, it can sometimes be challenging to address water management, especially in times of abundance when drought periods can be all too easily forgotten. However, a notable theme which emerged from the case study participants, such as on *Bokhara Plains*, *Dukes Plain* and *Gunningrah*, was to manage for low rainfall, rather than to rely on unpredictable higher rainfall events.

On an irrigated property, David Clayfield of *Clover Estate* is applying around half the water commonly needed for irrigation in the region due to the improved water holding capacity of his soils. On *Pine Lodge*, also an irrigated property, the Kleins have implemented a comprehensive recycling program to more effectively manage and use their water. Paddocks have been laser levelled to provide a gentle slope to enable flood irrigation. Any water runoff goes to the lowest point on the farm which is captured by a water reticulation system and re-used. Due to their improved soil structure, pastures which used to be irrigated every six days during the summer months are now only irrigated each nine or ten days.

On a dryland salinity effected region of the NSW Southern Tablelands, John and Robyn Ive of *Talaheni* (CS11, pg. 136) had additional reasons for capturing rainfall higher on their property. By achieving this through techniques discussed later in the Vegetation section, the Ives managed to lower the water table to below the level where saline ground water can rise to the surface, all but eliminating saline seeps across their property.



Pastures remain green longer across the seasons on *Gunningrah* as a result of increased rainfall infiltration and retention



## Slowing the Flow

Many of the case study participants are applying techniques which are based on the natural hydrology of the Australian landscape and how nature evolved and sustained immensely productive and resilient biosystems despite Australia being such a dry continent. By understanding these hydrological processes, resilient water systems can be designed and restored.

Australian creeks and rivers were unlikely to ever have been like those in Europe that constantly flow through the lowest level in the flood plain, draining away abundant water supplies. Substantial supplies of water on the Australian continent were mostly stored under the ground. The visible water in large rivers did not move much except in flood times. During major rainfall events, water levels would rise a metre or so and gently, without any erosive force, spill over the banks which, in Australia, in contrast to Europe, were at the highest level of the flood plain. Plentiful vegetation growing in hydrated soil along river banks would prevent significant erosion.

With the introduction of grazing across the Australian landscape, riverside vegetation was grazed and repeated stock access caused the banks to become eroded. Gradually, rainfall would wash into what was becoming a gully and only in significant rainfall events would it flow over the banks, each time washing away more soil. Confined to a gully, water flow would continue in the one direction at increasing speeds and the gullies became more deeply incised.

The level of the water in the floodplain is generally reflected by the level of the water in rivers or creeks. Today, this level can be seen to be up to many metres below some river banks, and accordingly, so is the water level under the floodplain. Where previously, plants in the healthy floodplains had their roots in hydrated soil all the time, they now depend on direct rainfall to soak down to them.

A primary step by many of the case study participants in more effectively managing water on their property has been to fence off water courses to prevent stock access, or limit access through time-controlled planned grazing, to reduce further erosion of river banks. Combined with the establishment of leaky weirs, as drawn from *Natural Sequence Farming* methods, this enables regeneration of vegetation and restoration of riparian areas to function as they did prior to the introduction of grazing.

Craig Carter and his partner Nicky Chirlian of *Tallawang* on the NSW North West Slopes and Plains (CS10, pg. 128) employed the assistance of Peter Andrews to

design structures and leaky weirs for his creeks. Mainly constructed from dead trees, later in conjunction with plantings of native reeds, these structures created a ponding effect and retarded water flow. Six years on, previously bare soils and gravel beds are covered with regenerating plants and considerable siltation is evident as the vegetation traps sediment carried from upstream. The creek on *Tallawang* is now a 'chain of ponds', and while inflow varies with rainfall, outflow is constant due to improved water retention in the soil and subsequent hydrological processes.

The Maslins of *Gunningrah* have also constructed over 30 weirs across streambeds and gullies on their property since the mid 1990s. Whilst two major weirs cost around \$2500, very little has since been spent on other constructions, with weirs made by hand with whatever materials were available. Combined with time-controlled planned grazing, these approaches have had significant impacts in as little as two years, with increased bank stability providing a greater ability to handle high flood flows. One weir collected an estimated 50 tonnes of silt in just three years, significantly healing erosion, and streams now flow for considerably longer after flood events, with clear, rather than silty runoff.



The river on Tallawang is healing from an exposed basalt rock base (top) to a gently flowing 'chain of ponds' (below)





*Establishment of weirs on Gunningrah has lead to significant gully restoration in as little as two years - 2006 (left), 2008 (right)*

Similar techniques are being used in the landscape as well as in waterways; indeed groundcover management, for example through time-controlled planned grazing, has a pivotal role in capturing and slowing the flow of rainfall. On *Tallawang*, swales have also been constructed to slow, retain and more effectively use water in the upper parts of the landscape. This has enabled surface water to better infiltrate, and pastures higher in the landscape are maintained longer in quality and quantity. On *Jillamatong*, Martin Royds has shallow drains radiating out from weirs to divert water from the waterway across the paddock, and the Joyces have employed Keyline design principles to contour water away from gullies and as required to dams on *Dukes Plain*.

For Craig Carter, Martin Royds, the Maslins the Joyces, and many others who have increased their groundcover and soil water absorption, dams no longer provide a reliable gauge for rainfall capture. The water is held in the landscape rather than flowing rapidly across it and draining to the lowest point. The water quality of any overland flow and storage is also improved by greater groundcover acting as a filter for sediment in runoff into dams, as well as reducing nutrient inflows from livestock which are now excluded from dams most or all of the time.

On a much larger scale, Ben and Graham Forsyth of the 480,000 hectare *Three Rivers Station* in the WA Mid West (CS5, pg. 84), are constructing major earthworks to try and protect their land from the infrequent but heavy rainfalls which have washed away topsoils and caused massive erosion. After de-stocking their property in response to increasing landscape degradation, they are now investing in regeneration activities to build perennial grasses and enable effective planned grazing in the future. Plant life regeneration since destocking has already assisted in restoring soil health to support better rainfall absorption. To slow the flow of water, the Forsyths have built bunds and rakes - rows of sturdy poles at about one metre spacing - to capture sediment and debris and slow water flows. The captured sediment and decomposing organic matter provide fertile soils in which grasses and shrubs can grow, and seed banks become established to spread further as the soils improve.



*Heavy rainfall washes away bare topsoils to expose hard subsoils on Three Rivers Station (top); rakes have been constructed in water courses to catch debris, build up sediment and spread water back out to the floodplain (below)*



## Reticulation

Many case study participants have established reticulated water systems to provide trough water for their stock as a function of reducing stock access to waterways as well as implementing time-controlled planned grazing on increased numbers of paddocks. This practice is evidenced in the extreme on the million-plus hectare property of *Beetaloo Station* on the NT Barkly Tablelands (CS4, pg. 76), managed by the Dunnicliff family. Discussed further in the later Planned Grazing section, John Dunnicliff is establishing a network of bores and pumps connected by hundreds of kilometres of 75mm pipe in order to access previously untouched grazing land and support a potential stock rate of 100,000 head of cattle – or more.

Establishing a reticulated troughing system also contributes to more effective water use, minimising evaporation and waste. It also ensures clean water for stock, that has health benefits over high-use dams which are often contaminated by excessive animal nutrient from wastes.



Top: Hundreds of kilometres of pipe are required to reticulate water across Beetaloo Station;

Below: Many farmers gravity-feed water to troughs from 'turkey's nest' dams located high on the property

## VEGETATION

Managing for increasing biodiversity in vegetation will sustain ecological processes critical to delivering the ecosystem services that provide the life support systems for the planet. Vegetation and its life-cycle processes form the basis of food chains, purify the air, protect water quality and yield, store carbon, maintain soil fertility and stability and support the industries of forestry, agriculture and aquaculture<sup>2</sup>. Nutrient cycling, as previously discussed, is essential for maximising plant – and food – nutrition.

Managed landscapes provide the major opportunity for revegetation and sequestration of carbon back into the soil and for restoring natural hydrological cycles. Establishment or re-establishment of biodiversity in pastures, crops, trees and other plant life through regenerative land management practices is therefore achievable across much of Australia.

Each of the case study participants emphasised the importance of vegetation in their regenerative landscape management practices, especially in maintaining groundcover. The previous sections have described how groundcover is fundamental in generating SOC and maximising the water-holding capacity of the soil. Vegetation can therefore be seen as the engine driving the water/carbon cycle.

## Tree Cover

Trees can improve agricultural production by providing shade and shelter that protects stock and crops from wind and extremes of heat and cold. Vegetation contributes to an effective water cycle through the restoration of diverse woodland communities. Together with extensive, slow biodegrading litters, such vegetation reduces surface wind speeds and extreme temperatures that would otherwise encourage significant evaporation losses.

Studies on a wide range of sites have shown that shelterbelts can improve crop productivity, typically by 5% to 20%<sup>3</sup>. Trees established as shelterbelts and woodlots can be managed to produce timber and other tree products, thus increasing diversification of farm income<sup>4</sup>. Experiences of case study participants have further demonstrated the benefits of tree regeneration and/or revegetation.

On *Dukes Plain*, Shane Joyce is measuring the financial benefit of increased vegetation in his pastures, after observing the increased production of paddocks with regenerated stands of brigalow (*Acacia harpophylla*) than those that had been cleared.



Shanes' own observation and monitoring on *Dukes Plain* identified the importance of shelterbelts and tree canopy levels in relation to production, as well as for regeneration of natural resources. Shane observed a balance between sunlight reaching the grass understorey for photosynthesis and the benefits to that understorey of having shade during hot periods when photosynthesis would otherwise shut down. He noted that shelterbelts also provide protection from wind shear on both moisture loss and animal performance in cold, as well as a barrier to frost impact on leaf production. As trees have deeper roots, they also intercept nutrient from depth, recycling to topsoil and subsequently grass production via fallen leaf and residues.

Whilst the Joyces observed that approximately a 40% canopy provided optimum pasture production, this is not a fixed ratio and will change from area to area relative to seasonal values of temperature, wind and rainfall frequency. The optimum level will vary from farm to farm, but is an area that can be investigated to maximise individual outcomes.

*On Dukes Plain, the Joyces experimented with narrow (right) and wide (below) shelterbelts to determine optimal vegetation cover to support production. Natural regeneration with approximately 40% canopy cover evidenced the best results*



On *Talaheni*, John and Robyn Ive are using revegetation to capture rainfall higher in their property to lower the water table and subsequently reduce salinity problems. They have used innovative techniques, employing strategic grazing to exploit variable seasonal conditions, and using livestock to disturb hard ground surface to facilitate germination. Together with additional manual planting, the Ives estimate they have established more than 200,000 trees on their property. Data from regular monitoring over 20 years shows a significant decline in watertable levels and salinity levels of groundwater, suggesting that they have achieved success through revegetation and other on-farm actions.



*Revegetation has been fundamental to the Ive's approach to regenerative landscape management on Talaheni, converting bare soils with visible saline seeps (1982, top) to productive pastures (2012, below)*



## Pastures

Planned grazing, discussed overleaf, is demonstrated in many of the case studies as an effective technique for increasing groundcover and preferred pasture species. Vegetation succession to more productive species of grass and shelter in turn promotes stronger mineral and water cycles and attracts a greater diversity of animals to then recycle nutrient back to plants.

Establishing and maintaining perennial grasses through these techniques assists in providing resilience to the landscape. Increased persistence of native perennial species in the pasture provides for more continuous groundcover. This protects the soils from erosion and weed incursion, produces root biomass, builds SOM to enhance water holding capacity and enhances resilience against drought. Many case study participants cited the goal of “100% groundcover, 100% of the time”. Preferred species can be encouraged through grazing techniques and by monitoring and responding to plant life cycles to maximise – or minimise – plant succession.

On *Winona*, Colin Seis’ ‘pasture cropping’ technique aligns with perennial grass lifecycles, ensuring continuous groundcover and delivering multiple production lines from his land. Colin sows crops into dormant perennial pastures and has integrated his grazing enterprise to graze the crop stubble and regenerating pastures.

Deeper rooted plants can draw on deeper moisture and nutrient for plant production. This in turn increases water holding capacity and structure to receive moisture infiltration where there is greater groundcover. As illustrated by Martin Royds of *Jillamatong*, deep rooted plants can be sought out to facilitate this. Martin elected to encourage growth of chicory (*Cichorium intybus*) and plantain (*Plantago major*), after observing the deep tap roots of weeds that he was removing from his more shallow-rooted pastures. He also observes that by allowing pastures to grow longer through planned rotational grazing practices, the dew condensing on the tall perennial grasses each night now provides additional water that helps sustain soil moisture and healthy pasture growth.

Another technique being applied to increase pasture quality and quantity is the establishment and protection of seed banks – or “seed orchards”, as Ben and Graham Forsyth of *Three Rivers Station* call them. By protecting clumps of preferred grasses enabling them to complete their lifecycle, seed can spread and increase the population of the preferred species.



Flourishing native perennial pastures on Winona (top) and Jillamatong (below)



Tap-rooted plants, such as chicory, help to draw nutrients and moisture from deep within the soil

## Planned Grazing

A key theme displayed by the majority of case study participants was the recognition of grazing management and animal impact as effective farm tools. Driven by holistic decision making, livestock management can be used to shift the landscape towards increasing diversity, and thus resilience.

Many of the case studies demonstrate the positive production and environmental outcomes that can be obtained by using planned grazing. In the mixed enterprise case studies, animal impact is also shown to be integrated very successfully into cropping enterprises.

Positive environmental outcomes span across each of the key regeneration process drivers of soil, water and vegetation, actively driving the water/carbon cycle and include:

- increasing groundcover quality and quantity;
- improving rainfall infiltration;
- encouraging preferred species;
- minimising weed incursion;
- optimising pasture use;
- supporting nutrient cycling;
- increasing SOC;
- increasing long-term carrying capacity; and
- providing early feedback of feed supply to enable adjustment of stocking rate.

The grazing management technique used by many case study participants is a form of time-controlled planned grazing. These comprise variations on rotational or cell grazing, though display similar principles; primarily:

- reducing paddock size and rotating stock through the paddocks;
- matching stocking rate to the carrying capacity of the land;
- determining the pasture rest and recovery period by plant growth rate;
- controlling graze period; and
- adjusting stock density, usually through paddock size and number.

These techniques are based on observations and research, firstly by Frenchman Andre Voisin (as documented in *Grass Productivity*, initially published in 1959) and later developed into Holistic Management practices firstly in Zimbabwe and later in the United States by Allan Savory. Implementation and management experiences of case study participants are as follows.

## Infrastructure

Each of the case study participants using planned grazing have made some investment in infrastructure, generally fencing and watering points. However, many commenced the practice just by mobbing their stock into larger herds and moving through existing paddocks. Paddock sizes observed in the case studies vary with property size and capital available for construction. Evidence from the case studies indicate that it is the application of the technique rather than a prescribed paddock size that will deliver results. For example, on 3350 hectare *Lana*, paddock size is continuing to decrease, now averaging between 10-15 hectares each, with some as small as four hectares. In comparison, on the 1,054,700 hectare *Beetaloo Station*, the Dunnicliff family is aiming to reduce their paddock size to 1200 hectares. Regardless, different versions of the same approach are being applied.

Across the numerous case study participants using this technique, paddock designs also vary significantly. Some have combined paddocks into cells, others are using 'wagon wheel' designs around water points, and others have laneways running between paddocks. Some paddocks are designed to facilitate nutrient transfer and others to group landscape types. Some properties incorporate a mixture of these designs. This indicates that there is no single way of successfully applying this technique, and the fundamental principle is to tailor the approach to individual requirements.

Many case study participants commented that capital investment in increased infrastructure can be recouped within two to three years through increased production and reduced inputs.



Fencing and water-points, such as the 'wagon wheel' design adopted on Tallawang, are fundamental infrastructure for effective planned grazing





The provision of water is fundamental to support rotation of stock through multiple paddocks. To take advantage of the available resource base of *Beetaloo Station*, John Dunnicliff is investing millions of dollars to establish a stock watering system and fences to enable his stock to graze the far reaches of the property. He understands the critical role that animals play in ensuring constant pasture regeneration when combined with planned grazing and what that means for production. These practices also replace the use of fire to encourage new growth, which in turn better protect the soil microbiology for healthy functioning. John's innovative vision is demonstrating possibilities for a new approach to grazing in the vast regions of Australia's north which could significantly increase cattle production – whilst regenerating the landscape.



*On Lana, sheep and cattle are grazed separately or together, depending on desired pasture and stock outcomes*

### Flexibility

Once implemented, planned grazing has been illustrated to provide flexibility in stock and pasture management.

Martin Royds of *Jillamatong* demonstrates an unswerving commitment to looking after his pastures by stocking accordingly, moving from the traditional measure of success being the size of his herd. Martin has trialled a number of paddock configurations to gauge the carrying capacity of his land, ultimately adopting a design which enables his stock to move from areas of high to low fertility, spreading nutrients as the Wrights do on their farm *Lana*.

Animal management priorities on *Jillamatong*, like many others, are on stock weight gain. Martin uses a flexible balance across cattle trading/breeding/agistment to enable him to manage stock numbers in accordance with pasture availability to maximise animal health and weight

gain results. The Joyces of *Dukes Plains*, Finlaysons of *Bokhara Plains*, Craig Carter of *Tallawang* and the Maslins of *Gunningrah* also use a similar approach. These practices not only ensure continuous improvement of the natural resource base, but also maximise animal health and reduce input requirements, such as buying additional stock feed.

On *Lana* the Wrights are managing greater diversification of enterprises, providing flexibility and risk management in the farm ecosystem. The Wrights apply a level of sophistication in the complexity of their grazing rotation, mixing stock classes and animal types, gaining greater level of pasture utilisation and subsequently nutrient cycling. In terms of the differing requirements of animals in their enterprises through time, the Wrights are able to spread the feed demand between production for fine wool, fat lambs, breeding cattle and fattening cattle, better utilising the resources naturally available at different times of the year.

A reduction in labour input required to manage their stock has also been experienced by those using planned grazing. On *Lana*, labour requirements have reduced from one person per 5,000 DSE to one per 12,000 DSE. On *Gunningrah*, labour efficiency has improved by 40%. While animals are being moved regularly, a pattern with which they become familiar, this increased human exposure also makes them easier to handle and monitor for general farm practices.

These enterprises have changed from grazing practices with poor relationship and feedback loops between monthly feed availability and the stock rate being run, such as set stocking. They now have the flexibility and capacity to proactively respond to influences on production they cannot control, such as seasonal rainfall and temperature and related grass and water resource availability. They can then manage carrying capacity to match the resources on hand whilst there is time to manage the outcome of too much or too little feed, without degrading the natural resource base.



## Improvement of the Natural Resource

The use of grazing management as a farm tool has been clearly demonstrated as a technique for improving the natural resource – soil and vegetation naturally linking to greatly improved water infiltration and holding capacity.

Planned grazing practices enhance nutrient cycling, as discussed earlier, and trigger succession from low order species to more palatable and productive plants, particularly perennial species. This is due to the removal of grazing pressure for long enough for the preferred plants to compete for moisture and nutrients with the less palatable species, as demonstrated on *Bokhara Plains*.

By using higher density stocking, regrowth of unpalatable mature grasses is knocked down and this, plus any other plant litter is trampled into the soil enabling it to break down more rapidly. This also strongly contributes to the generation of SOM and ultimately SOC level improvements.

Observation and measurement play key roles in these practices. This enables the maximisation of solar energy flow to plant life for recovery and regrowth. By including measures of groundcover and rainfall infiltration, farmers using these methods are ensuring change in production is not at the expense of the resource base. Case studies on *Jillamatong*, *Gunningrah* and *Lana* clearly display the importance of monitoring pasture recovery periods in between grazing. On *Dukes Plain*, Shane Joyce, like a number of others, highlights the advantage of investing in the best and most productive pastures first, the returns from which can then be invested in regeneration of less productive areas.

The health of these property landscapes, including increases in organic matter and resilience to extreme weather conditions, provides evidence that farmers are not making a trade-off between production and soil health, but achieving long-term economic and environmental success.

The quantity and quality of pasture being regularly produced for the carrying capacity on many of the case study properties, hints at the amount of carbon that may be being sequestered through these regenerative landscape management practices. While significant testing such as that performed on the practices at *Winona* has not yet been performed, depending on management practices, up to 80% of the total biomass produced as a result of the continuing vegetation growth, could potentially be converted into stable soil carbon via the microbial ecology of the animal gut and/or soil.

## Breaking Weed and Parasite Cycles

On *Shannon Vale Station*, the Chappells are following similar grazing management principles but using a technique suited to their particular circumstances. Bull breeding does not allow for the high density herd grazing and trampling needed for plant succession, so the Chappells are mimicking the action of planned rotational grazing by employing a mulcher to mechanically provide the same process. This has been successful in helping them to combat their weed problems by breaking the weed lifecycle and to generate healthy, productive pastures.

Many of the case study properties using planned grazing have also demonstrated a reduction or cessation in the use of drench for intestinal parasites. By using planned rotational grazing, the parasite lifecycle can be broken. Stock are moved from being in contact with hatching parasites and then not returning until after worm burdens have been degraded by the environment in the absence of a host to pick them up from the pasture. This outcome is likely to require some time to achieve, but, as demonstrated on *Lana* and *Gunningrah*, a reduced dependence on drenches can be accomplished through good grazing management.



*Planned grazing techniques have been adjusted on Shannon Vale Station to accommodate for social pressure between bulls and to convert weed-infested pastures*

## SUPPORTING BIODIVERSITY

Biological diversity - biodiversity - reflects the health of the natural system and is an indicator of healthy soil, water cycle and vegetation cover. Biodiversity is the variety of all life forms on earth. It includes the plants, animals and microorganisms, and the terrestrial, marine and freshwater ecosystems of which they are a part<sup>5</sup>.

Biodiversity provides a measure of the existence of species robust enough to survive and rebuild ecosystems in the face of disease, climate change, fire and drought<sup>6</sup>. A healthy functioning natural system will support biodiversity to effectively continue providing fundamental life support services.

A number of case studies with good biodiversity of pasture species, such as *Shannon Vale Station*, *Jillamatong* and *Briandra* reported increased stock weight gain or health. An improved diversity of pasture species with associated increase in total root mass and depth accessing a greater level of nutrient, results in greater mineral content and quality of feed. Where trees are part of the grass system, their ability to draw minerals from significant depths and to cycle that back to topsoil via fallen litter explains a further contribution to improved feed quality. The greater feed quality during critical times of stock joining is a possible explanation for the increased conception percentages experienced on a number of properties.

In addition to obtaining biodiversity outcomes through holistic practices, a number of the case study participants are actively dedicating portions of their property as biodiversity areas. *Lana* has been gazetted as a wildlife refuge since the 1960s and pastures are actively managed to encourage biodiversity, particularly of native species.

It is not just the amount of biodiversity that signifies health in the system, but sufficient variety, particularly in microorganisms, to ensure the life support services can be delivered. Moving away from monocultures is important in supporting this, as demonstrated on *Inveraray Downs* where green manure crops are being incorporated into crop rotation, organic compost is being applied, grazing is integrated to break down sorghum and corn stubble and dedicated biodiversity zones are being maintained.

Below the ground, investment in biological management of the soil, such as that being undertaken by the *Prospect Pastoral Company*, and on *Milgadara*, *Clover Estate* and *Briandra*, is ensuring that there are sufficient microorganisms, beneficial bacteria and fungi to perform essential services within the soil.



*A combination of techniques focusing on soil health have overcome weed invasion, resulting in lush, nutrient-rich pastures on Shannon Vale Station*

## WEED REDUCTION

The existence of weeds in the landscape is often a bio-indicator of poor soil health and insufficient vegetation cover. Due to their survival and reproductive habits, weeds are often the first species to colonise disturbed or debilitated terrain. With many current land practices impacting on soil health, it is unsurprising that weeds continue to invade many areas and thrive.

The consequences of weed invasion are felt on many levels. Economically, all Australians are directly or indirectly affected by weeds. Agricultural, horticultural and forestry industries lose productivity through impacts such as crop and water invasion, reducing crop yield or quality, or through contamination, such as harm to livestock. It is estimated that weed control activities cost Australian farmers around \$1.5 billion a year, and a further \$2.5 billion is lost in agricultural production<sup>7</sup>. In terms of time and money, in 2004-05, 73% of Australian agricultural establishments reported weeds as the natural resource management issue most affecting landowners. By comparison, only 46% of farmers reported soil and land issues and 38% water issues<sup>8</sup>.

This problematic invasion is a symptom of the degraded natural system. Innovative farmers are observing that weeds can have a positive role in the environment as pioneer species to help improve the structure of degraded soil to promote the healthy growth of native plant communities<sup>9</sup>.

The case studies of regenerative landscape management show that effort exerted in the areas of soil health and water management, actually reap benefits in managing weeds. Healthier soils help to maintain vegetation and

biodiversity, competing with and eventually replacing weeds. Reductions in the use of chemical inputs has been demonstrated to further help to restore the natural system and repress weed invasion.

By using organic-based fertilisation targeted to address soil and plant nutritional deficiencies, combined with planned grazing techniques, the Chappells of *Shannon Vale Station* have rejuvenated their pastures. These activities replaced a chemical dependency that was economically unsustainable and still resulting in almost complete reversion to African lovegrass (*Eragrostis curvula*) after pasture sowing. Now, the Chappells can sustain growth rates in their bulls of a kilogram a day all year round.

On *Tallawang*, Craig Carter is encouraging natural processes to take place on his waterways and in his pastures. Supported by planned grazing practices, this is resulting in increased native plant biodiversity and groundcover. Craig has observed a natural reduction in weeds as the health of his landscape increases, so now manages weeds by allowing them to complete their natural sequence.

Charlie and Anne Maslin have adopted a different organic weed management approach on *Gunningrah*, integrating a herd of goats into their enterprise. Goats have a grazing preference for briars and thistles, and the Maslins are using strategic grazing to address any problem areas on their property with good success. Chemical use has also been greatly reduced. As an aside, the sale of goat meat is also providing a profitable complementary production line.

## REDUCED INPUTS

The case study participants' adoption of regenerative landscape management practices has shown a reduced reliance on off-farm inputs. For example, by using grazing management as a farm tool and maintaining groundcover, as discussed earlier, there is a reduced need for farm machinery, seed for re-sowing of pastures, synthetic fertilisers and related labour and capital.

A reduction in synthetic chemical inputs, such as non-organic fertilisers and bio-cides, has been an active decision for some of the case study participants, and for others a consequence of their changed practices.

The Kleins and the Joyces are producing certified organic produce, and in doing so have explored other methods to replace traditional chemical fertilisers. As discussed earlier, on *Pine Lodge*, Ian and Wendy Klein are now successfully treating their dairy effluent with aerobic and beneficial bacteria, enabling it to be used as an effective and economically valuable fertiliser for their pastures.

On *Dukes Plain*, Shane Joyce elected to pursue his interest in biodynamics. Through this he developed an innovative and cost-effective way to address nutrient deficiencies and improve soil fertility. By placing his biodynamic preparation in a 'tea bag' made from shade cloth and placed by the inlet valve in water troughs, the product is 'steeped' every time the cattle drink, passing through their digestive system and distributed across his property by his cattle waste.

Biodynamic preparations can have a highly concentrated population of rumen organisms, which have been cured in a controlled environment, and can achieve a pro-biotic response in ruminants. When delivered to cattle via aerated water from the float valve in a trough, this would provide an inoculant of those species naturally occurring in ruminant intestines. The outcome of increased rumen organisms is a greater utilisation of free nitrogen in the feed intake being converted to protein and taken into the bloodstream, rather than being lost to excretion in urine or manure. Nitrogen so utilised then remains in the body as a protein form for animal production, broken down over time into amino acid forms, which are ultimately excreted to the soil in a form that produces plant growth more palatable than that driven by free nitrate or ammonia forms.

Moving to organic and chemical-free practices has led to a reduced need for pesticides and herbicides in a number of case studies. This is due to increased biodiversity, such as beneficial predatory insects like spiders and ants, and the greater resilience in plant life through healthy nutrient cycling.



Goats have been introduced to Gunningrah as an innovative form of weed control





Though not seeking organic certification, some case study farmers, including those on *Jillamatong*, *Lana*, *Winona* and *Inveraray Downs* have all actively ceased or reduced their use of non-organic fertilisers and bio-cides with positive production and economic results.

With the demonstrated carry capacity increases, the decision not to use chemical fertilisers or bio-cides has not reduced the ability to grow sufficient quantity of quality desired species. Although the presence of weeds is still acknowledged by many of these farmers, increased groundcover often means that proliferation is much reduced.

As discussed earlier, many farmers using planned grazing are also experiencing a reduced need for drench for intestinal parasite control. This continues to reduce farm external inputs and associated costs, including labour and capital.

## PRODUCTION AND ECONOMICS

Sustainable production outcomes can also be an indicator of the health of the natural biosystem. By adopting regenerative landscape management practices some may experience short-term trade-offs in terms of production, yields and returns. However, as demonstrated in the case studies, many innovative farmers seek more than a production increase, with goals related to sustainability, better health or a balance in lifestyle.

Regardless of personal goals, case study participants have demonstrated gains across the whole of the farm balance sheet: increase in profits, production volume, water use efficiency, soil health and maintenance and improvement of the natural resource base. The positive result of such outcomes are being felt economically, environmentally and socially.

A consistent outcome of adopting regenerative land management practices for many of the case study participants was to even out production, smoothing out the profit peaks and troughs often experienced with varying weather conditions.

By having a comprehensive understanding of the production their land can support, the Ives on *Talaheni* and Colin Seis on *Winona* have adjusted their enterprise or integrated others to support both continuous improvement of the natural resource base and sustainable production. Many case study participants identified that the best production outcomes could be achieved, by first working on the best land and extending from there, rather than a more usual strategy of injecting resources into the poorest areas first. By maximising production on the best performing areas of the farm, profit can be leveraged to invest in changing poorer performing areas over time, without exposing the business to undue cash flow stress. Many also took a similar incremental approach to infrastructure enhancement, developing small areas first and investing production increases into further improvements.

The Finlaysons on *Bokhara Plains*, Martin Royds on *Jillamatong*, the McKellars on *Inveraray Downs* and the Dalys of *Milgadara*, are also diversifying their product lines, providing for both stability in income, whilst also reaping the benefits of complementary land use.

Overall, each of the 17 individual case study participants expressed their own motives for adopting regenerative landscape management practices, and correspondingly, each had varying production goals. However, by addressing soil health and focusing on their landscapes, particularly in terms of water management and biodiversity of vegetation, the innovative farmers in the case studies have experienced production and economic improvements as per the table on the following pages.





Property/Enterprise	Production and Economic Highlights
1. <i>Dukes Plain</i> (pg 48) Cattle Innovations commenced: 1993	<ul style="list-style-type: none"> <li>30% increase in productivity with introduction of cell grazing</li> <li>Increased productivity paid off infrastructure investment within 3 years</li> <li>External inputs costs for seed, labour and machinery have ceased</li> <li>Gross margin per hectare now between \$64-\$113; greatest in revegetated paddocks (about 40% canopy cover), measurably more than cleared paddocks</li> </ul>
2. <i>Bokhara Plains</i> (pg 60) Cattle Innovations commenced: 2001	<ul style="list-style-type: none"> <li>Converted claypan and poor soils into productive pastures</li> <li>Carrying capacity so far increased from 56 DSE days per hectare per 100mm rain to over 100</li> <li>Diversifying production for income stability, including beef cattle trading and tourism</li> </ul>
3. <i>Shannon Vale Station</i> (pg 68) Cattle Innovations commenced: 2005	<ul style="list-style-type: none"> <li>Cost of production reduced by 30-35%</li> <li>Overall production increased by 10%</li> <li>2011 weight gain for bulls and heifers up 20% on earlier averages</li> <li>Carrying capacity increased</li> <li>Significant weed infestation overcome</li> </ul>
4. <i>Beetaloo Station</i> (pg 76) Cattle Innovations commenced: 2002	<ul style="list-style-type: none"> <li>Significantly increased access to pasture for cattle, with a corresponding increase in carrying capacity</li> <li>Developed a potential model for sustainable grazing in Australia's Top End</li> </ul>
5. <i>Three Rivers Station</i> (pg 84) Cattle Innovations commenced: 2004	<ul style="list-style-type: none"> <li>De-stocking to prevent further degradation of the natural resource base as a pre-cursor to landscape regeneration and re-stocking</li> <li>Working with lease-holding mining companies to revegetate the landscape</li> </ul>
6. <i>Clover Estate</i> (pg 96) Cattle Innovations commenced: 1995	<ul style="list-style-type: none"> <li>Stock output increased by 33%, using 25% less irrigation water per animal weight produced</li> <li>Growing 600-700 dairy heifers cows off 100ha per annum</li> <li>Reduced irrigation to 5ML annually compared with region average of 8ML</li> </ul>
7. <i>Jillamatong</i> (pg 102) Cattle, cottage industries Innovations commenced: 1994	<ul style="list-style-type: none"> <li>Productivity increased from 1.73 ha to 1.13 ha required to support one cow</li> <li>Weight produced per DSE 50% above regional average</li> <li>Diversification into complementary product lines to maintain cash flow</li> <li>Independent benchmarking showed total profit per hectare 14 times above the regional average</li> </ul>
8. <i>Gunningrah</i> (pg 112) Cattle, sheep, goats Innovations commenced: 1995	<ul style="list-style-type: none"> <li>Consistent profit increase despite lower rainfall</li> <li>Labour requirements reduced by approximately 40%</li> <li>Twin lambing rates improved by 20%</li> <li>Stock class more consistent</li> <li>Goats introduced for weed control, now also providing additional income stream</li> </ul>
9. <i>Lana</i> (pg 120) Sheep, cattle Innovations commenced: 1990	<ul style="list-style-type: none"> <li>Carrying capacity increased from average of 8,000 to 20,000 DSE</li> <li>Increased production maintained through periods of drought</li> <li>Wool staple strength increased from average 40 N/Ktx (newtons per kilotext) to 48 N/Ktx</li> <li>Wool fibre diameter improved from 17.5 to 16 micron</li> <li>Merino lambing increased from 80% to 90%</li> <li>Calving rate increased from 80% to 90%</li> <li>Permanent labour requirements reduced from one person per 5,000 DSE to one person per 12,000 DSE</li> </ul>



Property/Enterprise	Production and Economic Highlights
10. <i>Tallawang</i> (pg 128)  Cattle, sheep Innovations commenced: 2002	<ul style="list-style-type: none"> <li>Stock trading model introduced to match stocking rate with seasonal conditions</li> <li>Reduced input costs</li> <li>Expected 15%-23% profit on cattle production through breeding and trading programs</li> </ul>
11. <i>Talaheni</i> (pg 136)  Sheep, cattle, native trees Innovations commenced: 1980	<ul style="list-style-type: none"> <li>Markedly increased availability of productive land through salinity management</li> <li>Specialist provider of ultrafine sharleas wethers</li> <li>Revegetation provides timber for potential farm forestry</li> <li>Beef cattle a complementary product line</li> </ul>
12. <i>Winona</i> (pg 144)  Crops, sheep, native grass seed, kelpie dogs Innovations commenced: 1993	<ul style="list-style-type: none"> <li>Crop production maintained with annual input costs decreased by \$120,000 including no herbicide and 70% less fertiliser</li> <li>Concurrent enterprises ('vertical stacking') of grain, sheep wool and meat, native grass seed</li> <li>Wool tensile strength improved by 60%</li> <li>Vegetable matter in wool reduced by approximately 70%</li> </ul>
13. <i>Milgadara</i> (pg 152)  Crops, sheep, compost Innovations commenced: 2001	<ul style="list-style-type: none"> <li>Increased crop yields and improved crop quality with less fertilisers (canola up to 3t/ha and 47% oil; wheat 5-6t/ha)</li> <li>Increased carrying capacity</li> <li>Lambing percentages 150% in cross bred ewes, 120% in Merino ewes</li> <li>Wool staple strength not less than 36N/Ktx</li> <li>Complementary business with client base of over 2000</li> </ul>
14. <i>Inveraray Downs</i> (pg 160)  Crops, cattle, compost Innovations commenced: 2000	<ul style="list-style-type: none"> <li>Increased crop bushel weight</li> <li>Even yields across the property</li> <li>Reduced disease</li> <li>Reduced input costs (chemical fertilisers, herbicides, pesticides)</li> <li>Complementary production lines in agistment and compost sales</li> </ul>
15. <i>Briandra</i> (pg 166)  Crops, sheep Innovations commenced: 1996	<ul style="list-style-type: none"> <li>Increased cropping capacity through raising beds (\$200/ha) at a fraction of the cost for installing sub-surface drains (\$1000/ha)</li> <li>Crop production sustained with reduced inputs</li> <li>Increased sheep weight gain</li> </ul>
16. <i>Prospect Pastoral Company</i> (pg 172)  Crops, sheep Innovations commenced: 1994	<ul style="list-style-type: none"> <li>Continuing production trend to higher yields and higher quality cereal grains and hay on growing season rainfall as low as 100mm</li> <li>High quality 17-20 micron wool from sheep adapted to local environment</li> <li>Premium grade fat lambs at a lambing rate of better than 115%</li> </ul>
17. <i>Pine Lodge</i> (pg 180)  Dairy Innovations commenced: 1996	<ul style="list-style-type: none"> <li>Organic dairy produce delivering a 10% premium</li> <li>Veterinary costs substantially reduced</li> <li>Irrigation reduced by 30%</li> <li>No ongoing external input costs</li> </ul>

## MAKING THE CHANGE TO REGENERATIVE LANDSCAPE MANAGEMENT PRACTICES

A common experience for most of the case study participants was the challenge in changing behaviours to regenerative landscape management and breaking away from the status quo, as illustrated in the *Dukes Plain* and *Jillamatong* case studies. Many cite that their existing knowledge and mindset was the biggest hurdle to overcome, having to learn different theories, techniques and approaches to their practices. Incorporating new knowledge against their own and others' traditional values and approaches took confidence and persistence.

To question and challenge convention was a common factor across many of the case studies. Prior to adopting change, many experienced low points in terms of production, landscape degradation or personal health challenges, and identified that there had to be a better way to manage their enterprise.

### Taking a Holistic View

Taking a more holistic view of farm management, including maximising natural system functioning, guided practice change for many of the case study participants. This included addressing the underlying cause, rather than visible symptoms, as illustrated on *Lana* and *Gunningrah*.

In adopting changed practices, this often involved 'seeing' the landscape differently to conventional management, to understand what degradation and healthy functioning looked like in order to facilitate natural processes. On *Tallawang* and *Bokhara Plains* this involved accepting weeds as pioneering species to allow vegetation to commence regeneration. On *Milgadara*, *Inveraray Downs* and *Briandra*, crop stubble was retained rather than being cleared. On *Shannon Vale Station* and *Jillamatong* direct-drilling was adopted, rather than conventional practice of fully cultivating and re-sowing pastures

### Commitment, Trial and Error

The case study participants demonstrated fortitude and commitment to persist when the techniques were new and results took time to achieve. Farmers emphasised trial and error as an important process in learning and adjusting practices to suit the landscape and personal goals. Many cited that they made mistakes along the way, but, importantly, persisted. As highlighted by Tim Wright of *Lana*, "...we assume we could be wrong, and we monitor

and replan. This is the holistic feedback loop, which is really important. Tomorrow is another day – nature is changing every minute and we have to change with Mother Nature".

### Continuous Learning

Most case study participants committed to self-education and continuous learning, searching widely to identify what would work for them in their circumstances. Many noted that relevant information is much more available now than it was a decade or more ago when they commenced practice change. Very few adopted one single theory or method, and the more common practice was to learn widely and adopt techniques and practices that aligned with their own individual goals and the local landscape. In the words of Shane Joyce from *Dukes Plain*, "Select the tiles that *you* want, and make your own mosaic".

### Observe and Measure

Observation and measurement were central to the adoption and maintenance of regenerative landscape management practices by many of those interviewed for the case studies. Maintaining regular records and observing the landscape through techniques such as keeping a fixed point photographic record allow incremental change to be tracked. This then provides a feedback mechanism to identify which practices are working and which are not, to determine what should be extended and what should cease. John and Robyn Ive of *Talaheni* provide a key example of these practices, capturing over 30 years of data. John notes, "If you do not measure it, you cannot manage it".

Some case study participants are maintaining a direct link between management practices and production. For example, on *Dukes Plain*, measurement of the planned grazing practices includes the stocking rate, shelter type,



Understanding and performing soil tests helps to support regenerative practices



percentage of canopy cover as well as grazing pressure - which can be converted to grass consumed, based on the known consumption patterns of the stock class concerned. Production is measured in terms of kilograms of beef produced per hectare of pasture. Cause and effect relationships can therefore be determined and influencing factors adjusted.

Matching stocking rates to the carrying capacity of the land was evidenced as a very important factor by a number of grazing enterprises. The use of grazing charts to generate a benchmark carrying capacity per 100mm rainfall, as illustrated on *Gunningrah*, effectively provides a feedback loop from pasture to management about when to increase or decrease stocking rates. This has been demonstrated to good effect, especially on properties adopting stock trading strategies, such as on *Bokhara Plains* and *Tallawang*.



Monitoring rainfall and matching stocking rates to the carrying capacity of the land helps to preserve - and improve - the natural resource

## COORDINATED SUPPORT

The wider adoption of regenerative landscape management is a strategic imperative for Australia's future wellbeing. Support mechanisms are required to assist land managers who are adopting regenerative landscape management or who have attended training activities or demonstration days in order to provide confidence in changing practices.

Support from like-minded individuals, groups or organisations was noted as beneficial for many case study participants in adopting changed practices. This can be seen in the *Bokhara Plains*, *Jillamatong*, *Gunningrah* and *Briandra* case studies, amongst others. Attending presentations, field or open days provides the opportunity to visit and learn, creating a forum for information transfer and peer review. Overall this leads to a sense of empowerment amongst participants and encourages cumulative learning. Such activities also create a community, even if it is separated geographically – which is essential to support widespread adoption of change.

*Soils for Life* selected two case studies to investigate support mechanisms in particular. These examined extension activities underway which are successfully leading, guiding and encouraging farmers and land managers to learn about and adopt regenerative land management practices.

The *North East Catchment Management Authority* (CMA) in Victoria (CS18, pg. 186) and the Tasmanian Natural Resource Management body, *NRM South* (CS19, pg. 196), provide two of many possible examples of effective means which could be used to provide the required encouragement and support to farmers and land managers to adopt regenerative landscape management practices.

*North East CMA* is achieving catchment-wide change in knowledge of how to build healthy soils. By identifying a critical knowledge gap – the ability to understand and respond to soil tests – the CMA has developed the *Soil Carbon Programme*. This program provides practical action and advice, in the form of soil tests, agronomic advice on options on how to respond to the soil tests and ongoing engagement and information activities based on farmer and land manager requirements. With funding of \$2.2 million over four years, over 500 farmers are actively involved and up to 1500 have been informed of improved soil management practices. This equates to around \$1500 investment in each farmer over a four-year period.

The project demonstrates a very cost-efficient way of encouraging change in farming practice. If extended across Australia's 53 other CMA/NRM organisations it could potentially realise 25,000 farmers actively changing their soil health for the better, together with more than another 50,000 informed to make a change.

On a smaller scale, the projects being managed by *NRM South* are encouraging landholders to adopt regenerative landscape management practices in a low risk way that suits the situation of individual farmers.

*NRM South* provides a range of options to assist farmers to change their practices, with ongoing engagement to support changes beyond the initial enthusiasm experienced at field days or workshops. In particular, their *Building Evidence for Regenerative Agriculture* assisted trials in planned grazing are empowering farmers and land managers to understand new techniques at their own pace. Trial demonstration sites also allow for sharing of results and broader discussion and to generate interest across the catchment. Through this support technique, the landholders are a part of the change, with minimal disruption to their production, and they can choose whether or not to adopt practices based on their own evidence.



Through an expanded communications program, the results of projects such as those being run by the *North East CMA* and *NRM South* could be shared with not only land managers but also to local government, businesses and schools. This would provide wider community awareness of regenerative landscape management practices, the importance of soil health and the methods of achieving improved sustainable production.

In addition to government-funded organisations, there are also many private consultants working in natural resource

management fields who are also having significant impacts in supporting the adoption of regenerative landscape management practices. A number of case study participants cited the use of consultants individually selected to provide specific advice on the implementation and management of their innovative practices. The panel of agronomists accessible to participants of the *North East CMA's Soil Carbon Programme* was an important part of the project. Sourcing providers whose approach aligns with farmers' own goals is central to the success of such support.

## PRINCIPLES FOR REGENERATIVE LANDSCAPE MANAGEMENT

The *Soils for Life* case studies show that many different techniques can be applied to regenerate the landscape. Indeed, tailoring a variety of methods to the landscape and personal preferences of the landholders is a common theme. There is no single solution to landscape regeneration.

The following principles consistently emerge from case study participants as underlying their regenerative practices – regardless of location or enterprise. These can be applied by other landholders as a basis for their own regeneration journey.

- ◆ Improve the structure of soil, through enhancing organic matter content
- ◆ Use and conserve rain where it falls
- ◆ Manage holistically
- ◆ Care about the land as a resource
- ◆ Commit to education and constant learning
- ◆ Search out communities of interest for help and advice
- ◆ Work on best land and extend from there
- ◆ Strive for maximum groundcover, for the majority of the time
- ◆ Manage times of plenty for times of shortage
- ◆ Reduce reliance on off-farm inputs
- ◆ Observe, measure and respond



## CONCLUSION

The *Soils for Life* case studies illustrate that adopting high performance regenerative landscape management practices - focussing on and interlinking the key process drivers of soil, water and vegetation - can rebuild the natural and efficient biosystem. Using regenerative landscape management practices, the case study participants have also demonstrated reduced input costs, with less expenditure on machinery, synthetic inputs and labour, reducing the overall cost of production and subsequently increasing profits.

On the individual level, these case studies show how triple bottom line outcomes – economic, environment and social – can be achieved. However, the potential for these outcomes to be experienced on a national and global scale is also clear. These include, but are not limited to:

- ◆ soils that are increasing in organic content, microbial and biotic activity, with restored carbon and essential nutrients for plant growth to revegetate the landscape and provide the basis for sustained nutritious food and fibre production;
- ◆ environments that are resilient and can better cope with extremes of climate such as flood and drought, whilst positively influencing climate remediation;
- ◆ water efficiency to maximise the use of every drop of rain that falls onto the landscape;
- ◆ sustainability, through cycling essential plant nutrients rather than introducing off-farm inputs such as chemical interventions;
- ◆ landscape biosystems that are healthy, regenerative, productive, profitable and encourage diversity; and
- ◆ better returns to farmers and land managers through profitable production, maintenance and improvement of the natural resource base, leading to more balanced and healthier lives.

To realise the opportunities of high performance regenerative landscape management on a broader scale, land managers and agricultural communities Australia-wide will need to be encouraged to change their management practices. Regulatory and economic impediments need to be removed so that land managers can extend the adoption of such practices, to help regenerate degraded landscape profitably; and create the commercial conditions and incentives to foster such land regeneration innovation.

In essence, change will need to be inspired and encouraged by governments, potentially at the highest level, and coordinated 'on the ground' by knowledgeable, supported and willing land managers.

Such an approach could provide a model for others to follow, leading action to meet the demands of a growing population and changing climate.



## RECOMMENDATIONS

### 1. Strategic Direction

Foremost, Australians must recognise that our landscape is degraded and is not improving at the rate that will guarantee our future wellbeing. At the federal level, we need a simple policy statement that highlights this degradation; that practices must change and that we have the answers. This statement can then drive a strategic, holistic plan to regenerate our landscape, that is coordinated at the Deputy Prime Ministerial level (equivalent) and encouraged by local action on the ground. The plan must highlight the requirement for integrated improvements in soil health, water use and conservation, together with an increased biodiversity of vegetation across the landscape.

### 2. Policy

Supporting policies need to be developed in the following areas. These need to be enabled to move quickly to implementation and action.

**A. Soil.** Recognise the potential to improve Australian soil health, to support production, sequester large amounts of CO<sub>2</sub>, build resilience in the landscape and contribute to our ability to adapt to a changing climate.

**B. Water.** Adopt an in-soil reservoir approach in water management from when it first reaches the soil to redress the measurable declines in soil moisture, diminished rainfall, high evaporation rates and increasing temperatures. This would also assist water users to adjust to the much lower amounts of water likely to be available in dams and reservoirs in the future under current management approaches. Such 'front of pipe' policies could focus on:

- regeneration of wetlands (large numbers of which are in higher reaches), which would improve both the quality and the quantity of our water;
- Improving the capacity of slopes for water infiltration - restoration of soil carbon to improve capture of water into the landscape; and
- Regenerating riparian zones and flood plains (slowing movement) by reconnection of the creeks and rivers with their flood plains, to improve absorbance of overflow for productive use in dry times.

**C. Vegetation.** Target revegetation and natural regeneration, including effective pasture management, reduction of monocultures, increased diversity and establishment of diverse woodland communities and deep-rooted trees to restore natural pedogenesis, in-soil reservoirs, hydrological cycles and help to keep salinity within the subsoils.

**D. Recognition.** Actively support high performance land management innovators to ensure that they, together with their communities and regional authorities, can play a leading role in extending these solutions more widely. Farmers should be recognised as the primary stewards of our agricultural landscape and rewarded accordingly.

**E. Education.** Establish a program that informs, educates and mentors a broad range of stakeholders on leading performance in landscape management to provide confidence that changes will make a difference and to encourage wider adoption of these practices.

**F. Research & Development.** Reallocate proportions of funding for research and development to focus on addressing areas of land management that can have both immediate and long term effects, such as improving soil health and increasing efficiency of water use and conservation to achieve greater return from investment already available.

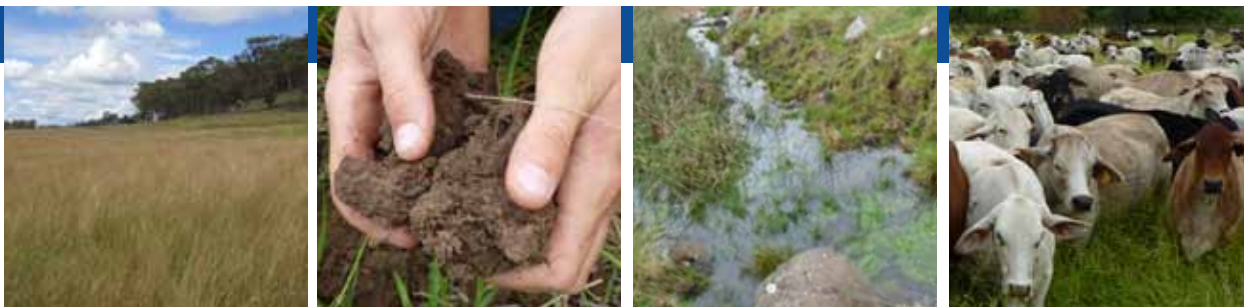
The *Soils for Life* case studies provide compelling stories of innovators achieving success in the landscape - with information available in the time frame elected to complete them. Further research and development capabilities should focus in these areas that are already achieving positive outcomes.











## CASE STUDIES OF LANDSCAPE REGENERATION IN PRACTICE

The case studies on the following pages were identified through a comprehensive selection activity in response to a call for expressions of interest (EOI) to participate. The program sought case studies of better practice enterprises that have been proving their viability over at least five to ten years, supported by reliable records and data collected over time.

Promotion for the EOI activity in December 2011 was through a media release sent to key national newspapers, including The Rural Press; direct email to members listed on current the Outcomes Australia database; and letters distributed to the State and Territory Ministers for the Environment and Agriculture (equivalent), advising them of the planned activity, along with a similar letter to the various Catchment Management Authorities (equivalent), to seek their cooperation.

The EOI format was developed to allow credible decisions to be made during the selection process without being an onerous process for farmers and other interested parties.

Once received responses were confirmed as complete, they were entered into a database prior to consideration by the selection panel. The selection panel was chaired by The Hon Gary Nairn and comprised a group of specialist advisers from backgrounds including primary production, hydrology, soil health and environmental science. The panel conducted the evaluation of all the responses to the EOI in accordance with a documented process. The activity was independently reviewed and endorsed by *Price Waterhouse Coopers*.

Seventeen innovative farmers were ultimately selected through this process for the first tranche of *Soils for Life* case studies. Two additional case studies were performed

on community organisations which provided examples of coordination and cooperation in supporting farmers and land managers to adopt regenerative landscape management practices.

Selected case studies were interviewed by the *Soils for Life* field team between January and June 2012. These reports were edited for consistency and reflect the experience of the landholders as interpreted by the interview team. Data reported in the case studies is as provided by case study participants. Products or services mentioned in the case studies are documented as part of the landholders' experience and should not be seen as an endorsement by *Soils for Life*.

Finalised case studies were provided to the selected landholders for review prior to publication. A technical support network comprising specialists from fields including soil microbiology, agronomy, water quality and management, forestry, agricultural science and farming systems reviewed the case studies for technical accuracy and contributed to the analysis presented in Chapter Two of this report.

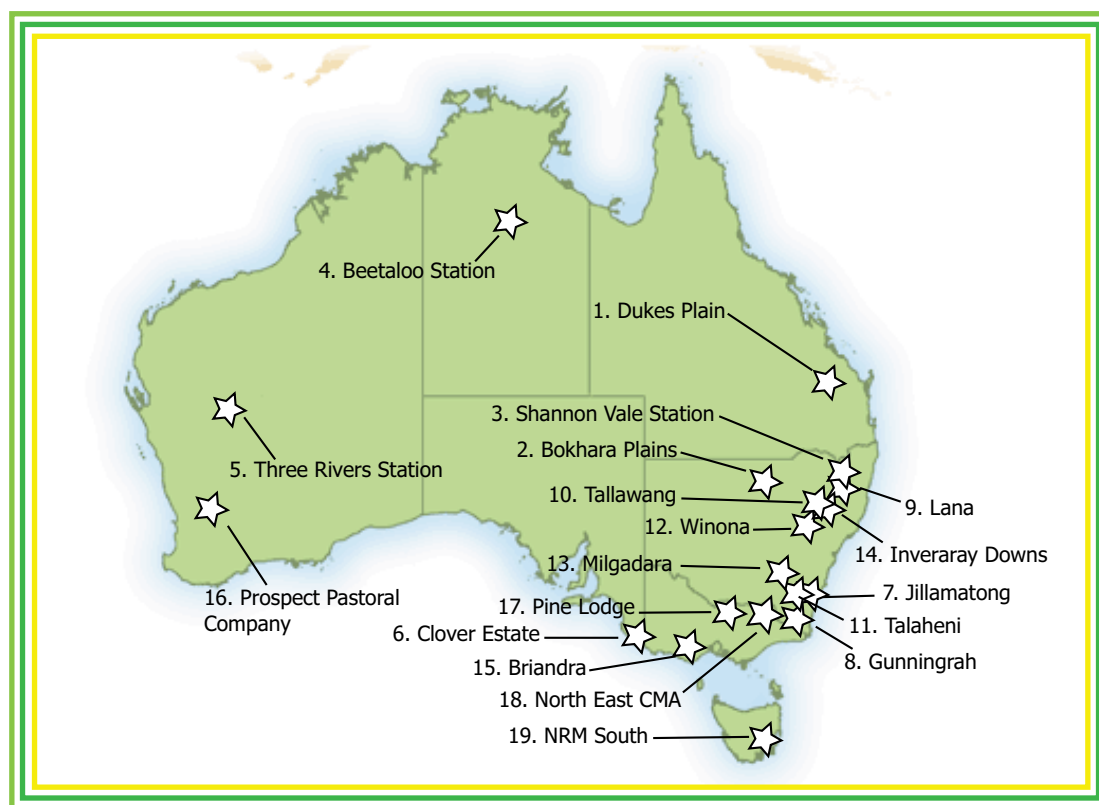
The merit selection process aimed to ensure that case studies comprised a regional spread across Australia; with a range of land uses together with a cross section of innovative techniques. The diversity was somewhat restricted by the responses received, with the most noticeable gap being a horticulture case study and a slight over-representation of grazing case studies. Further tranches of case studies will seek to address these gaps.

Case study statistics are presented in the tables overleaf.



## Case Study Locations and Summary

Number	Property Name	Principal(s) Name	Nearest Town	State
1	Dukes Plain	Shane and Shan Joyce	Theodore	QLD
2	Bokhara Plains	Graham and Cathy Finlayson	Brewarrina	NSW
3	Shannon Vale Station	Greg and Sally Chappell	Glen Innes	NSW
4	Beetaloo Station	John and Trish Dunnicliff	Elliott	NT
5	Three Rivers Station	Graham and Ben Forsyth	Meekatharra	WA
6	Clover Estate	David Clayfield	Mount Gambier	SA
7	Jillamatong	Martin Royds and Trish Solomon	Braidwood	NSW
8	Gunningrah	Charlie and Anne Maslin	Bombala	NSW
9	Lana	Tim and Karen Wright	Uralla	NSW
10	Tallawang	Craig Carter and Nicky Chirlian	Willow Tree	NSW
11	Talaheni	John and Robyn Ive	Murrumbateman	NSW
12	Winona	Colin Seis	Gulgong	NSW
13	Milgadara	Bill and Rhonda Daly	Young	NSW
14	Inveraray Downs	Cam and Roxane McKellar	Spring Ridge	NSW
15	Briandra	Brian and Sandra Wilson	Lismore	VIC
16	Prospect Pastoral Company	Ian and Dianne Haggerty	Wyalkatchem	WA
17	Pine Lodge	Ian and Wendy Klein	Shepparton	VIC
18	North East CMA	Region - North-Eastern Victoria	Wodonga	VIC
19	NRM South	Region - South and Eastern Tasmania	Hobart	TAS



CASE STUDY	1. Dukes Plain	2. Bokhara Plains	3. Shannon Vale Station	4. Beetaloo Station	5. Three Rivers Station	6. Clover Estate	7. Jillamatong	8. Gunningrah	9. Lana	10. Tallawang	11. Talaheni	12. Winona	13. Milgadara	14. Inveraray Downs	15. Briandra	16. Prospect Pastoral Co.	17. Pine Lodge	18. North East CMA	19. NRM South
Page Number	46	58	66	74	82	94	100	110	118	126	134	142	150	158	164	170	178	186	196
<b>Industry/Enterprise</b>																			
Cattle	•	•	•	•	•	•	•	•	•	•	•			•					
Sheep								•	•	•	•	•	•		•	•			
Cropping												•	•	•	•	•			
Dairy																	•		
Other		•					•	•			•	•	•	•					
Environmental Organisation																		•	•
<b>Key Practices Discussed in Case Studies</b>																			
Addressing soil chemistry/ carbon	•		•			•	•		•	•	•	•	•	•	•			•	
Addressing soil structure		•	•		•	•	•						•	•	•	•			•
Addressing soil biology	•		•			•	•						•	•	•	•			
Application of bio-fertilisers/ amendments	•		•			•	•						•	•	•	•	•		
Composting			•				•						•	•			•		
Supporting nutrient cycling			•			•	•		•			•	•	•	•		•		
Addressing salt-affected soils							•				•					•			
Water reticulation	•	•	•	•		•	•	•	•								•		
Slowing water flow					•		•	•		•	•								
Capturing rain where it falls	•	•	•	•			•	•	•	•	•	•	•	•		•	•		
Planned grazing	•	•	•	•			•	•	•	•	•	•	•	•	•	•			•
Direct-drill cropping/ sowing			•				•					•	•	•	•	•			
Revegetation	•	•			•						•								
Proactive weed control			•					•											
Reduction/cessation of chemical inputs	•		•			•	•					•	•	•			•		
Stock trading/agistment	•	•					•			•				•					
Supporting adoption of regenerative landscape mgt.		•																•	•
<b>Average Annual Rainfall/Irrigation</b>																			
<400 mm		•			•											•			•
401-699 mm				•				•			•	•	•	•	•		•	•	•
>700 mm	•		•			•	•		•	•	•	•	•	•				•	•
Dryland	•	•	•	•	•		•	•	•	•	•	•	•		•	•		•	•
Irrigated						•								•			•	•	•
<b>Property Size (hectares)</b>																			
<500						•	•			•	•						•		
501-2000			•									•	•	•	•				
2001-5000	•							•	•										
5001-10,000		•														•			
>10000 - 1,000,000+				•	•														



# Delivering continuous improvement of the farming resource



## DUKES PLAIN

### Farm Facts

30 km south of Theodore,  
Southern QLD Brigalow Belt

**Enterprise:** Cattle

Certified organic beef cattle breeding,  
backgrounding and fattening

### Property Size:

7900 hectares, 3000 hectares farmable

**Average Annual Rainfall:** 700 mm

**Elevation:** 300 m

### Motivation for Change

- Inputs and maintenance costs exceeding production returns

### Innovations

- Comprehensively monitored and measured time-controlled cell grazing
- Soil improvement using biodynamic methods
- All organic management
- Innovations commenced: 1993

### Key Results

- 30% productivity increase with gross margins between \$64-\$113 per hectare
- Higher yields on revegetated brigalow paddocks than cleared paddocks
- Increased water availability due to increased rainfall infiltration and reduced losses to evaporation



Shane and Shan Joyce have been involved in farm landscape regeneration for 37 years. They believe that mixing their own and other peoples' experiences has helped them in their successes and in achieving their vision for the landscape at Dukes Plain.

Shane and Shan Joyce came to Dukes Plain in 1982 from a background in organic farming. Over the years they adopted new management practices: ceasing the use of fire, retaining timber and valuing regrowth, prioritising pasture diversity and native pastures, and employing low production costs and inputs. In 1993 a radical change was made to the grazing system on Dukes Plain, moving from continuous grazing in seven paddocks to a cell grazing system across almost 100 paddocks. Focus moved from the production bottom line to a measure of kilograms of beef produced per hectare of available pasture. Production increases were experienced within two years of adopting planned grazing management.

In addition to cell grazing, outcomes were further enhanced by the later application of organic and biodynamic methods.

By persisting through obstacles and impediments to change, the Joyces have experienced improvement in the natural resource with healthier soils, more diverse pastures, more trees, fewer weeds, improved water quality and water use efficiency, as well as increased carrying capacity, easier animal management and reduced labour requirements. They have been able to maintain or increase production through periods when many properties have had to reduce stock numbers.

Observation, monitoring, and recording data has allowed the Joyces more informed decision making, benefiting both landscape and business health. Approximately 800 hectares of crop land has been returned to perennial pasture at a zero dollar cost and gross margin per hectare is now between \$64 and \$113 on land types varying from eucalypt forest to brigalow scrub.

Contact Shane & Shan Joyce: [sjoyce1@bordnet.com.au](mailto:sjoyce1@bordnet.com.au)



## Dukes Plain

Dukes Plain is a 7900 hectare sub-tropical property of which 3000 hectares is used as grazing land for beef cattle. This country was formerly dominated by brigalow (*Acacia harpophylla*) scrubs and semi-evergreen vine thicket, which are both endangered ecosystems, and small areas of eucalypt forest.

The remaining 4900 hectares is sandstone escarpment of virgin native vegetation comprising eucalypts, spinifex, acacias, grass trees and numerous other shrubs, forbs, and grasses. This area is a significant wildlife corridor linking Isla Gorge and Precipice National Parks.

Traditional management of Dukes Plain had seen continuous grazing over its seven paddocks, with water provided through open dams with constant stock access. The brigalow and other vegetation had been cleared from the landscape as a result of government lease conditions in the newly opened 156,000 square kilometre Fitzroy River Basin in central Queensland in the 1950s and 1960s. The clear and burn practices reflected the tree management techniques of the era. Regular fires were also used to control timber regrowth.

Shane Joyce points out that, as a consequence of the prevailing farming practices, the landscape was in steady decline from the beginning of the brigalow scheme. Pastures were degrading through loss of soil structure and fertility and species variety had reduced. This was combined with a reliance on external inputs with rising costs all at the same time as commodity prices were falling.

Shane and Shan took over operation of the property in 1982 after coming from a background of permaculture and organic farming on the Sunshine Coast. Not daunted

by what they had come into, they began experimenting with elements of various farming management systems ranging from fully conventional to what, at the time, were considered extreme alternatives. They read about advantages of various alternative agricultural models from around the globe. They constantly questioned their farming practices and the resultant impacts on the land and production. In this process they focused on differentiating between symptoms and causes in the indicators that they observed.

This process of observation and review continued over the next ten years until Shane and Shan had gained a body of skills and knowledge that enabled them to begin to measure the results of their management practices.

## Embracing Change

Change was evolutionary on Dukes Plain, but became inevitable when a cost benefit analysis demonstrated that input and maintenance costs from their current farming practices were far exceeding returns from production.

The reality of the inevitable outcome of this situation firmly committed Shane and Shan to a complete change of production management. They realised that the landscape was out of balance and it needed to be returned to balance to achieve long term economic production. They were convinced that, once the balance was returned, they could increase cattle carrying capacity, using the same area of land, without detriment to the landscape.

Self education played a big part in deciding what changes to make to production operations. For the Joyces this included reading, observation and experimentation with both alternative and conventional systems. Shane and Shan spent eight years learning about and working with



permaculture techniques. Knowledge was furthered through attending workshops, courses and field days, and engaging with leading edge consultants. They eventually completed the Grazing for Profit course which, among other outcomes, provided the tools and guides to enable measurement of production success.

Changing the grazing system on Dukes Plain was the major single change to overall production. The introduction of cell grazing for their cattle focused on high stock density for minimum grazing time to allow pasture maximum time to recover. This has led to significant improvements in landscape health and production outputs, as detailed below, as well as substantial reductions to inputs required. As Shane says, "The 'cow tractor' is now the most used piece of farming equipment".

A one-off capital investment in fencing and water distribution was necessary to establish the cell grazing system. An extensive network of single wire electric fences, sub-divide the property into what are now 97 paddocks of around 20-40 hectares each. A water reticulation system services all paddocks, gravity fed through polythene pipes from two 'turkey's nests' – dams constructed at high points of the property which can have water pumped into them as required.

Continual monitoring and adjustment has been an essential part of the Joyce's strategy. Receiving peer input through exposing the property and management to public scrutiny by hosting field days has also been an important element of implementation. Close working relationships have also been established with conservation groups and Queensland National Parks officers.



*Seven paddocks were turned into ninety seven on Dukes Plain*

Currently, Shane and Shan are being approached by resource companies seeking to purchase environmental offsets. These organisations have been attracted to the farm by the high levels of regrowth on the previously cleared endangered brigalow and semi-evergreen vine thicket land types. Shane and Shan see the potential for possible future sale of soil carbon credits. However they note, "This is a complex issue that requires further investigation and clarification to ensure appropriate recognition of the land, the landscape and agricultural production".

## Impediments to Change

Shane cites a broad range of challenges that he has encountered in the process of changing their property management, "The first and most obvious challenge was overcoming prior learning ranging from my schooling days – the broadly ingrained views that Australian soils are old, barren, degraded and can't produce topsoil – to the generally accepted use of low management techniques".

Shane points out that this long accepted approach is seen as the easier path, but over time it inevitably degrades the land, leading to ever falling production. "From that outcome it is only a short step to the general acceptance of external interventions such as fertiliser dependency, re-seeding and drought feeding regimes, all of which also eventually contribute to degradation of the system."

Even with newly acquired information and the benefits of formal study and research, the Joyces found that it was challenging to put the theoretical principles into practice in a manageable form. This was exacerbated by a lack of peers to share ideas with or successful models to 'copy' from. General scepticism of new or different ideas was, and is, commonly encountered. Both Shane and Shan say that having the courage to try new methods and trust their own judgement has been an obstacle in itself. Old habits can be hard to break.

In addition, Shane notes that, "Declining product value across the agricultural sector, in contrast to increasing land values, provides additional challenges. Wrong decisions can easily lead to economic hardship".

Shane also sees a threat to innovative land management in the dictation of practices, such as vegetation and pasture management, by authorities which often do not have direct experience on the land. "Ordinary people in remote places lack the opportunity to 'have a conversation' with such entities. To share and demonstrate actual experiences, is a missed opportunity for these authorities and virtually guarantees 'more of the same' from them."

## Delivering Continuous Improvement

Shane Joyce firmly believes that the natural resource base does not have to inevitably 'run down' with production over time, as is a commonly held view. With the management techniques applied, the Dukes Plain environment is clearly 'running up', showing only continuing improvement, not degradation over time.

A number of principles have helped the Joyces to achieve continuous improvement of their farming resources, including:

- ◆ Maximize animal density through large mob size and small paddocks.
- ◆ Match stocking rate to carrying capacity. Have a good agent who assists with selling and acquisition of appropriate stock as determined by rainfall and pasture conditions.
- ◆ No purchasing of supplementary feed for livestock during drought (see point two).
- ◆ Do not become emotionally attached to livestock (see point two).
- ◆ Provide adequate rest for pastures to fully recover before grazing.
- ◆ Continually monitor and adjust.
- ◆ Encourage diversity of animals and plants.
- ◆ Provide adequate tree cover on landscape to minimise stress on land, livestock and people.
- ◆ Continue to up-skill management and staff through ongoing education.
- ◆ Minimise external inputs.
- ◆ Seek the best in external advice.

The 97 paddocks are now grouped into three cells to manage the various mobs of cattle. Actively managed rotation averages around two to three days grazing and 60 days recovery, longer in slow growing season. Stocking is based on 26 stock days per hectare per 100mm of rainfall. This is based on one adult equivalent – a 450kg animal at 0.5kg per day live weight gain to 2 hectares. The stocking rate is continually adjusted according to rainfall and feed availability.

In 1995 the Joyces began to record individual paddock yields. Records maintained and grazing practices are based on those learned in the *Grazing for Profit* course. Measurements were more rigorous in early years, though these have been adapted over time and reduced to what is most useful. Specific ground cover measurement processes used to be followed in a regular format to record both ground cover and species present, but these have been reduced to set point photographs taken twice a year at the end of the growing and dry seasons (see overleaf).

Shane sees a real strength in having the ability to measure the results of different landscape management methods in dollar terms – tools to measure trends in both landscape and business. The paddocks are now continually monitored and measured and grazing time adjusted accordingly to support optimum grazing and recovery periods.



*A recently grazed paddock (left) next to a recovering paddock (right)*

Shane points to the importance of planning, "Once the infrastructure was established, preparing, monitoring and controlling the grazing management plan became the major regular input required for the operation of Dukes Plain. A one to two month grazing plan can be prepared in a couple of hours, outlining paddock rotation in a form that can be followed by anyone. Less physical work is now required on the property, mostly just opening and closing the electric fence tape 'gates' to move cattle from one paddock to another, in accordance with the plan, and occasional fence repairs".

Shane and Shan value continuous learning. All management and staff on Dukes Plain attend the *Grazing for Profit* workshop, as well as the *Low Stress Stockhandling* workshop, various field days and biodynamic farming workshops.







*Fixed point monitoring top to bottom: October 1997 ,  
October 2011, , March 1998 and March 2012*

As an added bonus, the increased human visibility and animal handling has made the stock far more approachable and easy to manage. The stock are familiar with the rotation process and eagerly move between paddocks once gates are opened.

## Creating Healthy Soils

Shane and Shan use biodynamic products to enhance soil fertility and have adopted innovative distribution practices for improving the soil quality on Dukes Plain. "Fertile soils provide oxygen, water and nutritious food for plants, animals, insects and microbes", Shane acknowledges. Good soil underlies – literally and metaphorically – much of the success on the Joyce property.

Good litter cover on the soil and denser stands of healthy perennial grass plants and legumes, all contribute to creating soil organic matter, leading to greater water absorption, and minimising surface erosion and runoff. Traditional management practices saw soils in decline with poor water and mineral cycles. District averages for soil organic matter are less than 1%. Measured in 2003, Dukes Plain showed around 4% soil organic matter.

The 2003 soil tests revealed no glaring deficiencies, however more recent analysis identified insufficiencies in levels of boron and manganese which are now being addressed. It was through a series of events that Shane developed an innovative and organic way of increasing the nutrients in his soil.

Upon adopting cell grazing, Shane felt pressure to put urea in the water for the cattle as a protein supplement. Uncomfortable with this concept, due to urea's potential toxicity, Shane explored other options, influenced by previous experience in permaculture and interest in biodynamics. Initially he experimented with releasing liquid seaweed in water troughs by means of a special dosage pump mechanism. However, in 2002 he explored other options as management of the dosage pump/medicators was challenging when caretaker maintenance of the property was required.

Shane decided to address nutrient deficiencies and improve soil fertility with a product entirely sourced and made on the farm. He developed a biodynamic preparation drawing various components from the field to produce what he now calls 'soil activator'.

Originally attempted methods of distribution by spraying on paddocks was time consuming and unachievable for the size of the property. Aerial spraying was too costly,



so alternative distribution methods were considered. Shane noted that the stock responded favourably when diluted supplement was added to the drinking troughs, and thought that the preparation could also act as a tonic for the animals. Further experimentation for dosage control led to the development of a 'tea bag' made from shade cloth, filled with the soil activator and placed by the inlet valve of water troughs. As a result, the product was 'steeped' every time the cattle drank, passing through their digestive systems and eventually ending up on the soil in their waste.

Shane observed the formation of greener patches related to cattle dung and urine points, also noting that the cattle did not avoid these areas in their grazing patterns. Soil biology indicators showed improvement in comparison to 'untreated' ground. These green patches have gradually expanded over time.

Ingredients to make soil activator can be purchased for around 60 dollars a kilogram, and Shane's biodynamic preparations are sold by one of Australia's top biodynamic educators. The 'tea bags' weigh only a couple of kilograms and diffuse into the water, moving from paddock to paddock with the cattle, for up to a number of weeks before they need to be replaced.

This method of distribution is an innovative way of using the 'cow tractors' to further fertilise the land and improve soil biology at a very low cost. Results from 2012 soil biology tests are being eagerly awaited.



'Tea bags' filled with biodynamic preparation are attached to a float and placed into water troughs

## Optimal Vegetation

Shane Joyce shakes his head in response to the previous vegetation management practices and how they are today costing him money.

"Through the 1950s and 1960s the brigalow and softwood scrubs were pulled with bulldozers, let lie for a couple of years, then burned and aerially seeded with a mixture of grasses. Subsequent timber regrowth was dealt with through burning and mechanical means from the 1970s. With fuel price rises and commodity price declines, by 1982 the cost of maintaining the pasture was beginning to outstrip the grazing return."

Management practices changed, fire ceased being used on the property in 1977 and regeneration was allowed to occur naturally. Some strip removal of regrowth was performed in 1988 - corridors were blade ploughed for 120 metres with 30 metre shelterbelts, and later narrower corridors of six to seven metres with same sized shelterbelts on another part of the property. Original intentions were to undertake further clearing and thinning, however this was never performed, particularly once production rates were observed.

"Areas of natural revegetation with around 40% canopy cover are yielding nearly 40% greater return than those areas that were completely cleared. Counter to the long held views that the land needed to be cleared to provide more pasture for grazing, the trees are instead providing protection to the pastures and soils, allowing for much better growth and increased fodder for the cattle. Water loss through evaporation is better controlled, and the trees – notably the narrower corridors more so than the wide ones – protect the pastures from wind and frost damage. Increased diversity in grasses is also evident."

Shane points out where up to 50% of previously cleared land on Dukes Plain has now retained regrowth. He estimates that around a 40% canopy cover appears to be optimal in the brigalow landscape, and natural thinning seems to be occurring.

He also points out that previous management practices had pastures which were developing into monocultures of buffel grass (*Cenchrus ciliaris*), and native grasses were being dominated by unpalatable species such as white spear-grass (*Aristida leptopoda*), wiregrass (*Aristida calycigna*) and yabilla grass (*Panicum queenslandicum*).

"Grass diversity, particularly native, increased quite quickly after establishment of cell grazing. Native grasses which emerged and rapidly increased include curly Mitchell



(*Astrebla lappacea*), hoop Mitchell (*Astrebla elymoides*), kangaroo (*Themeda triandra*), flinders (*Iseilema membranaceum*), satin top (*Eulalia aurea*), Queensland blue (*Dichanthium sericeum*) and sorghum alnum."

As a result the 'monoculture' species decreased, though there seems to be a natural increase and decrease in the predominance of all species over time, with native grasses growing into introduced pastures and vice-versa. When asked about the mix of native grasses into improved pastures, Shane says that it is harder for native grasses to dominate as they have longer rest and regeneration requirements as well as unpalatable stages of growth. "Production does not always support the predominance of natives, for example kangaroo grass is the first to emerge in spring, and hence is eaten first. However, the regular movement of stock – which can also be manipulated and controlled with selected rotation – allows for animal transfer of grass seed to desired areas and some influence on pasture variety." The cow tractors help again.

The Joyces use no chemical interventions and are not attempting to remove any particular species from their pastures as greater resilience is obtained through biodiversity. Also, over time cattle grazing preferences have been observed to change. Native legumes also multiplied naturally with cell grazing, and the leguminous shrub *Leucaena leucocephala* has also been randomly introduced to enhance animal protein supply. Protected for a couple of years until they are established, these shrubs are a favoured fodder for the cattle, which quickly strip the leaves in their couple of days in the paddocks.

Pasture grasses growing under eucalypt  
Inset: Recently grazed grass under brigalow



Cell grazing, more fertile soils and vegetation protection has also allowed for grasses to grow right up to trees in both the brigalow and eucalypt. Some areas of high animal traffic are still bare, but this too is constantly improving.

Overall, recovery periods with cell grazing provide for root development and better and continuous ground cover (which, as previously mentioned, equates to increased rainfall infiltration and water holding capacity). Pasture root systems are visible down 1.7 metres.

Shane is insistent that maintaining a minimum pasture height and having sufficient leaf allows grasses to grow from sunlight energy rather than from root reserves so pastures are more resilient and recover quickly with minimum impact on the root system.

Stock have become used to being handled as a consequence of the grazing strategies. Despite only being held by a single wire electric fence, the stock do not try to push through fences as the grass is not always greener on the other side, and regardless, they know they're going to be moved in a day or two, so are always content.



Leucaena provides a source of protein for the cattle  
Inset: Shrubs are quickly stripped during grazing periods





*A single strand electric fence easily contains the cattle which wait patiently to be moved to the next paddock*

## Water Management

Provision of water to stock and enhancing rain infiltration in the landscape are the Joyce's primary water management practices. These have now resulted in greater water use efficiency and enhanced water quality.

Dukes Plain lies at the top of the catchment area, with only one creek, Cattle Creek, originating in a neighbouring property, running along the southern boundary. Outflows from the property all run into the Dawson River, from Cattle Creek in the south, Red and Four Mile Gullies which flow to Gorge Creek in the North, as well as through Lambing Gully. There are no wetlands on the property and the only spring is high on the escarpment and not useful to the property.

As a result, all stock water is provided by farm dams filled from overland flows. Water is reticulated through a poly pipe system to poly and concrete troughs from the 'turkey nests'. Water points are located at the intersection of four paddocks (see image at right). Shane initially attempted his own installation of polythene piping across the property, but later obtained advice from local pipe and pump experts to ensure the use of the most effective pipe size and to obtain suitable pressure.

Most dams remain open to stock access, though with paddock rotation they are only exposed to stock for a maximum of some 21 days per year. This exposure aids compacting of dam edges, as completely protected dams had previously dried and cracked then split in flood. As stock access is limited, any damage is minimal.

A couple of dams are still fenced, one to control the water point from animals living in surrounding scrub the other to allow for enhancement and rebuilding.

Shane describes outcomes of his watering plan, "With the reduced stock access and increased vegetation experienced with cell grazing, both water quality and water-use efficiency has improved. Algal blooms which had previously caused fish and duck deaths no longer occur. The improved ground cover now filters nutrient load washing into dams and less stock time on dams has reduced concentrated nutrient sources [dung and urine] in the immediate area".

With an average annual rainfall of 700mm, in recent years rainfall has varied from as little as 314mm in 2006 to a high of 1538mm in 2010. The Joyces monitor post rain events to observe how deep moisture has penetrated and have found that rain infiltration in the soil has improved. Rainfall events of less than 10mm have traditionally been seen in the area as "useless", however with the conditioned land and high levels of soil organic matter, this moisture is now being absorbed into the Dukes Plain soil. With around 70% of rainfall events comprising less than 10mm rainfall, the Joyces are now able to harness this resource that previously had been lost.

As shown overleaf, land has been contoured in certain areas away from gullies and as required to dams. This technique follows Yeomans' Keyline Design principles and aims to 'keep water on the farm, not in the gully'. This is happening across the property as improved vegetation helps to keep moisture in the soil and pasture. Whilst the reduced overland flows result in increased difficulty in filling stock dams, this is an acceptable part of having increased soil moisture content.



*Water points are located at paddock intersections and provide clean drinking water to four paddocks*



*View over Dukes Plain showing narrow strip cleared shelterbelts (upper left), wide strip cleared shelterbelts (upper right) and water contouring (centre)*

## Pests and Weeds

Previous methods of weed and pest control used included fire, 1080 baiting for dingoes and shooting of pigs and kangaroos. Now no control methods are used other than through cell grazing strategies.

While some weeds persist to varying degrees, amongst the increased diversity of species these are seen as symptomatic of a particular issue and allowed to follow their cycle. Weeds are seen as an ally to colonise bare ground and help change the nature of the soil to make it more suitable for growing grasses.

A better balance of wildlife now exists on the property and despite more extensive water availability; kangaroo and wallaby numbers have reduced and are at an acceptable level. This could be as a result of these animals preference for short new growth, which is less common on Dukes Plain with current management strategies. There are some feral pigs and wild dogs in the region but these are not particularly problematic.

## Biodiversity

Increased biodiversity in plant, animal, insect and other species is a clear outcome of the farming practices employed at Dukes Plain.

Diversity in pastures of both native and introduced species is extensive. There is an increase in leguminous shrubs and forbs across the paddocks. Ground cover has increased and regeneration is occurring naturally. In areas where trees numbers are high (too many stems per hectare), a natural self thinning appears to be occurring.

Vegetation linkages are severely limited to the north and east by clearing of surrounding properties, however linkages to south and west are strong due to the topography, which has limited clearing. The area which had received wide strip clearing in the 1980s showed greater biodiversity than the narrow corridors, but this was due to its maintaining connection with surrounding remnant vegetation, whereas the other area had been previously disconnected.



*Golden Orb spiders assist with pest control*



Across the property increased diversity and population of birds has been observed over time. Regrowth areas provide wildlife corridors to the undeveloped ridge country and habitat for many more bird species, including significant numbers of small birds due to regeneration of small prickly shrubs which provide habitat that used to be burned.

Earthworms, spiders, ant and other insect numbers and types have increased. The vegetation has also provided the ideal habitat for the orb weaving spiders which can consume significant numbers of insects, such as grasshoppers, which damage crops and pastures.

## Signs of Success

Shane and Shan are experiencing financial, social and environmental gains as a result of their property management practices.

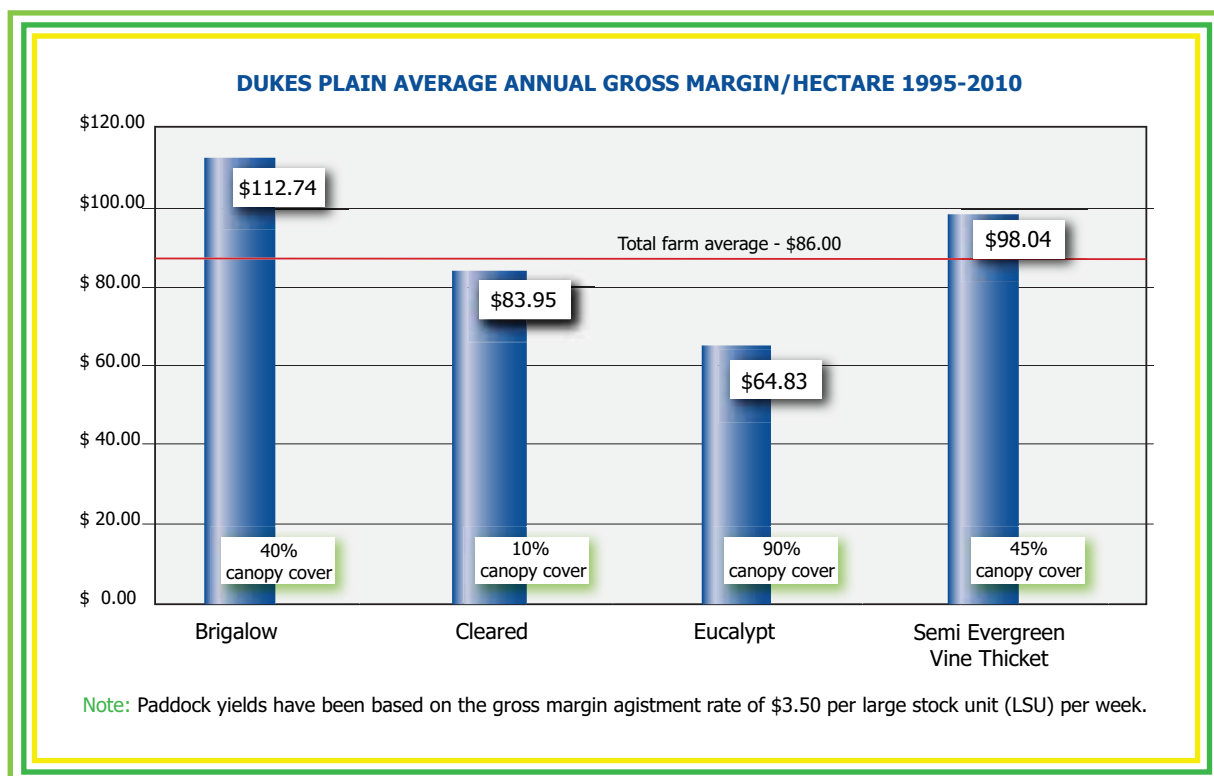
A 30% productivity increase was obtained with cell grazing – paying off implementation of the new model, such as investment in infrastructure, in three years. Previously high external inputs such as seed, machinery and labour have all gone. No production, pasture or land management expenses or inputs costs have been incurred for 24 years. They are no longer required. Shane believes that the value of this method is clear in the lack of input costs – profit is inevitable.

The previous focus on animal genetics and individual animal performance, or production per head, has been replaced with the simple measure of kilograms of beef produced per hectare of pasture.

Greatest yields are being experienced in the revegetated paddocks – a clear demonstration that totally clearing paddocks is ultimately detrimental to pasture production.

As shown in the graph below, yield figures from the past 16 years of data demonstrate that totally cleared paddocks (scrub soils) are yielding measurably less (\$83.96 per ha per year) than paddocks which have 40% (\$112.74/ha/year) and 45% (\$98.04/ha/year) canopy cover, while eucalypt forest with 90% canopy is yielding \$64.83/ha/year.

The property now serves as a host for a broad range of visitors, including field days for the public, work experience for school groups, WWOOFers (willing workers on organic farms), and grey nomads. The Joyces feel that hosting helps with re-building the community on farm, which also flows on into the local towns. Hosting is also a valuable way to bridge the gap between city and country, also providing an excellent method of education.





*Shane Joyce branded beef is certified organic*

The Joyces believe that quality food for people is being produced on Dukes Plain through organic and biodynamic practices. In addition, biodynamic preparations are being produced for on-selling by one of Australia's top biodynamic educators. This helps fund the continuing education of farmers and gardeners in the biodynamic methods.

The improved landscape health would arguably result in cleaner water entering the Dawson River and eventually into the Great Barrier Reef.

Overall, compared to the previous business model on the property, the Joyces have experienced improvement in the natural resource and natural capital through more diverse pastures, more trees, fewer weeds, improved water quality, efficient water use, increased carrying capacity, easier animal management, and reduced labour input and requirements.

Shane and Shan are experiencing a greater sense of wellbeing with their current management practices, "the landscape is telling us that we are on the right path". Observing the problems that have arisen in agriculture in the recent past, and not being affected by them, provides the clear impression that they are doing is working.

There is a clear sense of satisfaction and pride in being a part of the landscape for management, staff, volunteers, and visitors of Dukes Plain.

## Lessons Learned

Shane and Shan have found that data capture, planning, monitoring and adjusting has been invaluable to success on Dukes Plain. By ensuring careful observation, such as of plant lifecycles, and behaviour adjustment, such as not grazing when grasses are just shooting, better outcomes can be received. Shane says that he wishes he had been more diligent in these activities in the early days of adopting changed practices.

"However", he says, "I have been lucky, I have learned to have the courage to make mistakes and re-label them as learning opportunities. I believe more time can always be spent in seeking out knowledge".

And what about a baseline from which to judge progress? In Shane's region he finds that the roadside provides a good comparison tool for his own pastures. "Without technology or investment, they provide me with the opportunity to observe what is occurring naturally. That stimulates thinking on what systems or management can be implemented to replicate healthy results."

Shane's experience has shown that investment in most productive areas first, reaps the greater rewards, "Improvements will spread to less productive areas, and increased production will subsidise later action in the harder to regenerate areas".

With the broad range of practices available, Shane advises to choose what works for you from the range of methods and information available and from your own ideas and experiences and to "select the tiles that *you* want and make your own mosaic". Ultimately, he recommends "care deeply about the land and take responsibility for your decisions and actions".

Reference: Joyce, S. (2000), "Change the management and what happens – a producer's perspective", in *Tropical Grasslands*, 2000, Volume 34, pp223-229



# Reaching the real potential of the NSW rangelands



## BOKHARA PLAINS

### Farm Facts

35km north of Brewarrina,  
NSW North West

**Enterprise:** Cattle. Tourism

Beef cattle agistment and trading;  
accommodation and event venue

**Property Size:** 7200 hectares

**Average Annual Rainfall:** 380 mm

**Elevation:** 115 m

### Motivation for Change

- Identifying the potential to improve the landscape and production

### Innovations

- Using stock to break up claypan
- Holistic Management techniques to regenerate the rangeland
- Stock trading to balance stocking rate with pasture availability
- Diversifying into tourism
- Innovations commenced: 2001

### Key Results

- Carrying capacity almost doubled to over 100 DSE days per hectare per 100mm rainfall
- Revegetation of claypan landscape
- Strong, positive community relationships



Graham and Cathy Finlayson have used stock to convert claypans to pastures, significantly improving their carrying capacity, while diversifying into cattle trading and tourism to drought-proof their property.

When Graham and Cathy acquired Bokhara Plains in 1999 they accepted that the property was run down. Ground tanks were bogging sheep every summer, they needed to cut scrub for fodder to keep sheep alive and large areas of the property were claypans. But they felt that things should be better than they were.

Graham and Cathy turned this belief into action after identifying potential in the claypans from observing new plant growth where the surface had been disturbed. Stock were eventually used to break up the claypans, allowing water to penetrate and seeds to germinate. Combined with Holistic Management techniques, the claypans are now being reverted to productive, pastured rangelands with an increasing carrying capacity. Further diversifying into cattle trading and tourism to ensure that they remain viable regardless of the rainfall, Graham and Cathy are well on the way to reaching the real potential of the NSW rangelands, and are providing a shining light for others to follow.

Contact Graham & Cathy Finlayson: [info@bokharaplains.com](mailto:info@bokharaplains.com)



### Seeing the Potential

Bokhara Plains is located on the Goodooga road some 35km north of Brewarrina, NSW. The property has frontage on the Bokhara and Birrie Rivers, tributaries of the Barwon River and is part of the Murray Darling Basin and the Western Catchment Management Authority.

The property was traditionally farmed for wool production based on the sparse seasonal pasture growing on the flood plains of the two rivers.

When Cathy and Graham took over the property in 1999, about 50% of the area was claypan or otherwise bare ground. The claypans added nothing to the feed potential of the property. Even in good seasons, the land had struggled to maintain one of the lowest stocking rates in the district.

Graham realised that merinos were not profitable in this environment, and set stocking without matching numbers to carrying capacity was exacerbating ecological problems in the landscape. He explains, "We were almost totally reliant on my wife and I both working off farm to make ends meet. Continually running into dry periods and wishing / praying for rain was having a terrible emotional effect on my mental attitude, and a feeling of helplessness seemed to prevail".

"I had read Allan Savory's book on Holistic Management and realised that we could change the way we did things. One of two things drives fundamental change - pleasure or pain - and for me it was pain!"

Potential in the landscape was identified after the former owners carried out work on some of the claypans. A 400mm high bund was graded to form large shallow ponds. The theory of this method was that the water would soften the clay seal and allow seed to germinate.

The impact of ponding on the claypans was minimal but Graham noticed that there was significant growth on the edges of the claypans where the surface had been disturbed.

Graham states, "In 2001 the place was pretty well degraded and the whole ecological system had broken down. I felt that if we could restore the health of the rangeland that it could withstand drought... low rain in a healthy system could still be productive. It seemed to me that rangeland science was about understanding how the rangeland currently works, not about trying to change or improve it".

Graham chose to build on the former owner's ponding operations, initially by using their small Ferguson tractor

to mimic the use of a larger grader, and then later using a mouldboard plough to break up the hard capped surface. At this point, he did not have the numbers of cattle that he needed to create the disturbance necessary, and recognised that using a small tractor, although relatively economical, was not nearly as efficient or effective as using cattle. Particularly someone else's cattle.

Graham eventually identified that regeneration of the claypans and planned rotational grazing could allow the property to develop into productive rangeland with prolific native grasses and herbage suitable for cattle grazing. Agisting cattle allowed Graham to increase his numbers, which he then used to break up the surface of the claypans.

The results were significant, with earlier colonisers like copper burr (*Sclerolaena spp.*) responding quickly to the changed conditions, followed in due course by a variety of native grasses spreading over the bare surface.



Grass seeds in disturbed claypan (top) and regeneration of early coloniser, copper burr (below)



*Disturbed surface and early claypan regeneration*

## Realising the Potential

In achieving the potential they envisaged on Bokhara Plains Graham recognised that claypans were not a natural formation and could be restored to rangeland. Combined with Holistic Management principles, Graham determined that rangelands would respond positively to managed grazing practices, using livestock as partners.

After reading Allan Savory's book, Graham undertook a RCS *Grazing for Profit* course followed by four years in the Executive Link program. "We also became inaugural participants in a program called Enterprise Based Conservation (EBC) through which we accessed some financial help to undertake a significant water and fencing project for much better control of grazing management." This pilot program was run by WEST2000 Plus and included a five-year conservation agreement on land placed under voluntary conservation management.

Graham and Cathy also undertook major changes in their livestock enterprises, moving from sheep breeding to trading, then to agistment sheep to agistment cattle and now also cattle trading. They specialised in the larger herbivores from 2007 when they recognised that cattle were giving much better ecological and management benefits.

Graham follows three guiding principles for Bokhara Plains:

- 💧 Match the stocking rate with the carrying capacity of the land.
- 💧 Plants need adequate recovery.
- 💧 Monitor what is going on across the property, make plans, then manage against these plans.

## Infrastructure Changes

Graham and Cathy planned their infrastructure around their grazing strategies. The fencing forms a number of 'wagon wheels' with a watering point at the hub, producing a number of 'cells'. For additional fencing to match stocking rates to carrying capacity, they rely on electric fencing supplied from an inverter connected to mains supply at the house.

Fencing was initially based on the original infrastructure but Graham has modified the layout to reflect his requirement that stock should preferably not travel more than 1.5km to access water. On Bokhara Plains fencing cost about \$400 a kilometre for material and labour. Graham points out that the cost can be recovered in a year with increased production from the planned rotational grazing and Holistic Management strategies. Much of the labour for fencing was on-farm, comprising Graham, Cathy and their daughter, Harriett.

## Stocking

Graham and Cathy plan their grazing on availability of pasture at any one time. Graham explains, "Agistment is the basis of our operations and we trade against the variation of available pasture. Pasture recovery before returning with livestock is paramount, along with creating the 'beneficial impact' described previously. We monitor pasture availability and plan and manage against that".

The agistment runs at \$/head/week basis for 6-12 months. Stock trading is used to balance the agistment with pasture availability. Stomach and skin parasites are not an issue in the region and stock are not drenched or treated for lice.



*Graham discussing his stock trading chart*





*Increased pasture availability has enabled a significant increase in stocking rates*

In their stock trading operations, Graham and Cathy use strategies developed by Bud Williams in the USA, and now taught by KLR Marketing in Australia. These are based on keeping the three inventories of price, available pasture and stock holding in balance. Using a 'sell-buy' process rather than a 'buy-sell' process, in the balanced inventory context, they can decide on selling and re-stocking options.

Graham and Cathy use a 12 month rolling rainfall figure to calculate the stocking rate per hectare by month and annually per 100mm of rain. Using this method, they can reduce stock accordingly when conditions deteriorate and do not have to purchase feed. While they have de-stocked in earlier times, they are confident that they will not have to do so again.

Using these methods, stocking rates have increased exponentially on Bokhara Plains. Graham and Cathy have been measuring their stocking rate or DSE<sup>1</sup> days per hectare per 100mm of rain since 2002, and have seen their benchmark capacity lift from 56 DSE days per hectare to over 100.

Standing at a watering point where six paddock fences join, Graham points to a 60 hectare paddock with 1100 cattle spread throughout the tall grass, "That paddock would typically only carry about four head year round in a set-stocked operation".

<sup>1</sup>DSE is a stock measurement, 'dry sheep equivalent' based on the feed requirements of a 45kg wether. This can be multiplied for various types of stock, for example a ewe with one lamb is measured as 1.5 DSE, and a dry cow is equivalent to 6-8 DSE.

## Water Management

Graham acknowledges, "Water supply is the limiting factor for our grazing enterprise".

Previously, Bokhara Plains had a very poor water cycle, with substantial runoff from the bare eroding soils. Livestock water was all supplied through open ground tanks, and the two river systems that transect Bokhara Plains, had a long history of set stocking.

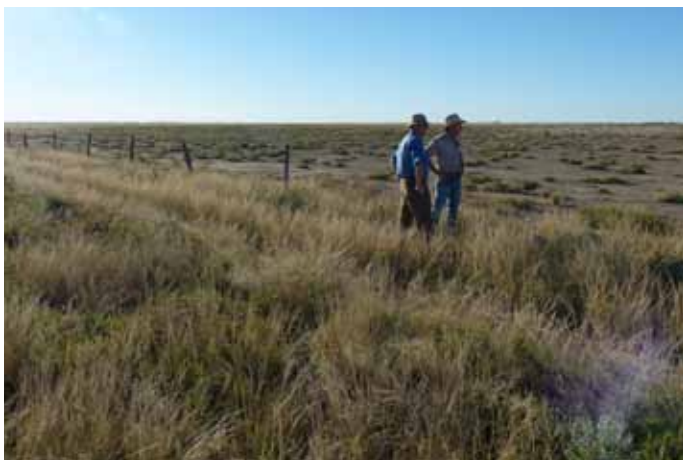
Graham's current sources are the two rivers and access to a bore. The rivers do not always flow, but when it is at high flow he stores water from the Bokhara River in a dam. Both rivers have now been fenced off to allow for strategic grazing. The old ground tanks have been blocked off or fenced in, and 35km of poly pipe has been laid to nine poly tanks and troughs. Water from the dam is pumped to stock watering points. The header tanks at the water points gravity feed to the troughs.

Graham structures his grazing plan around water availability and understands how much water is required on a daily basis per 1000 head of cattle. He works on his principle of, "Plan as if there will be no rain, then adjust when it does arrive!"



*The waterpoints are the 'hub' for multiple paddocks in the wagon wheel design. They are high-use areas when accessible (top), but the pasture can recover after rest (below)*





Improving the soil has enabled increased ground cover and nutrient cycling - visibly different to remnant claypan

## Soil

The soils across Bokhara Plains, which have not yet been subject to soil testing, are varied. The country off the Bokhara and Birrie rivers comprises typical black soils, with lighter Mitchell grass (*Astrebla spp.*), Neverfail (*Eragrostis setifolia*), Queensland bluegrass (*Dichanthium sericium*) and bladder saltbush (*Atriplex vesicaria*) country interspersed with scalded claypans in between the rivers.

Claypans are a dense, compact, slowly permeable layer in the subsoil with a much higher clay content than the overlying material. The subsoil claypan layer becomes exposed when original topsoil is lost or degraded, exhibiting very different physical properties and behaviour. Claypans are usually hard when dry, and plastic and sticky when wet. They limit or slow the downward movement of water through the soil.

The techniques applied by Graham however, have enabled the bare ground to be converted to productive rangeland. The vastly increased ground cover has demonstrably increased overall soil biological activity, particularly the visible beneficial decomposing fungal activity in the soil, which regenerates healthy topsoils. Reducing paddock size and the successful grazing strategies are pointing towards potentially even higher stocking rates and therefore towards greater soil fertility as animals spread more dung and seed.

## Vegetation Management

At acquisition, the Bokhara Plains was a dustbowl. Approximately 50% of the total land area was bare ground, and aerial photographs showed huge areas of claypan. However, there were reasonable patches of Mitchell grass and bladder saltbush in places. Besides providing some basic stock feed, this existing vegetation provided a seed bank.

The WEST2000 Plus Project on EBC, that predated the intervention of the CMA, was aimed at increasing ground cover. The project paid on percentage of ground cover achieved. Graham and Cathy had a personal target of 70%, although the EBC target was 40% which is recognised as a critical threshold point to stop wind and water erosion, and was measured in the most likely month for being dry – October. Graham and Cathy noticed that the areas of high-impact grazing recovered better and they could see that, over time, stocking rates could be increased. They amended their own target to “100% ground cover 100% of the time”, and although difficult to achieve, Graham believes it should be every land managers goal whatever the environment. It had become obvious to Graham and Cathy that grazing strategies had to be part of their vegetation management and enterprise-based conservation.

The planned rotational grazing practices have given young trees and shrubs respite from literally being ‘nipped in the bud’. Independent monitoring from the beginning of the EBC Project has shown a steady increase in the number of native trees, increased ground cover and the presence of perennial grasses.



Vegetation diversity and coverage has significantly increased



They also noticed that the best gains came from improving good land and not necessarily from regenerating claypan. They therefore concentrated their efforts on the good land first.

Weeds were not previously a significant concern on Bokhara Plains, and now, besides small and decreasing outbreaks of Bathurst Burr (*Xanthium spinosum*), which they deal with by hand, there are no appreciable weed and pest issues on the property

## Diversifying

Graham and Cathy are admirers of the Joel Salatin approach of many synergistic enterprises stemming from the one farm. Aligned with this approach they have a willingness to diversify with complementary enterprises. One such enterprise has seen the development of a tourism venture 'Bokhara Hutz', which they have grown over the last ten years into a reliable source of income, particularly through the four separate occasions when they have totally destocked the property.

This successful 30 person capacity farm stay business also provides a venue for local events, such as weddings and parties. Plans for the future include generating more farm produce, to be less reliant on off farm purchases.

Cathy notes, "Our diversification into tourism has allowed us to reach toward our goal of drought proofing our business".

## A Shining Light

### ...On the Farm

The infrastructure design and layout, the ready availability of water to stock, the rested and fresh pastures and the careful management of all farm operations combine for exemplary Holistic Management practices. This is a far cry from when Graham and Cathy took over six dusty paddocks and a flock of struggling sheep in 1999.

Graham summarises, "This has so far been a ten year learning process, which we expect to continue for some time yet. Installing infrastructure, etc., was implemented with some financial help through the EBC project involvement, however much of our innovation has been off the back of work done by many friends, colleagues and other people I've met while learning and studying all over the world [Nuffield Scholarship 2008], due to their desire and preparedness to share their own experiences".



Healthy pastures have replaced the once degraded landscape

Through intensive cattle grazing using agistment and trading to give flexibility in numbers, Graham and Cathy have revegetated and rejuvenated a much degraded landscape. "We have taken Bokhara Plains from a six paddock extensive layout with poor water security, to a 100 plus paddock planned cell system with fully reticulated and controlled water system. We have also diversified into tourism / accommodation, and have hosted many farming tour groups in our facility, Bokhara Hutz."

**"Our potential to improve our ecological resource, particularly in the semi-arid areas is far greater than conventional rangeland science understands or accepts."**

Graham and Cathy's original goal was to develop their property to be able to run around twice the original estimated 56 DSE days per hectares per 100mm of rainfall. They now see that the potential is much greater, perhaps up to three to four times that DSE rate, whilst continuing to build positive environmental outcomes. These increases are possible, due to the resilience in their pastures through increased diversity of their ground cover and improvements in soil health brought about by their grazing management. Their profitability is now based on a sell/buy approach, where the ups and downs of the markets are smoothed out. And to provide further surety, a careful balance between agistment operations and a trading herd is maintained.



Graham points out that the “economics stack up” - the potential for increased production on the property is better than investing in more property.

“Often people in the area believe that expanding their land holding is the only way to survive in the light country of the region”, states Graham. “A quick cost benefit analysis suggests that this is not the case at all. Enterprises of our size can prosper. At a rate of around \$12 per acre to establish water points and fencing will allow intensive grazing approaches to be established, with immediate improvement in the quality of pastures, percentage of ground cover and health of the stock. These improvements come with no additional overheads, unlike purchasing additional land at upwards of \$100 an acre and the associated taxes and other costs.”

He continues, “And, it’s all about flexibility. You can’t manage without people and animals. Smaller places are the answer, not more land. We should make the most of what rain we get and develop the land we have. We always plan for no rain. If there is a rain event, then we re-plan”.

However, Graham laments, “Our potential to improve our ecological resource, particularly in the semi-arid areas is far greater than conventional rangeland science understands or accepts”. Reliance on science leading the way, with a lack of supporting policies and unreasonable bias against livestock, provides some of the greatest impediments to wider adoption of the sort of practices that are employed at Bokhara Plains. Indeed, Bokhara Plains is a shining light, in stark contrast to others seen around the landscape when driving through the west of NSW. For the Brewarrina area, a stocking rate of 4 head of cattle (24 DSE) to 60 hectares is considered suitable. That Graham can have 1100 head in that same area for two days might be considered by some to be ridiculous and not sustainable.

Graham points out that it is important to manage equity and debt levels against cash flow to ensure potential to increase carrying capacity and the possibility of increasing the margins from stock trading. In addition, in the context of all the activities, it is necessary to watch for ‘staff burn out’ and to employ additional labour at the right time.

For Graham and Cathy, reduced overheads through increased productivity and the use of contractors for specialised operations has contributed to more satisfying outcomes and better use of family time.

### ...and in the Community

Graham and Cathy note, “Since we first had a change in thinking back in 2001 we have endeavoured to be able to help others achieve the same. Our view is that we want to live in a more profitable farming environment, with more neighbours not less, and in a community that is not struggling or welfare reliant”.

Graham is an active mentor to others in developing their enterprises to more sustainable grazing and enjoys the opportunity to encourage others through both mentoring and education programs.

Many people who attend various training courses that educate people on the possibilities of changing what they do, still find it difficult to take the first step when they return to the farm. Support needs to be provided to people to help them on their way.

This fact has been recognised by the Western CMA who has ‘hired’ successful grazing course graduates to mentor locals to assist them in their transition.

Graham is considered a role model for other farmers in the wider region wishing to consolidate their formal grazing management training, through his Western CMA sponsored mentoring of four farming business. This activity includes on-farm visits and teleconferencing to help his clients focus on outcomes, not issues.

Graham’s training was based on the RCS *Grazing for Profit* Course and this program allows for expansion of this support through a well developed extension program.

Graham and Cathy now enjoy many social benefits from the enterprise. Bokhara Plains has hosted ‘Keep In Touch’ days for graduates of earlier grazing management courses, and field days (including hosting his mentors - Allan Savory and Terry McCosker at different times). On these days around 150 people, many of them young farmers, eager to learn and talk about a wide range of challenges both on farm and more strategically are able to share experiences.

“...we want to live in a more profitable farming environment, with more neighbours not less, and in a community that is not struggling...”

Cathy remarks that one of the clear positive community aspects of their lives now is the opportunity to sit down at dinner most nights with a wonderful and varied group of people from all walks of life.

Graham was adjudged the NSW Young Farmer of the Year in 2005, relatively early in the transformation of Bokhara Plains, and has gone on to be recognised with Carbon Cocky and CMA awards.

Graham and Cathy have been involved in the P and F at a local school, the Rural Financial Council, and in the local

Show and Rodeo committee. They also host an annual visit to Bokhara Plains by the Warringah school group as part of a sister city relationship with Brewarrina.

The Bokhara Hutz accommodation package has also delivered welcome benefits for the family. Cathy and Graham both enjoy the opportunity to interact with their visitors and interested farming groups coming to visit the property. "It provides another opportunity to show people what we have done over the years and to learn from those around the table."





# Weed control without herbicide is not a load of bull



## SHANNON VALE STATION

### Farm Facts

12km east of Glen Innes,  
NSW Northern Tablelands

**Enterprise:** Cattle

Angus bull breeding from high performance  
seed stock

**Property Size:** 1450 hectares

**Average Annual Rainfall:** 750-850 mm

**Elevation:** 1000-1090 m

### Motivation for Change

- Drought, economic viability and gaining a deeper understanding of biological cycles

### Innovations

- Organic fertilisation tailored to soil and plant nutrient requirements
- No cultivation or herbicides
- Managed grazing pressure
- Innovations commenced: 2005

### Key Results

- 30-35% reduction in production costs
- 10% increase in production
- 20% increase in bull and heifer weight gain
- Rejuvenated pastures and weed control



Greg and Sally Chappell have shown that pasture improvement using organic-based fertilisation together with carefully planned stock management can overcome significant weed problems and vastly improve productivity.

Greg Chappell taught agricultural science at the Farrer Memorial Agricultural High School (FMAHS) for 13 years before taking up farming full-time. He and Sally then developed an Angus bull breeding business, initially at Willow Tree. When the business out-grew the farm they moved to a property at Moree and then, in 2001, to Shannon Vale Station. Although he had taught conventional agriculture at FMAHS, Greg's experience on his original farm at Willow Tree made him realise that conventional methods weren't sustainable, so he was already beginning to explore other methods of land management when faced with the weed challenge that emerged at Shannon Vale.

Weeds including African lovegrass (*Eragrostis curvula*), blackberry (*Rubus fruticosus*), nodding thistle (*Carduus nutans*), Chilean needle grass (*Nassella neesiana*), carpet grass (*Axonopus spp.*), rat's tail fescue (*Vulpia myuros*), sorrel (*Rumex acetosa*) and St Johns wort (*Hypericum perforatum*) were proliferating under the previous management system at Shannon Vale, badly damaging productivity and profits. Using organic-based fertilisation targeted specifically to address soil nutritional deficiencies, Greg and Sally worked to create an environment that allowed pasture species to re-establish from dormant seed.

The Chappells experienced productivity increases after only two years. Pastures now out-compete the weed species and are capable of sustaining growth rates in the bulls of around one kilogram a day all year round.

Contact Greg & Sally Chappell: [dulverton1@bigpond.com](mailto:dulverton1@bigpond.com)

## Shannon Vale Station

Shannon Vale Station is a gently undulating property with five kilometres of frontage to the Mann River. It is a remnant of a 250,000 hectare estate allocated in the 1820s to an officer of the New South Wales Corps, after whom the river was named. Following fragmentation and many changes of ownership and use, Greg and Sally Chappell acquired the property in 2001.

Due to the high elevation of around 1000 metres, summers at Shannon Vale are mild and winters cold; temperatures can drop down to minus 17 degrees Celsius and snow is common. Soils are transitional and weathered granite sand to sandy loams; these are poorly structured, highly erodible and have a high rate of leaching so that nutrients can be lost quickly.

Today, Shannon Vale Station comprises a total of 1450 hectares and is managed solely to breed Angus bulls. Bull breeding presents unique requirements for farm management. A high rate of weight gain must be maintained at all times so that bulls reach market weight within 24 months, while stocking rates must allow for the paddock space required to minimise interaction between the bulls.

However it was other challenges that the Chappells were initially up against upon taking ownership of Shannon Vale.

## The Weeds Tell a Story

By the time the Greg and Sally bought the property it had been subject to many years of a conventional annual superphosphate and nitrogenous fertiliser program and regular pasture improvement. Pasture improvement consisted of using herbicide to eliminate all species already present, complete cultivation, addition of superphosphate and nitrogenous fertilisers and then sowing with preferred pasture species, which were mainly annuals. Set stocked grazing management was used. Some areas had been used to grow corn, potatoes and other crops, however the light granite soils of the property were not really suited to sustaining such high nutrient-requiring crops.

The initial efforts of Greg and Sally were focused, within the day-to-day management of the property, on improving measured carcase trait performance of their product lines, the Dulverton Angus and the Currawee crossbreds. The attempts to provide all-year-round nutrition to this seed stock enterprise were based on the standard agronomic approach to farming in that region: weed knock down chemicals, cultivation to prepare seed beds, application of nitrogenous and phosphatic fertilisers and use of annuals such as Italian rye, oats and soy beans in rotation.

The use of the standard agronomic approach and a decade of drought resulted in the seed stock not realising their full genetic potential in regard to growth to sale weight over time to maturity and the expected 90% weaning rate of the cows. It became apparent to Greg and Sally that their pastures were not delivering adequate protein and energy and that digestibility was poor.

Besides the production issues, the combined effect of pasture management, cropping practices and climate led to large tracts of the property becoming completely dominated by weeds. As Greg and Sally say, "The weeds won".

**"...we were in a cycle of dependence on inputs to sustain and prop up the production that was not economically viable."**

The most problematic of the weeds was African lovegrass, which has negligible nutritional value and which effectively shuts down production of palatable pasture species by blocking sunlight and access to nutrients and moisture. This grass was so pervasive that 80-100% of each paddock would return to African lovegrass after pasture sowing. The pastures were lasting two to two and a half years after each conventional pasture renovation cycle but it was taking three to three and a half years to recoup the cost of renovation. The Chappells explain, "It became necessary to spray out [with herbicide] and start again before the economics made it pay. Hence we were in a cycle of dependence on inputs to sustain and prop up the production that was not economically viable".

Topsoil was being lost to sheet erosion caused by rainfall on bare soils across the property, and river banks were eroding due to cattle traffic. Organic carbon levels were falling, which reduced water-holding capacity and increased sensitivity to drought. The property had become dependent on high cost inputs of fertilisers and other chemicals, and in addition, grain that cost \$500 a tonne was needed to sustain weight gain on the bulls.

Despite all the costly inputs, the weeds were taking over, productivity was declining and the business was going under. Greg recalls, "The majority of gross margin achieved in the sale of production was consumed in the maintenance of pasture production".

At this point, Greg and Sally came to the realisation that weeds flourish in poor soils and that the structure, chemistry and biology of the soil, and soil health in general, needed attention.



## IMPROVEMENTS TO SOIL FERTILITY

Greg recalls, "The decade of drought made it increasingly obvious that the production system overlaying our landscape was brittle. It was not sustainable beyond short term props from seed, chemical, drench, fertiliser, drugs! In 13 years as an Ag Teacher and 20 years as a grazier we came to acknowledge the importance of the biological and physical components of the system in addition to the chemistry".

In terms of the decision to change, Greg notes, "[It was] drought and economic viability primarily, with deeper understanding of biological cycles, role of floral succession, potential for beneficial grazing impact on landscape. Reappraisal of practices and enterprise viability led to a decision to act".

### Soil as the Weed Solution

From 2005, the traditional pasture renovation program based on synthetic fertilisers, herbicide and cultivation was totally abandoned and replaced with one based on planned grazing, use of organic fertilisers and no soil disturbance. Greg and Sally sought advice from local consultants on pasture management and nutrition and compost production.

Greg describes, "We have, since 2006, embraced the biological approach. We are rebuilding soil structure by increasing the organic and carbon content of the soil. Our research has indicated that for each additional 1% of carbon stored in the soil, we are able to improve the water holding capacity by 144,000 litres per hectare on an annual basis. To date we have increased our soil organic carbon content across our 11 monitored sites. This increase equates to an additional water holding capacity of 120,000 to 150,000 litres per hectare, on an annual basis."

Additional water holding capacity is important. Although annual rainfall averages between 750-850mm, in recent years it has ranged from 544.5mm in 2002 to 1078.5mm in 2011.

Year	Soil Organic Carbon %	Phosphorus [Colwell] (parts per million)	pH Range	Average pH
2002-06	1.00	31.0	4.7 – 5.3	5.0
2008	1.46	34.5	5.1 – 5.7	5.4
2011	1.44	32.2	5.85 – 6.43	6.5
2012	1.47	40.0	5.84 – 7.16	6.47

Greg and Sally point out that soil health underpins their whole operation. "We have embarked on a course of putting emphasis on soil health and, in doing so, improving our pasture productivity. However, we don't compromise our animals. Our business success depends on those animals achieving the key performance indicators for growth to maturity."

In the rejuvenation of their soils and pastures, the Chappells use techniques that include:

- applying compost
- mulching existing pasture stubble
- rotational grazing
- sod seed/direct drill seed
- strategically timed foliar nutrition sprays to increase feed quality or quantity



*Lush pastures have returned to Shannon Vale, assisted by the improved soil health*



## Fertiliser Application

"Other than for spraying blackberry patches, no herbicides have been used on Shannon Vale for approximately six years. Basically, we changed from synthetic fertiliser to a manure-based compost, being differentiated from others by having additional trace elements or macro nutrients added to round it out to a complete fertiliser which best matched our specific soils. This was not possible with conventional granular fertiliser. Where needed, we add pasture seed into the compost for broadcasting in place of cultivation."

"We have managed to create the environment required for succession to allow dormant seed to re-emerge and compete with the weed species."

The organic fertiliser used on Shannon Vale is derived from composted feedlot wastes to which macro nutrients and trace elements are added. The nutrients and trace elements added are based on plant analysis. Using sap analysis as well as plant tissue analysis ensures that short

term and longer term deficiencies are identified. Plant sap analyses reveal short term nutrient deficiencies, which can be redressed immediately with foliar liquid fertilisers. Plant tissue tests of pasture mineral levels and quality confirm longer term trends in nutrient flow into the plant and how that affects animal performance. The fertilisers used therefore rectify specific soil fertility deficiencies in each paddock. Both tests are important for maximising pasture growth which enables year-round weight gain on the bulls.

The organic fertiliser is spread at a rate ranging from 300 to 600 kilograms per hectare, according to need.

The foliar fertilisers used generally include the nutrients missing in the plant tests. These are, in effect, like a stock feed supplement for plants, in that they have protein,



Red clover (*Trifolium pratense*) has become 'naturalised' on Shannon Vale

energy and minerals to generate a plant response over and above nutrient alone. These are applied with the assistance of the Chappell's consultant and are based on the growing environment and soil and plant data (e.g. as presented in the table below). This fertiliser is applied with water to total 50 to 120 litres per hectare and triggers a response when carrying capacity or feed quality needs to be increased quickly. Greg explains, "Measurements have been taken of pasture feed quality and quantity, to identify the benefit of triggering a plant response from judicious foliar nutrient. This allows us to achieve increased daily weight gain in animal performance and hence achieve target weights sooner, which results in longer rest periods".

Most pasture rejuvenation has been achieved by providing the growing conditions required for previously sown species to become re-established. Nutrient cycling, coupled with a more thorough understanding of species succession, have contributed to a more biologically friendly outcome in healthier soils enabling a more productive all-round pasture base.

In only two years, paddocks dominated by African lovegrass have become substantially re-established with high quality pasture species that have not been sown for many years, in some cases since the 1990s.

### PLANT TISSUE ANALYSIS

Year	Nitrogen %		Phosphorous %		Potassium %		Sulphur %		Calcium %	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
<b>2011</b>	3.7	3.13 - 4.15	0.34	0.31 - 0.37	2.4	2.03 - 3.00	0.24	0.18 - 0.27	0.99	0.78 - 1.38
<b>2012</b>	3.8	3.05 - 4.17	0.36	0.31 - 0.43	2.91	1.85 - 4.24	0.22	0.17 - 0.27	0.85	0.56 - 1.02



Where they have not returned naturally, seed of preferred pasture species is added to the compost fertiliser and some paddocks have been direct drilled, without herbicide. Greg points out, "We no longer get bent out of shape by the presence of so-called 'lower order' weeds, such as rat's tail, sorrel, yorkshire fog, dandelion, etc. We see these for what they are, indicators of poor soil health. We use the production from these species to help build soil organic matter and therefore soil capable of supporting the higher order, more prolific species such as prairie grass, cocksfoot, fescue and clovers. The clovers provide the nitrogen capable of sustaining higher levels of quantity and quality of prairie grass, cocksfoot and fescues".

## Grazing Management

Greg points out that their livestock management has been adjusted to assist in maintaining soil health. "We use liquid supplements in winter to help with digestibility of standing dry feed. These supplements ensure the cow pads are softer and so able to be buried by dung beetles. The lack of cow pads on the surface helps break the worm cycle and reduce buffalo fly habitat. This means less drenching. We only drench cows once a year and they have developed a workable tolerance to worms, but it is not so easy to combat fluke." The Chappells rotational graze their stock. This also has the advantage of breaking the worm cycle.



A Shannon Vale pasture after three days grazing

Subdivision fencing was installed across Shannon Vale to reduce paddock size to increase grazing pressure and allow longer periods of pasture rest and recovery. The productive paddock size is about 14 to 30 hectares. Greg points out, "Reducing paddock size to increase rest and recovery periods must be balanced with the need to minimise stocking rate to avoid social pressures between the bulls".

Each mob of bulls is now rotated between two to three paddocks. The number of days per cycle is determined by seasonal pasture growth rates and ranges from 26 days in summer to 40 to 50 days in winter. Greg says, "We began, and continue to expand, a practice of rotational grazing, enabling rest and recovery of desirable species throughout the year. Bulls are run in mobs of 40 to 55, that is, one per acre. Our productive paddock size is about 16-24 hectares".

The Shannon Vale grazing management practices open up the unproductive African lovegrass to sunlight and trigger other species for germination. Greg notes, "Perhaps one of our most notable achievements has being able to reduce the almost total domination of the species, African Lovegrass. Four years ago, we purchased a Schultz 5150 Mk2 slasher/mulcher. We mulched the heavily infested paddocks during the middle of autumn and the middle of spring. The mulching smashes up the lovegrass stubble, leaving it, not in a windrow, as with a normal slasher, but evenly dispersed over the surface of the ground. We mulch a couple of days before removing stock. The herd impact helps compost the mulch and bring it into contact with the soil. The effect is more pronounced if there is rain."

"This mechanised smashing of unpalatable tussocks leaves residues in contact with the ground, and biological processes, to be decomposed and return minerals to future plant cycle - instead of being tied up within above ground trash indefinitely", Greg says.

This process is used to substitute for the benefits of high density rotational grazing, which cannot be followed at Shannon Vale as, Greg explains, "Bulls need space to contend with high testosterone social pressure". This technique also reduces competition, enabling the preferred perennial pasture species, such as fescue (*Festuca arundinacea*), cocksfoot (*Dactylis glomerata*), clovers and plantain (*Plantago lanceolata*), to re-emerge.



*Diverse pastures now thrive on Shannon Vale year-round*

**“Our soil health approach saves about one third of the amount we spent on conventional pasture establishment... and our new approach provides a better all round outcome.”**

## Stock Water

Stock water was previously provided by dams and the Mann River. Greg and Sally place a high value on the importance of the availability of fresh, clean, quality water to ensure optimum growth rates of stock, particularly of calves on cows.

The frontage to the river has now been fenced off and an off-stream watering system comprising pumps, tanks and a gravity fed reticulated supply to a trough in each paddock is continuing to be developed. At this point, all bull growing cells have reticulated water.

Greg notes, “The stock therefore have access to higher quality water and river bank erosion is reduced. Fencing off the river has reduced weeds, because weeds deposited in riparian areas by floodwater are no longer spread into the paddocks by cattle”.

“The reticulated system has had the added benefit this spring and summer of assisting in our controlling bloat by our adding bloat oil to the trough.”

## Financing Infrastructure Support

Installing reticulated water is expensive, but the Chappells have been fortunate to receive financial assistance in fencing off their 5.2km frontage to the Mann River. This has not only prevented stock damage to stream banks but has excluded stock from riparian zones so that these areas have more potential for regeneration. Twenty-five per cent of the \$100,000 required for the fencing and water supply

system was provided under a grant from the Northern Rivers Catchment Management Authority, under their River Reach Program for the Mann River. This program sought to reduce bank erosion and pollution to improve riparian environments and water quality for aquatic fauna and downstream use.

The input costs for infrastructure have been offset to a considerable degree by savings gained through ceasing cultivation, the use of chemical fertiliser and other costs associated with sowing annual pastures. Whilst transfer of some input costs to subdivision fencing reduced the overall capital requirement, Greg and Sally note that, “providing reticulated waters have been a capital constraint to faster implementation”.

Overall, however, Greg says, “Our soil health approach saves about one third of the amount we spent on conventional pasture establishment... and our new approach provides a better all round outcome.”

## Vegetation

Trees are necessary for stock shelter in the cold climate of the northern tablelands and also play an important role on Shannon Vale. The original eucalypt tree cover had been reduced to a sparse cover, mostly on the higher slopes and ridges. Trees have since been established in blocks on high points and in shelterbelts along fences and tracks to provide shelter against cold temperatures often exacerbated by wind, frequent frosts and occasional snow falls. Establishing tree belts is also contributing to increasing biodiversity on the property.





## Robust Results

Greg's and Sally's approach to land management has eliminated the need to periodically renovate pastures. Complete ground cover is maintained at all times, soil condition is improving and carbon content is increasing. Costs have been reduced on Shannon Vale while production has been increased - the family business is now viable. Greg and Sally point out, "Our guiding principle has been to regenerate the landscape to its potential, whilst not compromising the high standards and output of the business, the breeding enterprise".

The majority of the farm can now boast diversity of species within the pasture, including legumes, herbaceous species and perennial grasses, which are increasing year by year, even though they have not physically been brought onto the farm in at least six years and in many cases more than ten years.

"We have managed to create the environment required for succession to allow dormant seed to re-emerge and compete with the weed species."

Diversity and density of pasture has increased. Where unpalatable species of lovegrass dominated, desirable perennial pasture species, such as fescue, cocksfoot, clovers and plantain are now well established.

Earthworms and saprophytic fungi that help break down organic matter not previously found in the region have become common. Dung beetles are active in breaking down manure, which in turn accelerates decomposition and nutrient cycling, improves soil organic matter content and structure, helps break the parasite worm burden.

Greg tells the story, "Over five and half years we have nurtured a very tired old degraded paddock growing potatoes and corn, back to full productivity. The full succession process has occurred from sorrel, rats tail, cudweed, etcetera, to the bromes, the ryes then the clovers and then to cocksfoot and fescue that were seeded within compost four years ago. The pasture established is now capable of sustaining growth rates in the order of one kilogram a day per bull year round".

Dependence on ration supplement to achieve sale weight for the bulls in the second winter after practices were changed decreased significantly with increased grass production and subsequent stock weight gain. Stock feed purchases had reduced to less than half by about three years into the pasture improvement program.

The Chappells are clearly proud of their results, "Cost of production has reduced by 30 to 35 per cent and overall production has increased in the order of ten per cent, excluding the most recent six months, which was an above average season. The last year is up 20 per cent on overall production for bulls and heifer weight gain on earlier averages".

The results of the new approach taken by Greg and Sally can be seen in the bull growth figures over the past two years (see below). Given that the genetics of the Angus herd have been stable over the past two years and management of the herd has been identical over the same period, Greg and Sally attribute growth statistics to soil and pasture outcomes.

	2011	2012	Difference
<b>Number of Animals</b>	<b>61</b>	<b>54</b>	
Growth (Kg/day)	0.96	1.11	+0.15
Rump (P8) & Rib Fat (mm)	3.4 - 2.8	5.9 - 4.7	+2.5 - 1.9
Eye Muscle Area (EMA) cm <sup>2</sup>	84.3	98	+13.7
Intra-muscular Fat (%)	4.7	5.1	+0.4
Scrotal Circumference (cm)	37.8	40.3	+2.5

In 2011, their top-priced bull sold for \$15,500. The average price across the 67 bulls sold was \$6,700.



'Dulverton Blaster' - a whole lot of bull



Numerous Catchment Management Authority, industry and Landcare sponsored field days have been held on Shannon Vale to help communicate the principles and changes taking place and that are continuing. Greg and Sally regularly receive requests for visits from industry types, growers and the like and are content to share their lessons in landscape management and weed control.

## Management Guidelines and Lessons

Greg and Sally have kept records at pasture monitoring sites prior to change for later quantitative comparison. They have found however, that, "Testing, measurement, recording and analysis to determine how we are going and where we will end up, is time consuming and costly". Learning when to start and stop trials, particularly with their region's climate also provided challenges to Greg and Sally in implementing their innovations. The lack of local research on species selection for agronomic suitability to balance nutrition was also problematic. However, trial and error, and accessing assistance outside the local mindset has helped Greg and Sally to succeed. They have learnt, "There is not a black and white recipe to the farm. Being an ecosystem it requires flexibility and constant review".

Greg and Sally are adamant that, "Progress has also come from surrounding ourselves with a committed and knowledgeable team. Their assistance, amongst others including our two immediate neighbours, continues to be integral".

Apart from their personal management guidelines (right), the Chappells understand that flexibility is essential in achieving results, and consequently their management approach is not a static model. Ongoing learning is constant, and they continue to develop the details of their approach once they are confident that their principles are sound. Some of their key lessons include:

- "Trust that species succession will happen if the environment is right for the species you want."
- "Correcting mineral imbalance takes time. It is not all about phosphorus and nitrogen alone, the other nutrients are also critical."
- "Grazing pressure is critical. The focus needs to be on the grazing pressure the paddock needs balanced with the animals needs, not just picking a number for want of a simple recipe."

### Management Guidelines

Greg and Sally follow a number of guidelines to achieve the results gained on Shannon Vale. In managing their property, Greg and Sally **do not** allow:

- bare ground
- cultivation - direct drilling is used if necessary
- grazing without a planned recovery period for pasture
- use of chemical herbicide, except for spot spraying of blackberries
- funding with debt, "We transfer costs from less efficient inputs or increased production".
- compromise on the profit drivers, that is, the livestock



Overall Greg and Sally are proud that their business has expanded in scale and structure and achieved capital improvement to the asset. But they note that the journey is not over, "We are not at Utopia; we are still learning and will continue to do so".



# First add water



## BEETALOO STATION

### Farm Facts

60km east of Elliot, 800km south of Darwin,  
NT Barkly Tablelands

**Enterprise:** Cattle

Brahman and Brahman-Senepol cross beef  
production

**Property Size:** 1,054,700 hectares

**Average Annual Rainfall:** 450-650 mm

**Elevation:** 220 m

### Motivation for Change

- Previous experience that water supply is critical for productive grazing on vast properties

### Innovations

- Delivering a reliable water supply to support grazing across vast areas of previously unused native rangelands
- Establishing smaller paddocks on a very large scale to concentrate grazing animals to ensure managed use of pastures and continuing improvement of soils
- Innovations commenced: 2002

### Key Results

- Significant increase in carrying capacity – 100,000 head of cattle viewed as “conservative”
- Development of an innovative vision for grazing in Northern Australia
- Delivering time-controlled planned rotational grazing on a significant scale



The innovative practices developed by John Dunicliff and his family at Beetaloo provide, potentially, an efficient and sustainable method of cattle production applicable to vast areas of northern Australia – just by adding water.

When the Dunicliff family acquired Beetaloo in 2002, it had been managed for the previous century in the traditional way. Much of the country was effectively virgin cattle country, having never really been grazed, while the areas near water had been seriously over-grazed and the pastures and soil were degraded. With experience running grazing properties in various regions of Australia, including the Kimberley region where water supply is an equally important issue, they could see the potential to significantly increase productivity while simultaneously rehabilitating the degraded landscape. The key was the provision of water.

Since taking over the properties, John Dunicliff has embarked on a massive development program to provide stock water across vast areas of the properties. The scale is based on a model that cattle should not have to walk more than 2km for water. Full implementation of the plan could see production expand from the current carrying rate of 50,000 head of cattle to a potential target of 100,000, with an ultimate production cost of 32 cents per kilogram.

Advice was obtained along the way from tropical animal production expert Dr Steve Petty, who is based at Kununurra, and from holistic management experts, Terry McCosker and Allan Savory.

Contact John & Trish Dunicliff: c/o info@soilsforlife.org.au

### A Whole Lot of Land

The Dunnicliff family has been farming in various parts of Australia, starting in northern New South Wales and including King Island and the Kimberley Region of far north-west Western Australia. In 2002, they acquired Beetaloo Station, which encompasses the perpetual pastoral leases of Beetaloo, OT Downs and Mungabroom.

Beetaloo Station is vast. The total area of Beetaloo and OT Downs is 707,800 hectares and the Mungabroom property is 346,900 hectares. Combined, the total area is 1,054,700 hectares or 10,547 square kilometres. The distance from west to east is approximately 130km and from north to south about 120km - as the brolga flies. Approximately 50,000 cattle are currently run on the properties.



Beetaloo Station extends over one million hectares

The climate in this region is monsoonal. Average annual rainfall ranges from 450mm in the south-east of the properties to 650mm in the north. However, nearly all of this falls in the wet season from November to March. Due to the hot climate, annual potential evaporation is about 2700mm. This means that, while rainfall is not particularly low, there is a substantial water availability deficit in the dry season.

Newcastle Creek runs through the Beetaloo property, providing a series of wet season waterholes and three large wetlands that rarely dry completely. The OT Downs property, part of the northern watershed of Newcastle Creek, also has some wet season waterholes and semi-permanent wetlands. The Mungabroom property has no permanent water, only temporary waterholes along the creeks after the wet season. Large volumes of good quality water are available from shallow aquifers underlying the entire area.

The dominant soil types across the property are heavy, hard-setting alluvial clays that have formed on the flood plains. Lateritic sandy soils and red earths are derived from sedimentary rock, such as sandstone and limestone, which underlies and projects above the alluvial plains.

The natural vegetation includes open plains dominated by Mitchell grass (*Astrebla spp.*), which occur on the heavy clay soils. These plains are surrounded by and interspersed with woodlands and low open forests dominated by coolabah (*Eucalyptus coolabah* or *Eucalyptus microtheca*) and bauhinia (*Bauhinia cunninghamii*). The sandy soils and red earths support dense low forest of lancewood (*Acacia shirleyi*) with scattered eucalypts.

Water birds, including pelicans, ducks and brolgas, are prolific on the wetlands, temporary waterholes and earth tanks. Wedge-tail eagles, kites and other raptors are a common sight.



Wetlands and waterholes support significant biodiversity

John and Trish Dunnicliff manage Beetaloo Station with the assistance of their daughter, Jane, and her husband, Scott Armstrong. The Dunnicliff and Armstrong families participate in a program with the Barkly Landcare Conservation Association, which has a project to investigate production from differing grazing techniques, and will contrast rotational grazing on Beetaloo with a nearby 'control' of the status quo management style, set stocking and with a biodiversity monitoring program run by the Northern Territory Department of Natural Resources, Environment, Arts and Sport.



## Improving Production through Adding Water

When John purchased Beetaloo there were 40 bores and associated 'turkey nest' earth tanks scattered over the properties. John considers that "Less than 10% of the land area was effectively watered. Most of the country was in a relatively natural state, apart from areas affected by heavy stocking, surrounding most of the watering points. Large areas had never been grazed, due to lack of water. As a consequence, fires were a constant problem before each wet season".

John's observations of the grazing effect at increasing distance from water points (see images, right) suggested that the realistic maximum effective grazing distance from water is less than 2km. Cattle no doubt go further from water to graze when pastures near the bore are depleted – some people argue up to 10km – but John believes that the constant travel to and fro would eliminate any benefit and they will work off any weight gain on the way. This observation has been substantiated by work done by the CSIRO.

There are other management problems associated with using vast paddocks, such as the inability to control grazing intensity, inability to force cattle to graze less palatable areas and the high cost and inefficiency of mustering.

The cumulative effect of this form of grazing management is gradually declining grazing value, as the accessible pasture becomes degraded, increasing vegetation and soil degradation and loss of habitat for native species.



Top to bottom: Pasture at watering point; 1km away; 2km away; and 3km away from watering point



Cattle on degraded land close to a watering point

John could see the grazing potential in extensive areas of native pastures which were being very inefficiently used. Drawing strongly on his previous experience in the Kimberly, he saw the opportunity to develop, "A large scale, naturally sustainable cattle operation that is simple to operate, economically viable, environmentally sustainable, productively utilises all the available grazing area and aims at being an industry leader in low cost beef production".



By developing a water supply and reducing paddock size to distribute grazing pressure across large areas previously inaccessible to cattle, John believed that he could relieve pressure from previously overgrazed areas and facilitate rotational grazing that would enhance soil fertility and pasture growth.

The solution was providing many additional water points to encourage the cattle to graze areas previously not accessed. Now about three quarters of the way through implementing this solution across the million hectare property, the evidence is becoming clear, and John says, "We are looking for an increase in perennial pastures, and opening up of previously unwatered, unutilised country is increasing carrying capacity dramatically. As a consequence stocking rates are being increased to utilise this capacity".

Undoubtedly, the expense of developing the necessary water supply infrastructure was a major impediment. However, arguably the more problematic impediment was overcoming the traditional paradigm, that cattle production in the open rangelands of northern Australia is effectively based on practically uncontrolled grazing across vast areas. John notes that uncertainty and self doubt were a challenge to overcome in implementing innovative methods in the region. Advice received from Dr Steve Petty, Terry McCosker and Allan Savory assisted in reinforcing his plans and concepts.

## Grazing in the Northern Australian Rangelands

### Pastures

Possibly the first mention of the Barkly Tablelands region by a European is by William Landsborough. Writing in 1860 while searching for the Burke and Wills expedition group, Landsborough, leader of the "Queensland Relief Expedition" described "... a plain with the richest soil, and with grasses of the most fattening nature, but which at this time are old and dry. This tableland I have named Barkly Plains, after His Excellency Sir Henry Barkly" (Purdie et al. 2008).

The lease was first settled by Harry Bathern (also known as Bullwaddy) at the turn of the 20th Century. When the Dunnicliff family took over the lease in 2002, the land had been managed for a century in the traditional 'Top End' manner with few infrastructure improvements and a reliance on seasonal watering points, a few bores and dams and whatever grassland was available within cattle walking distance to water.

Landsborough's comment that the grasses were "old and dry" has proved remarkably perceptive. It reveals a fundamental reality that is still relevant today: while the region has considerable potential for grazing, much of it is not being used. Pasture growth is prolific when there is ample rainfall. But nearly all of the rain falls in the few months of the wet season. This rapidly dissipates in the hot climate of the dry season. The pastures then go to seed and senesce, by which time they are of little use for fattening cattle.

There are only two ways to ensure that the grasses remain useful for grazing: animal impact or burning. The grasses regenerate readily after burning, but at the cost of loss of organic matter, soil biota and volatile nutrients. Frequent burning degrades the soil. Conversely, brief periods of high pressure grazing consumes or knocks down the pasture before it goes to seed and senesces. This maintains pasture in a vigorous growing condition.



*Cattle now graze previously untouched pastures due to the provision of water nearby*



*New grass shoots after burning*





*Water provision in traditional local grazing management was to pump bore water to open earth tanks then troughs, resulting in substantial evaporation*

### Water Access

Grazing in the vast expanses of northern Australia depends entirely on access to water. Cattle can travel only limited distances each day to reach water without loss of condition. While the landscape is extensive, very little of it is sufficiently close to water to be effectively used for stock grazing. The small number of (relatively) permanent water sources has been increased significantly since the realisation that there was a significant underground source of artesian water. While bores had been sunk by previous owners to access this water, by 2002 the distribution of bores was grossly insufficient to provide water to much of Beetaloo.

Traditional grazing management on the Barkly Tablelands was to drill a bore, from which water was pumped by windmill to an open earth tank and then to a trough. A large percentage of the water pumped evaporated, which meant that, where used, a large amount of the diesel fuel used was wasted.

Sparsely distributed bores typically led to serious over-grazing close to the bores and steadily decreasing grazing with increasing distance from the bores.

Over years of grazing, this leads to the elimination of the native perennial pasture species close to the bores and colonisation of annual species. The annual species have grazing value but do not persist for long through the growing period. This low-value ground cover steadily spreads out from the bores year after year. Immense areas too far from the bores are left unused – like the “old and dry” grasses noted by Landsborough in 1860. Perennial pasture species also die through stagnation.

## Adding Water

### The Infrastructure

To extend the use of land on Beetaloo Station, John’s basic strategy is to establish a network of bores to provide a reticulated water supply system. The previous paddocks that were scores of square kilometres can then be reduced in size. Building on his observation that the maximum effective distance that cattle can travel is less than 2km, the goal initially was to reduce paddock size to 4km by 4km (1600 hectares). Observing that it is still difficult to get grazing pressure high enough to use the pastures effectively at that paddock size, this is in the process of being reduced to 3.3km by 3.3km (1200 hectares). Consequently, as John points out, “This water development is being carried out in conjunction with an extensive fencing program”.

A network of bores is being installed and connected with 75mm diameter pipe installed at a depth of 800mm running along the fence lines. Burying the pipe 800mm deep ensures it does not expand and contract with temperature changes, which could cause leaks to develop. A steel tank of 170,000 litres useable capacity or a plastic tank of 20,000 litres capacity is installed at each fence intersection. The tanks are filled from the bores by diesel pump. Windmills could not generate the pressure required for this and solar-powered systems are far too costly. Despite the long distances to travel to them, the pumps are manually operated because remote electronic switching systems have been found to be unreliable.

Concrete or steel troughs installed in the corner of each of the four nearby paddocks are filled from the tanks by gravity. Each bore supplies around nine tanks and each tank supplies four paddocks. The pipelines being linked in a grid arrangement means there is multiple back-up in the event that a bore fails. Similarly, having four troughs in each paddock provides a backup in case a tank is unserviceable.

One person is employed full-time during the dry season to maintain the bores, tanks and trough system, including refuelling, servicing and repairs.



*The helicopter provides both transport and safety capabilities*



*Water infrastructure now comprises a network of steel or plastic storage tanks, concrete or steel troughs and bores  
Inset: A diesel bore pump*

Work place safety is a major concern in this remote region. As well as ensuring all staff attend safety briefings, providing safety equipment and ensuring appropriate signs are in place around the sheds and homestead area, staff at Beetaloo Station are trained in first-aid. Using a helicopter for travel around the property has the dual benefits of enabling faster travel for work purposes and providing a means of rapid evacuation of an injured person.

### The Cost

Developing the water supply is a massive investment. Each kilometre of laid pipe costs around \$3000. Even with the most cost-effective methods, the bores, tanks, fencing and other costs incurred to develop each water point come to around \$60,000. This seems a lot until the capital cost is divided by the number of cattle each unit of the investment can support, making it much more achievable.

Besides financial obstacles in obtaining capital, John has encountered other challenge in implementing his watering program across Beetaloo Station. He has experienced "resistance and scepticism from some members of the grazing community and industry bodies in relation to the changes", and regularly battles the restrictions on availability and supply of resources due to isolation. John states that trial and error and working closely with suppliers has been essential to resolve various technical issues, such as tanks failing.

Regardless, John continues to fund the development incrementally, investing all outputs from production increases back into the watering program.

### The Benefits

John has sought to implement his changes using a holistic approach to livestock management with minimal chemical and artificial inputs. His fundamental focus is on soil, plant and animal health and animal welfare.

Providing many smaller paddocks with troughs in each corner has delivered many benefits. John notes, "By increasing the available watering points, and control of the cattle with associated fencing systems, pasture availability has increased dramatically. This has enabled the spelling of paddocks, to assist with the regeneration of plants, and in turn soil health".

*"Experts indicate the targeted carrying capacity is conservative."*

Stock density can be increased to force cattle to graze a much higher proportion of the pasture than they would if left to roam much larger areas. The perennial pasture species are high value for grazing provided they are grazed early in the growing season. If they are not grazed early in the season they go to seed and soon lose nutritional value. Grazing each area in turn with a high stock density for a brief period – three days grazing with a mob of 6000 cattle units is the current aim – prevents loss of pasture value.



*The necessary stockpile of fencing materials, water tanks and polypipe stretches to the horizon*





At the same time, heavy grazing for a short period, together with the trough location that distributes cattle movement to four points within each paddock, prevents overgrazing, which discourages regeneration of annual species, and reduces soil degradation. Most importantly, short periods of intensive grazing build up soil condition and encourage pasture growth in the long term by breaking down senescent vegetation and litter and adding dung.



*The pastures and soils are benefitting from the new grazing regime*

### The Stock

John believes that with full infrastructure implemented across the property that he will be able to achieve a target carrying capacity of 100,000 cattle, and says, "Experts indicate the targeted carrying capacity is conservative".

The planned carrying capacity with the current water infrastructure implementation is 75,000 cattle units, based on a 400kg animal; a breeding cow is 1.5 units and a mature bull 2.0 units. Herd bulls run permanently with the herd.

At that carrying rate, annual production is expected to be 25,000 cattle units. These are young bulls (maximum weight 350kg) grown for the Indonesian market and larger animals grown for other export markets. Bulls produced other than for this prime export line provide herd bulls for the local and Indonesian markets and for meat markets in the Philippines and the Middle East. Most heifers are retained for herd growth and replacement. Heifers not in calf at 24 months age and culled cows are also sold to the overseas meat markets. John is active in building relationships with his markets, travelling overseas and

also receiving visitors to Beetaloo. This has given him confidence in regards to his animals' welfare after export. His clients are also satisfied that they are receiving quality, grass-fed stock, meeting their needs and expectations.

The Brahman cattle have advantages in the hot climate, being resistant to ticks and tolerant of the heat. However, fertility is generally lower than for other breeds. Crossing the Brahmans with Senepol, a short-haired breed originating in Senegal, West Africa, and developed on the Caribbean Island of St. Croix specifically also to cope with a tropical environment, has been found to provide some resolution to this issue. In addition, John's practice of culling 'empty' 24 month old heifers ensures that the breeding herd is gradually being selected for fertility.

Ticks are a common problem with cattle in the tropics and sub-tropics. Selecting tick-resistant cattle breeds helps, but does not eliminate the problem. Resting each paddock from grazing for long spells breaks the life cycle of the tick and therefore saves on other control treatments. This provides a further key benefit of the change from uncontrolled set stocking across large areas.

*"...a well organised, productive, sustainable business operation that will benefit the whole environment and landscape, without any unnatural side effects."*



*Cattle are bred to cope well in the tropical environment and are for resistance to ticks*

## An Innovative Vision for Grazing?

The experience on Beetaloo Station has demonstrated that cattle production can be significantly increased in northern Australia by providing adequate water supply to areas with grazing potential. There is also scope for the increasing carbon build-up in the restored soils to be achieved across vast tracts of land.

John knows that he is developing "...a well organised, productive, sustainable business operation that will benefit the whole environment and landscape, without any unnatural side effects. The changes being implemented have already been attracting attention from other graziers, advisors, industry bodies and NT Government".

However, he advises, "The cost of infrastructure on the scale required is enormous. The sheer size of the lease limits the pace of change that can be achieved. Make haste slowly, because the costs of getting it wrong are huge".

But this innovative approach also brings other opportunities. Beetaloo is too big for one family. The family's vision for the property is to enable it eventually to be divided into a number of units, each of which can support an efficient family run business. This could ultimately be a model for efficient and sustainable cattle production applicable to the vast areas of northern Australia, which, as John says, "Is essential for the long term survival of the industry and its participants".



<sup>1</sup>Sir Henry Barkly was the then Governor of the colony of Victoria and president of the Royal Society of Victoria

Reference: Purdie, J., Materne, C., and Bubb, A. (2008) *A field guide to the plants of the Barkly Region of the Northern Territory*, Barkly Landcare and Conservation Association, Katherine, Northern Territory.



# Restoring the Gascoyne rangeland – commitment, cooperation and hard work



## THREE RIVERS STATION

### Farm Facts

230km north of Meekatharra, 1000km north east of Perth, WA Mid West

**Enterprise:** Cattle

Bos Taurus beef production

**Property Size:** 480,000 hectares

**Average Annual Rainfall:** 225 mm

**Elevation:** 550-600 m

### Motivation for Change

- ◆ Degraded landscape unable to support stock

### Innovations

- ◆ De-stocking of property to allow for regeneration
- ◆ Construction of strategic earthworks to slow surface water flow, restore water flow to wetlands and floodplains, reduce erosion, build soil and promote perennial pasture regeneration
- ◆ Innovations commenced: 2004

### Key Results

- ◆ Gradual regeneration of perennial pastures
- ◆ Erosion stabilisation and reduction
- ◆ Water ponding and reduced evaporation



Graham Forsyth and his son Ben have an absolute commitment to the work they are performing on Three Rivers Station to slow the flow of water, restore soil health and regenerate their part of the degraded West Australian rangelands in the Gascoyne River catchment.

From their initial purchase of the pastoral lease in 1984, the Forsyth family built Three Rivers Station into a highly successful and extensive beef enterprise. During this time, the family came to realise that traditional management of the rangelands had caused them to decline to a critically fragile level. In response to this knowledge they began to implement different management practices to regenerate rangeland function.

Since 1992, increasing mining operations and exploration on the station has interrupted pastoral operations and made large demands on water supplies in the aquifers. However, it was observing cattle of below expected condition at the 2003 muster that led the Forsyths to make the difficult decision to de-stock their property. This has culminated in the effective suspension of pastoral operations while mine exploration and development is taking place, but has enabled conditions to help restore the landscape.

The Forsyths have turned what could have been a family catastrophe into an opportunity, working with the mining companies to halt the decline and accelerate the regeneration of the rangelands. After building their knowledge on local landscape and function, they have been experimenting with earthworking techniques such as rakes and bunds to stabilise erosion areas and nurturing perennial grass seed banks. This work has seen active gullies stabilised, surface water flow slowed and spread across the landscape and a dramatic increase in the abundance, diversity and vigour of perennial grasses.

Together, Graham and Ben Forsyth are investing in the future to re-establish grazing operations. They are restoring the degraded landscape in their part of the West Australian rangelands.

Contact Graham & Ben Forsyth: [ben@beefwood.com.au](mailto:ben@beefwood.com.au)



## Three Rivers Station

Three Rivers Station is located at the headwaters of the Gascoyne River in the rangelands in the mid-north of Western Australia, intersected by the Great Northern Highway. It has been used for extensive pastoral operations since 1898. The long term average rainfall is about 225mm with very large variability and a trend towards summer dominant rainfall or significant storm events evident in the last decades.

The Forsyth family purchased the Three Rivers pastoral lease in 1984. In 1992 they sold the lease to Plutonic Gold Mine, which is currently owned by *Barrick Resources Pty Ltd* of Canada. The Forsyths subsequently sub-leased back the grazing rights to the property.

The Forsyths built up a high quality breeding herd based on *Bos Taurus* genetics. From 1995 to 2004 the progeny from Three Rivers was used to produce the Forsyth family's own *Three Rivers Beef*, which was marketed across Australia, Hong Kong and Japan. The *Three Rivers* brand was notable not only for the quality of the product, but also for the values the brand embodied: integrity of relationship with the pastoral ecology and ensuring that everyone in the supply chain got a fair share of the profits. As Graham says, "We are responsible to produce food that makes people healthy and that gives a fair share to everyone in the supply chain so they can look after their people and the land".

The Forsyth family were conservative in their stocking levels and traditionally managed to a carrying capacity of 2,857 large stock units (unit of measure based on the feed requirements for a 450kg steer).

Availability of stock water is important when managing grazing in the vast rangelands where the size of the area makes fencing cost-prohibitive. Watering points are used to encourage cattle to move to areas ready to be grazed and to leave areas needing rest. Provision of water for cattle on Three Rivers Station is from permanent natural water as well as localised watering points. Watering points are supplied from local bores using a combination of windmill, tank and trough as well as solar and diesel pumps.

Initially, processing of ore at Plutonic Mine placed a large demand on water supply. In response, watering points had to be deepened by over a metre to reach the water table. Plutonic have since implemented recycling, water use efficiency programs and tapped into a second water table, somewhat easing the pressure on station water.

## The Fragile Rangelands

Western Australia's rangelands are vast areas of lands from the headwaters and catchments of major rivers including the Gascoyne and the Murchison. The original sandy loam topsoils have traditionally been a rich resource for extensive grazing operations and have been the base of major industries producing beef, sheep and wool. The rangelands are a fragile and sparsely populated landscape on ancient geology in a harsh and unforgiving climate.

The rangelands are also a mineral resource asset. Since starting slowly in the 1960s, mining interest in the area has accelerated. There are currently 40 mining and exploration leases and two active mines on Three Rivers Station. The main mineral interests are copper, gold and iron ore. Mining exploration and operations can be highly disruptive to pastoral enterprises and the landscape as they set up rigs, mines and roads and compete for water from the local aquifers.

There is ample evidence that unfortunately, until recently, some members of the rangeland community have not understood the brittle nature of the land, its vulnerability to the placement and construction of roads, the importance of perennial grasses to the landscape function and the vulnerability of the grasses to over-grazing.

Ben points out, "Generally, soil health in Western Australia's arid rangelands is historically unknown, or not considered, by land managers. The most limiting soil factor is water and the main symptom of soil ill health is landscape desiccation as a result of loss of perennial ground cover species and nicks in the landscape resulting in an accelerating incising of the drainage lines".



*An example of road construction re-directing the flow of water, potentially causing erosion threat to the flood plain*

The land is so brittle that areas of wagon tracks of the old settlers, or accidental 'nicks' in the landscape caused by new roads in contemporary times can have a major effect if they result in concentration of water into a channel on bare ground. The landscape is so flat, that an incision measuring only centimetres can change the water course. In large rain events, small incisions can result in rapid gully formation and change the drainages so significantly that the course of the river can be altered, leaving important wetlands and floodplains perched above even the most significant floods. Such a minor incision in this flat landscape can concentrate large amounts of water that should spread gently over the plains without damaging them, into destructive torrents that can wash metres of soil (and salt) downstream. This in turn threatens the productivity of lower areas in the catchment.



*Hard subsoils exposed after loss of topsoil along the river*



*Evident salinity in a streambed*

As a result of decades of poor grazing practice, the rangeland perennial grasses have steadily declined. This, plus erosion-causing surface damage, has left the fragile topsoil exposed and vulnerable to the variable climate and occasional, but quite extreme rain events. By the latter part of last century, much of the topsoil in the rangelands had eroded, leaving the hard, water-shedding subsoil that can only support sparse annual grasses and shrubs that are tough enough to establish roots.

## A Change in Tradition

The Forsyth family was endeavouring to stop erosion and to restore the landscape function whilst running a fully operational pastoral business, however incremental change was not sufficient. Ben points out, "When dramatic change is needed, more often than not dramatic action will be required to jar things out of the current paradigm".

Dramatic action was triggered at the 2003 muster when the family observed that the cattle did not look as good as they thought they ought to, given the amount of feed that appeared to be on offer. They made the decision to remove all the mustered cattle from Three Rivers and to de-stock the property. To this day Graham Forsyth is convinced that if he had not done this, many of the cattle would have died the following summer, even if heavy weaning was carried out. This courageous act has cost the family approximately one million dollars in direct costs and lost opportunity from the pastoral lease.

As a consequence, the combination of declined landscape function and the difficulties of integrating their pastoral operations with further mining exploration and expansion prevented the Forsyths from running a viable pastoral business at Three Rivers Station. In Graham's words, "When your cash flow stops, all hell breaks loose".

Pastoralists whose stations are already showing signs of degradation and who are also being significantly impacted by mining would be forgiven for selling their lease to the mines and leaving. Instead, the Forsyth family chose to turn what could have been a tragic end to a pastoral family tradition into an opportunity to accelerate rangeland regeneration.

Together, Graham and his son Ben, are forging a new era of pastoral cooperation with mining in the rangelands. They have formed a new business, Three Rivers Contracting, to provide services to the mining companies in support of their exploration and mining operations. This business leverages the Forsyth knowledge of the land, their skills with machinery and earthworks and their business acumen. The machinery used in support of mining is compatible with that needed on the rangeland for regeneration works. It allows them to earn an income from an alternate use of the land and the developing partnership has already enabled strategically important interventions to regenerate this valuable landscape.

Mining companies are obligated to restore the landscapes they have operated in. In the past, many mining restoration works have been focused at the closure of part of a mine, or at the end of operations, levelling hills of overburden into the excavations and restoring vegetation. Generally, the more remote the mine, the less effort devoted to rehabilitation. At Three Rivers, Graham and Ben and their partners in the mines, in particular Barrick Gold, are demonstrating that a great deal of highly effective landscape regeneration can be occurring whilst the mine is still operating. Such a progressive approach to regeneration potentially offers benefits to the mine and its personnel through local service provision to complement the mining company's own skills, greater landscape amenity through regenerated rangelands and possibly improved security of water supply by greater recharge of the aquifers - as well as beginning the landscape repair required as part of the mine's exit strategy.

## Learning in Order to Heal

A combination of influences and their own observations led the Forsyth family to recognise that the ecological health of Three Rivers Station was declining and that this was partly due to their own and others' mismanagement of aspects such as groundwater and roads which could have a negative impact the landscape.

Particularly influential were insights gained from working with respected rangeland ecologists, Dr. Ken Tinley and Dr Hugh Pringle. Together they worked on a program to facilitate ecologically sustainable rangeland management using the Ecosystem Management Understanding (EMU) approach, as delivered jointly by the West Australian Department of Agriculture and the Department of Environment and Conservation. Building on local knowledge, the EMU approach involves reading and recognising the terrain elements in the landscape, their internal and linking functions, condition and trends. This

allows for a comprehensive understanding of what the landscape can and cannot offer.

In addition to participation in these formal programs, the Forsyth family invested a great deal of personal effort in their study of the history, geography and climate of the area to better understand what was happening in the landscape. They used the diaries of the original settlers, examined the notes regarding rainfall and stocking levels from the pastoral families that had previously managed Three Rivers and searched newspaper archives.

They noticed that records from Three Rivers Station showed a repetition of cycles of drought years followed by wet years followed by dramatic reduction in stocking levels. They coupled this information with their own observations that the dominant vegetation during their tenure of the lease was shrubs with largely bare soil between them except for a short time following rain, when they observed a flush of annual grasses and forbs that quickly dried off and blew away.

As cattlemen, they also observed that the annual grasses and shrubs, although highly nutritious, could not support the same levels of animal productivity, water infiltration and soil health that perennial grasses can achieve. In transitioning from a grassland to shrub lands of woody weeds, the productivity of pastoral operations had declined.



*Typical shrub land of sparse grasses and woody weeds*

These cycles indicated to the family the importance of managing the balance between shrubs and pastures in maintaining the ecological function of the rangelands. From their work with animal nutrition, they came to realise that balancing shrubs and pastures in the rangelands was also important to cattle health and productivity.







*Thriving perennial pastures*

Contemporary understanding of the rangeland ecology by government departments, natural resource management groups and even pastoralists such as the Forsyths has been that many of Australia's semi-arid rangelands are shrub lands with little or no topsoil and little, if any, capacity to support perennial grasses. From their study however, the Forsyths concluded that diverse native perennial grasses had thrived in the rangelands in the past. They are now demonstrating that these grasses can thrive again, and showing that, with help, these pastures can also build soil, guard against erosion and increase ecological complexity and function.

## Investing in the Soil and Calming the Waters

In regenerating the rangelands, Ben points out, "Our focus is on looking after the soils before other aspects of management, as this is where true sustainability will be judged".

The Forsyth priority for helping the soil recover its health is to firstly to slow down the flow of water on the landscape so that it soaks into the soil. The best tools for this job are diverse communities of vegetation - dense swards of perennial grasses, forbs, shrubs and some trees. The reduction in grazing pressure to very light grazing has already resulted in vegetation re-establishing in some of the better areas, such as where healthier, protected soils held seed banks of perennial grasses. Perennial grasses are particularly important because they are typically deep rooted and persist all year, so they hold and build soil. Because the rangelands have already lost a lot of soil and plant species over the last 100 years of pastoral management, it has become a race of regeneration against erosion.

Graham and Ben judged that mechanical intervention was needed to speed up the recovery process and took advantage of earthworking equipment available through their contracting business. In the recovery process a fine balance is required between mechanical intervention, maximising perennial grass seed build up and the managed use of cattle.

Ben notes that they have been "Property planning using the EMU methods, identifying key erosion locations and required interventions and treatments on aerial photo overlays. These interventions have been implemented at a limited scale with encouraging results for controlling the loss of water from the landscape".



*Ben and Graham use aerial photos to identify priority erosion locations for treatment*

The Forsyths have trialled and developed "water calming" interventions, starting at the erosion source areas and working downstream. The techniques used at Three Rivers include interventions such as bunds (raised embankments), rakes (evenly spaced poles embedded in the ground to catch debris) and strategic banks. (See images overleaf.) These interventions are all slightly different methods for slowing water flow during rain events and spreading the water out over a large area so it becomes de-energised and loses its erosive power. Each has slightly different characteristics of performance and cost and is matched carefully to the situation being managed. As an added bonus, the interventions also trap debris and sediment which then becomes decomposing organic matter which in turn provides a nursery for grasses and shrubs to grow in.

An innovative approach to using local materials was generated by the Forsyth family's intimate knowledge of their land. They had noticed that a locally available rock, calcrete<sup>1</sup>, had a binding action and was having a beneficial effect on regeneration of perennial grasses. The Forsyths had noticed that where the truck that carted the calcrete had bounced on rough ground and spilled calcrete, "The effect on the palatability of that grass was unbelievable. For the width of the truck, where the spillage was, grass had been chewed down to the ground to the edge of the spill, beyond that, the dry grass was totally left alone. There's a lot more to it than meets the eye, that's for sure. I don't think much scientific work has been done on calcrete, I think we're the first people to try anything".

Where this rock had been used as a road surface, more grasses were growing along the road side. Whilst no soil testing has been performed, as the rock is highly alkaline, it appears that it was helping the soil chemistry to suit the perennials grasses as well as being a strong road surface. They put this insight into action where the remnant flood plains were actively eroding, using calcrete in their regenerative earthworks.

equipment and they provide a rapid response as soon as it rains. They do not prevent flood water flow, but help to capture debris and sedimentation and to build soil and vegetation.

The areas of concern were mainly those lower in the landscape, the river bed and floodplains. Because of the soil characteristics of the area and the lack of topsoil, the remaining soil is vulnerable to slumping when it becomes wet. The resulting 'crab holes' become an issue if they start to join up, creating extensive fronts of sheetwash erosion. The Forsyths have seen this result in some significant incisions in the landscape.

A technique Graham and Ben have developed to address this is simple and effective. It consists of chamfering (flattening) the erosion face to give it a gradual slope rather than a vertical face, then lining the fresh face with calcrete. They have found that this is a very low risk approach, and even if the work fails in places, the calcrete armour prevents erosion from progressing. This technique appears to have an added bonus of the calcrete lifting the soil pH and helping the perennial grasses to grow vigorously.

Bunds, rakes and banks are very practical in that they can be implemented with readily available



*Calcrete bund to slow and divert the flow of water  
Inset: Thriving kangaroo grass alongside the bund*

<sup>1</sup>Calcrete is a calcium-rich hardened layer in soil. It is formed on calcareous materials as a result of climatic fluctuations in arid and semi-arid regions. Calcite is dissolved in ground water and, under drying conditions, remains on or near the surface as the water evaporates.



*Small 'crab holes' of collapsed soils (top) can spread to form massive fronts of sheet erosion (below)*





## INTERVENTIONS ON THREE RIVERS STATION

Rakes are constructed on hardpan benches in water courses to act as a filter to catch debris, build up sediment and seeds and to spread channelled water back out to the floodplain



Strategic calcrete bunding on face erosion and sodic flats provides a 'speed bump' to slow surface water flow and incorporate acid pH amelioration



Native grass seed orchards to increase the critical mass of native seed in a given sub-catchment are protected with exclusion fencing





## Mosaics of Healing

The strategies put in place by the Forsyth family are clearly being successful in helping mosaics of regenerating soil and vegetation to establish and expand. Ben notes, "Historically Three Rivers has had a comprehensive photo and species count monitoring system in place. Due to the destocked period, and resultant drop in available time and money, monitoring has not been as thorough in recent years. Anecdotally, the perennial grass content of the pasture has dramatically increased in the last five years and there has been a definite decrease in erosion at the locations that have been treated".

Ben continues, "Significant increases in the population of perennial grass species has occurred since de-stocking happened in 2003-4. It is assumed that this will lead to an increase in soil biology and sequestration of carbon". Perennial grasses such as kangaroo grass (*Themeda triandra*) and silky brown-top (*Eulalia aurea*) are recolonising areas in groves that formed after the destocking. On slightly-sloping sheetwash eroded terrain, alternating strips of sandy topsoil are supporting these groves, separated by usually bare gravel bands that only support low annual wind-grasses for a short time after rain. These clumps of grass form seed banks – or "seed orchards" – which allow the grasses to build and spread.



Recolonisation of perennial grasses after de-stocking forming a seed bank

Kangaroos have long plagued Three Rivers Station, competing in droves for the scarce grasses with livestock. Ben and Graham have noticed that kangaroos prefer short grasses and will eat them to the roots, yet ignore longer grasses. Where grasses are growing taller, kangaroos are not to be found. As the impact of regeneration spreads across the landscape, Graham and Ben are seeing fewer and fewer kangaroos. They feel there is a strong possibility that, as the grassland returns, the kangaroos will maintain balanced and healthy numbers on Three Rivers Station.

Some gullies that were forming in the Middle Branch of the Gascoyne have been stabilised by the erosion-control earthworks and calcrete and this, combined with the respite from grazing from both cattle and kangaroos, has resulted in extensive perennial grass recruitment and probably increased recharge into groundwater. The river banks have more grass. Pools that used to exist upstream of the rakes have filled with sand. They still contain water, but as this is covered by 30cm or so of sand, there is no evaporation.



Water ponding upstream of established rakes

In one area, as is common, an accidental nick in the landscape due to road works on an old track had caused a small incision to start. This small incision had the capability of putting at risk the water course leaving some wetlands perched above the new stream level. The stream diversion banks, made of calcrete have been successful in stopping the progress of the incision and in restoring the flows of the river to this wetland.

Interestingly, a new grass has been found on Three Rivers which has not yet been identified. Graham Forsyth reports it as, "extremely vigorous, with very vigorous rhizomes and limited spread by seed. It produces a dense sward able to capture litter and sediment. It appears to be able to use soil moisture at any time and maintains green leaf well into dry periods. It is palatable to cattle and horses, both graze it only to a height of about 10cm."

Graham says, "Nature's wonderful and it's just waited for the right circumstances and the manager of the land. You change your intent towards your country and it responds".



*Chamfered erosion in September 2005 (top) and stabilisation through colonisation of annual and perennial grasses after summer rain (no flood) in March 2006 (below)*



*Discussing the as yet unidentified new grass on Three Rivers Station  
Inset: New grass shoot*

## On the Way to Restoration

Graham and Ben are looking forward to being able to expand these early successes across the landscape to get the full effect of them. "From an individual and family perspective, it has been affirming to see the positive results from our dramatic and very costly action to de-stock back in 2003. This decision was made after we became aware of the accelerating soil erosion and landscape desiccation processes that were rampant. Our family has been greatly encouraged by the rapid increases in the regeneration of the perennial ground cover species and the obvious benefits of the earthworks that we have been able to construct to slow the water and spread it across flood plains."



Once the mining activity in the area has been stabilised and the locations and requirements of the mines are known, pastoral operations will be able to be integrated back into the area. This is critical, not only the Forsyths, but to the ecological function of the area. Perennial grasses are an important component of the rangelands because of their function in protecting and building soil, storing carbon in the soil and infiltration of water into the subsoils and aquifers. Perennial grasses have evolved alongside grazing animals and the actions of grazing, trampling and recovery are vital to the renewal of the perennial plants and to the maintenance of plant diversity and abundance.

Graham and Ben have been studying leading grazing theory and practices from all over the world and integrated this knowledge with their own insights into the current and desired function of their land. Ben notes, "Destocking of the property allowed recovery while strategies were implemented".

In April 2012, 400 cows were returned to Three Rivers Station and it is anticipated that grazing pressure will slowly be increased. Ben advises that they are, "Establishing a plan to introduce rest and rotation to the grazing strategy, rigorously maintaining total grazing pressure to remain within seasonal carrying capacity and embracing technology for water point management and livestock monitoring".

The initial plan will see rotational grazing used across four paddocks on one floodplain area of Three Rivers Station. Once mining requirements become clearer and location of fence lines can be planned with confidence, Graham and Ben will sub-divide to smaller paddocks and a more intensive rotational grazing strategy. The strategy will be extended to other parts of the property as more grassland becomes available and resources become available to extend the watering and fencing infrastructure.



*A range of pasture conditions evidenced on Three Rivers Station: still degraded land (top left); initial colonisers (top right); beginning of perennial colonisation (below left); flourishing pastures (below right)*





The locally appropriate plan for management of grazing aims to build the ecological function and sustainability of the pastoral enterprise, improve aquifer recharge and build soil carbon stocks, protect the rivers and drainages, produce 'clean and green' and healthy livestock in a financially satisfactory way. The Forsyths are investigating some new processes and technologies to lower the fossil fuel footprint of their operation. This includes use of recycled materials and new technologies such as virtual fencing.

Graham and Ben Forsyth believe that Australia's rangelands are assets of national importance and responsibility for their condition extends beyond the current lease holders to the nation as a whole. Regenerated land at the headwaters of the Gascoyne and the Murchison will assist with the delivery of clean water downstream to important catchments surrounding Carnarvon. Fully regenerated pastoral leases will be vitally important to future generations through the revitalisation of the pastoral industry to help to meet the requirements for high quality protein for a growing population.

The Forsyth commitment to the land and its people shows in the determined and innovative approach they are taking to bringing the major stakeholders together to lead the process of taking collective responsibility for the degradation and working together to effect the regeneration and restore the decades of damage to the Gascoyne rangelands. Their leadership and innovation shows that together, mining companies, governments and farmers, as stewards of the land, have an opportunity for a strategic partnership in restoring the rangelands and realising the agricultural production opportunities that a healthy landscape will present.

As Graham concludes, "I believe we're going to need every bit of productive country that earth's got to offer over the next few years, we've got to nurture what we've got but if it can't be brought into production viably, then you've got to find other ways to still bring it back. Because if we don't bring it back, the Gascoyne River from this divide to the sea will just be a Grand Canyon. Now, we can't let that happen".





# Turning sand into fertile soil with applied soil science



## CLOVER ESTATE

### Farm Facts

Mil Lel, 15km north east of Mount Gambier, SA South East

**Enterprise:** Cattle

Contract rearing of dairy heifers

**Property Size:** 100 hectares

**Average Annual Rainfall:** 700 mm

**Elevation:** 56 m

### Motivation for Change

- ◆ Rising production costs and animal health concerns

### Innovations

- ◆ Introducing biologically-based soil conditioners to balance the mineral and microbial status of the soil
- ◆ Strategic use of foliar fertilisers
- ◆ Ceasing chemical inputs
- ◆ Innovations commenced: 1995

### Key Results

- ◆ Stock output increased by 33%
- ◆ 25% reduction in irrigation used per animal weight produced
- ◆ Infertile sand converted into fertile dark soils showing organic matter down to 60cm
- ◆ Thriving pastures with fewer weeds



David Clayfield has used applied soil science to create fertile, healthy soils from sand, in turn producing healthy pastures and healthy cows.

Faced with rising production costs and animal health concerns, David Clayfield made the link that improving soil health – physically, chemically and biologically – could address the cause of animal health and low productivity problems.

David eliminated the use of chemical and acid-based fertilisers, replacing them with biologically-based soil conditioners tailored to rectify deficiencies identified through soil tests.

Fifteen years on, yellow sands have turned into dark, healthy soils with a substantial increase in soil organic matter. Irrigation requirements have reduced from the region's typical seven to eight megalitres per hectare each year to five to six, subsequently reducing the energy used for pumping and distribution.

Pastures are thriving, animal health has improved and productivity has increased, while the veterinary bills have plummeted – positive results, all round.

Contact David Clayfield: [dclayfield@bigpond.com](mailto:dclayfield@bigpond.com)



## Clover Estate

David's grandfather came to Clover Estate in the mid 1930s to manage a large grazing estate. He bought a portion of it when the estate was subdivided for soldier settlement blocks after World War II. David's father grew up on the farm and has now retired, leaving David to run the property.

The typical soil in the region is five metres of sand overlying limestone. Native vegetation is low open forest dominated commonly by manna gum (*Eucalyptus viminalis*), brown stringybark (*Eucalyptus baxteri*) and blackwood (*Acacia melanoxylon*). Most of the native vegetation in south-east South Australia has been cleared to make way for farming and plantation forestry, but there is a small remnant left on the Clover Estate property.

There are no surface streams in the limestone plains area of south-east South Australia – rainfall infiltrates into the limestone, which forms an extensive shallow aquifer system. Dairying and cropping in the region depend on pumping irrigation water from this aquifer system.

David's grandfather and father operated Clover Estate as a dairy farm for many years, irrigating the pastures using water pumped from the shallow limestone aquifer underlying the property. After the dairy industry was deregulated the property proved to be too small to run viably as a milk producing dairy farm. Since 2000, the farm has been used to raise dairy heifers that are bred elsewhere in the district.

Heifers are reared on contract on a 'pay for weight gain' basis. The calves are brought to the property at four to five months age and within one year they have gained about 200 kg, i.e. a young dairy cow. The farm has the capacity to 'turn off' 600 to 700 heifers a year.

The current market for these young cows is the Republic of China. The heifers are shipped to China where they are mated upon arrival and begin producing milk before they are two years old.

A total of about 62 hectares of Clover Estate is irrigated and the rest is used for unirrigated grazing and cutting hay to provide feed during winter. A highly modified landscape, almost all native flora on Clover Estate has been replaced with introduced pasture species.



Clover Estate lucerne pastures which are interspersed with rye grass, clover and plaitain

## Deficient Sandy Soils

South-east South Australia is made up of distinct land systems. The main underlying geological formation comprises limestone layers that have produced fertile soil, including the famous 'terra rossa' (red earth) soils of the Coonawarra wine region. Scattered in bands across the plains are low wide sand ridges, running roughly parallel to the present coastline. These sand ridges formed along ancient coastlines in the past few million years as the sea level rose and fell and the land surface was uplifted during ice ages. These sandy soils have low natural fertility.

When the large grazing properties were 'broken up' for farming and closer settlement, these sandy soil plots were not in demand. The sandy areas in private ownership were used for grazing, rather than cropping.

Clover Estate and many other properties in the area have been used for dairying, irrigated with groundwater pumped from the limestone aquifer, for many years. This groundwater is rich in calcium, which increases pH from natural levels of around 5, that is, slightly acidic, up to 7 to 8, which is slightly alkaline. This change causes nutrient imbalances and encourages growth of Yorkshire fog or velvet grass (*Holcus lanatus*), a perennial grass. *Holcus lanatus* is generally considered in Australia to be a weed of saline and waterlogging-prone sites and has little grazing value. The traditional way to redress the nutrient imbalances in the area is to use superphosphate and potash - potassium-rich fertiliser.

In 1992, a soil test showed organic carbon at 2.1%, total cation exchange capacity 3.5, and deficient levels of 17 macro and micro soil nutrients at Clover Estate. Prevailing advice was to continue to apply higher amounts of chemical fertiliser to maintain production. But high chemical and



fertiliser inputs and high water use were proving to be financially unsustainable. Furthermore, excessive weed competition had been developing despite regular use of knock-down and selective herbicides. Insecticides were used regularly for red-legged earth mite and other pests.

These problems, high levels of irrigation per animal production unit, on top of recurring animal health issues – mastitis, prolapse, sore feet – and concern about personal exposure to chemicals, led David to investigate more sustainable ways to improve soil and forage quality.

## Identifying the Benefit of Healthy Soils

David had realised that management of animal health with medicines was only addressing the symptoms of animal health and performance, rather than the causes. Equally, chemical management was only creating recurring problems at extra cost. Conversely, improving soil health and mineral balance and availability in pasture would address the cause of animal health and low productivity problems.

David found that experimentation and mineral supplementation redressed some animal health problems. Success with this process indicated the strong link between animal nutrition and health. This prompted David to undertake further investigation to address animal health problems through the soil and fodder.

David's aim was to stop using chemical or acid-based fertilisers and pesticides. He wanted to improve soil fertility and water-holding capacity by adding biologically-based stimulants that increase soil organic matter.

He encountered challenges with adopting new methods, the initial impediment being a lack of information about alternatives to the 'single super' use way of farming. He was required to perform ongoing research, education and trial and error to identify his options and learn more about the links between soil and animal health.

David initially drew on information from Pat Coleby, a practitioner of animal health through soil health, which provided a useful guide. He also attended short courses in different approaches to fertiliser management, increasing his understanding and confidence in soil mineral and microbial management. David notes, "I have utilised interactions with agronomists and soil scientists from biological product supply companies to assist in fertiliser program management and planning".

David also read widely to supplement the courses and consultation. His collection of reference books include

Charles Walters and C.J. Fenzau's *Eco-farm*; Arden Andersen's *Science in Agriculture: Advanced Methods for Sustainable Farming*; and Pat Coleby's *Healthy Land for Healthy Cattle*.

An equally significant challenge was the lack of interest from other farmers, extending even to ridicule of some of the changes made and methods tried.

Regardless, David advises, "Work it out, stick to it, no matter what everyone thinks. With the experience and knowledge now available, you could build carbon and fertility in your soil in much less time than it took us to learn how by trial and error".

## Turning Sand into Soil

Understanding the physical, chemical, and biological aspects of soil through applied soils science and putting this knowledge into practice over time, has been the fundamental innovative practice applied at Clover Estate.

"Testing the soil and observing the plants and animals, it became obvious that use of chemicals and acidic fertiliser were not a long-term solution", David says. He stopped using chemical fertilisers in the mid 1990s, five years before the switch from milking to raising heifers.

"The aim was to start with the soil health, by balancing the mineral and microbial status of soil, and the subsequent benefits in forage quality and animal health would follow."



*Spraying biological liquid fertiliser*

“The aim was to start with the soil health, by balancing the mineral and microbial status of soil, and the subsequent benefits in forage quality and animal health would follow.”

The process began with soil testing to assess the situation. Soil treatments were applied with the objective of addressing mineral balance, improve soil biological processes and overall soil fertility specific to paddock soil test results. The key ingredients are residue-digesting fungi and nitrogen-fixing bacteria, including strains of *Azotobacter*, *Bacillus*, *Pseudomonas*, and *Trichoderma*<sup>1</sup>. Nutrients, carbohydrate and minerals are added to enable the bacteria and fungi to multiply in temperature-controlled 5000 litre aquaculture tanks. The minerals included a carbon, humic base to stimulate soil biological processes and organic matter building activity. The resulting brew is applied to the paddocks yearly at 50 litres a hectare.

In addition to soil building programs, a range of bio-fertilisers, such as foliar and fertigated (application through an irrigation system) mineral, microbial, kelp, fish, humic and fulvic fertilisers have been applied over the past 15 years. Leaf tests are taken to identify lacking nutrition, enabling application of nutrients to address imbalance in plants.

Animals’ performance and grazing preference, along with observing the plant species that are growing, are used as an additional guide as to excess and deficit minerals in the soil.

To target these treatments accurately, David has equipped himself with a refractometer, to measure the sugar concentration in plant sap, and other measurement devices and has soil tested by an agricultural laboratory in Adelaide.

In David’s words, the three rules for the soil remediation techniques he has developed and applied are “balance, balance and balance – carbon to nitrogen ratio, calcium to magnesium ratio, etc. ... look at the whole picture from soil to human health”.

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Above: Microbe brewing  
Top: David Clayfield with bags of soil treatment used on the property





## Healthy Soil Outcomes

The results are evident in the soil profiles of remnant and treated soils (see right). Soil carbon has increased by 45% in the top 150mm, and potentially substantially more at depth.

Organic carbon measurements show an increase from 2.07% in 1992 to 2.92% in 2011 (see graph, facing page).

David estimates that, since the mid 1990s, stock output has increased by 33% while he is using 25% less irrigation water per animal weight produced.

As is usual in the region, centre pivot systems are used at Clover Estate to irrigate with water pumped from the shallow limestone aquifer. Centre pivot irrigation uses sprays fitted on a boom that travels in a circle around the centre pivot point. Electric motors are used to drive the wheels that carry the boom. Two such systems operate at Clover Estate, one of about 300 metres radius, covering about 28 hectares, and the other a 330 metres radius, covering 34 hectares. A neutron probe is used to measure soil moisture levels and determine when watering is needed.

Due to the improved structure of the soils, David has found that his total water use is now around 5-6 ML/ha/year compared with the 7-8 ML/ha/year commonly used on sandy soils in the region. This is particularly noteworthy in relation to rainfall, with eight of the last ten years receiving below-average annual falls. As well as using less water, David's energy costs from pumping and driving the boom have halved.



*Clover Estate centre pivot irrigation layout*

Cessation of chemical weed control and David's soil management has ensured vigorous growth of preferred pasture species, combined with rotational grazing. The property is fenced into 50 paddocks, ranging from two to six hectares. The rotational grazing cycle also aims to break the life cycle of intestinal gut parasites.

David highlights, "Pasture plants grow better and there are now a lot fewer weeds. Lucerne varieties that had been abandoned due to poor performance by most typical, chemically managed properties perform exceptionally well on our property. Lucerne, rye grass, clovers, are the predominant species, along with a variety of herbs for balanced pasture. Animal health issues are primarily averted, due to the density and balance of the minerals in our pasture".

"Strategic use of selected foliar fertilisers... reduces or eliminates sap sucking insects attacking the pasture. We have found also that foliar fertilisers strengthen our desirable forage species, making them more competitive over weeds."

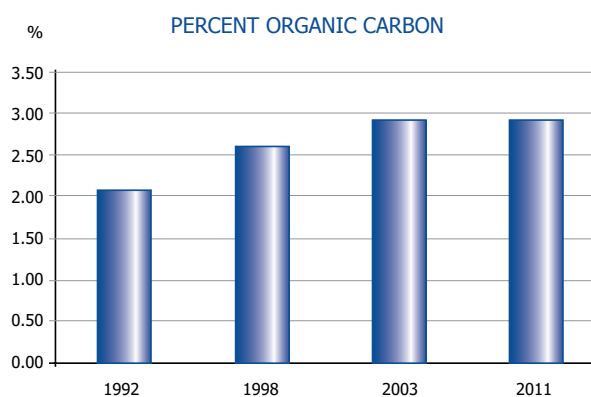
David believes that "Holistic management includes an appreciation of natural processes and an understanding of applied soil science. If soil biology functions to its best ability, the availability of minerals to plants will be at its best. If animals and people have access to adequate mineral diversity in diet, then disease is less ... and performance is better. Our farm enterprise is more profitable, and more enjoyable. We will leave an improved legacy."

"Our example has inspired other farmers, particularly dairy and graziers, to adopt aspects of soil management as we have. Looking at our soil profile, black to the depth that it is, speaks for itself. Most farmers appreciate that something is different and improved on our property. We are happy to share our journey, as it appears to give confidence to other food producers to take on similar management. Less chemicals affecting the environment, with improved quality of food for consumers is a better outcome than prior to adopting biological farming system."

<sup>1</sup> LawrieCo (2009), *Sustainable update winter 2009*, LawrieCo Sustainable Farming, Wingfield, South Australia.

### FROM SAND TO SOIL

The typical condition of the original infertile sand is indicated by the profile under the patch of remnant native vegetation on the southern edge of the property, where no treatments have been applied (left). The results of 15 years of organic-based treatments are evident in the much darker colour, resulting from higher organic matter content down to 600mm where it used to be devoid of biological activity (right), which means that nutrient and water holding capacity are far higher.



# Don't measure success by the size of your herd



## JILLAMATONG

### Farm Facts

5km south-west of Braidwood,  
NSW Southern Tablelands

**Enterprise:** Cattle. Cottage Industries

Beef cattle raising, agistment and trading; native  
grass seed, truffles, garlic and yabbies

**Property Size:** 453 hectares

**Average Annual Rainfall:** 719 mm

**Elevation:** 650-750 m

### Motivation for Change

- ◆ Learning about Holistic Management

### Innovations

- ◆ A number of complementary approaches founded on Holistic Management thinking
- ◆ Time-controlled rotational grazing within carrying capacity and designed to facilitate nutrient movement
- ◆ Replacing ploughing with surface cultivation and direct sowing
- ◆ Natural Sequence Farming approach to Watercourse management
- ◆ Use of organic wastes as fertilisers
- ◆ Innovations commenced: 1994

### Key Results

- ◆ Productivity increase from 1.73 to 1.13 hectares per cow
- ◆ Total profit per hectare per 100mm of rain more than 10 times greater than local average
- ◆ Cash flow stability
- ◆ Permanently flowing waterways
- ◆ Year-long green perennial pastures



From struggling farmer to award winner, Martin Royds, along with his partner Trish Solomon, have re-defined their own meaning of success on the land.

During the 1982 drought, Martin Royds watched in horror as tonnes of topsoil blew off hillsides and coated fences. Gully erosion was rampant, and when the rains eventually did come, any remaining topsoil and organic matter was stripped and washed away.

Over the years since, Martin Royds and Trish Solomon have turned their property around, battling advocates of traditional methods and regulatory constraints to create an agricultural enterprise example – and gaining well-earned recognition in the process.

Holistic management has helped deliver a property that is still able to fatten cattle during drought periods when neighbours are unable to run stock. Diversification has also enabled the maintenance of cash flow through other industries such as harvesting native grass seed, truffles, garlic and yabbies.

Martin has won or been nominated for a range of awards, including winning the award for 'Carbon Cocky for East of the Divide' in 2007. He is tireless in his thirst for gaining and sharing knowledge, attending or presenting at conferences and seminars across the country and maintaining membership with a number of organisations and committees.

Martin and Trish believe that there is a real divide between the farm and non-farm communities and a lack of understanding of the role of each in our present society. They want to set an example for those in towns and cities that farmers can produce nutrient rich food economically whilst also improving the environmental aspects of the landscape. Their story is one of success on many levels – social, financial and environmental.

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## The Way It Was

The Royds family settled in the Braidwood area in the first half of the 19th century and Martin's maternal grandparents acquired the Jillamatong property in 1952. Martin managed Jillamatong jointly with others in the family from 1985 and took over sole responsibility in 1996.

Jillamatong is about five kilometres south-west of the town of Braidwood on the southern tablelands of New South Wales. It is within the Shoalhaven River catchment, which is part of Sydney's water supply and managed by Sydney Water and the Southern Rivers Catchment Management Authority (CMA). Control is with the landholder, they manage water values.

The property comprises 453 hectares of moderate slopes and flats with an elevation ranging from 650 to 750 metres above sea level. Rainfall averages 719mm but has ranged from a low of 302mm in 1982 to 1250mm in 1959.



Jillamatong

Soils are moderately to well-drained yellow podsols and are often acid leached and infertile on the slopes with poorly drained black earths around the drainage lines. Soil samples have been collected since 1959 and showed that available phosphorus levels were very low, ranging from nil to a maximum of less than five parts per million (ppm). Soils were moderately acidic with a pH ranging from 6.1 to 5.2. Superphosphate has been routinely applied to help establish introduced grasses and clovers. By 1991 the pH had declined to 4.4 but available phosphorus levels had risen to 13ppm.

Prior to cultivation, the landscape consisted of an open grassy woodland with a native pasture of weeping grass (*Microlaena stipoides*), kangaroo grass (*Themeda triandra*), *Danthonia* species, and associated forbs and herbs. Manna gum (*Eucalyptus viminalis*) was scattered on the ridges while bogs and a chain of ponds with swamp gums (*Eucalyptus ovata*) and snow gums (*Eucalyptus pauciflora*) were common in the lower areas.

Previous management involved ploughing paddocks and sowing three introduced grasses and two clovers after first eliminating previous ground cover with herbicide. In 1991, spraying with various chemicals was intensified to try to establish five introduced grasses, three clovers and two forbs by direct sowing. Monocultures of wheat and oats were used mainly as a break crop to aid the re-sowing of pasture. The survival of rye grass and clovers was used as a bio-assay of when a paddock needed re-sowing.

These soil and management practices resulted in an abundance of weeds including three types of thistles, carrot weed (*Cotula australis*), sorrel (*Acetosella vulgaris*), rat's tail fescue (*Vulpia myuros*), Paterson's curse (*Echium plantagineum*) and serrated tussock (*Nassella trichotoma*). Herbicides were used to try to control these. Martin recalls, "Flat weeds were sprayed with MCPA and 2-4D amine. Paddocks were poisoned at each re-sowing between 1990 and 1995 with Roundup. Most paddock timbers were pushed up and burnt to reduce rabbit middens and increase the area for pasture, while rabbits were poisoned and trapped."

The paddocks were set stocked until the early 1990s. Sheep were drenched every six weeks with a constant watch for fly outbreaks and other problems. Cattle were also drenched regularly.

Stock water was from surface dams and free access to ponds in the erosion gully running through the property. There were no permanent waterways on Jillamatong.

Different water management strategies were applied in the past, with the NSW Soil Conservation Service involved in the 1960s in establishing a series of contour drains leading to dams the overflow from which was then piped to the bottom of the erosion gully. Water was seen as a problem to be drained away as quickly as possible.

Martin recalls, "There was extensive erosion with a series of headwall cuts working their way up the central erosion gully to a depth of over four metres".

Financially, environmentally and socially this way of farming was failing.



Pastures lasted five to seven years, much less than the ten to twelve years needed to recoup their cost of establishment.

Sheet and gully erosion were rampant and salt scalds were appearing. The major erosion gully was incised a metre at each headwall cut.

There were few trees left for shade and shelter for stock or pasture and habitat for any other life. The surviving trees were dying. In cold windy weather stock suffered.

Due largely to set stocking and overgrazing 10 to 15 centimetres of topsoil blew off entire hillsides during the drought of 1982. The only pastures that survived and regrew were the native pastures.

As Martin describes, "Many of my farming colleagues felt their land was being taken from under their feet, their backs were to the wall and they were constantly fighting for a fair price for their produce or against environmental catastrophes and the constant onslaught of weeds and regulations."

"The seemingly endless battle with weeds, serrated tussock in particular, was becoming a major problem. Many paddocks were so thick with thistle that we had to slash tracks to find and get stock out of paddocks. Wool quality was affected." Farming was hard.



*The floodplains on Jillamatong have been restored*

## Making Changes

Martin notes, "I had always set out with the goal to question the ways we farm and had been trialling different ideas from the early 1980s". The major catalyst for change on Jillamatong however, was attending a Dr Stan Parsons and Terry McCosker talk on holistic management in 1994.

This reinforced the need to focus on building healthy soil, pasture and water cycles. In the past the focus had been on stock numbers and how to fight weeds and pests.

Implementation of some changes required a complete transformation in ways of thinking. Martin says, "We started setting goals that incorporated the triple bottom line. Whole farm management for us meant including the bank managers and other people involved in the business. This included consulting and engaging with Landcare, CMAs, government agencies, and political decision makers, together with innovative thinkers in the agricultural, environmental and educational fields".

"We initially implemented tree plantings, changed fencing designs, off stream water points, soil biology enhancement and fertiliser techniques, assisted by grants from Landcare and the CMA."

The first wagon-wheel fencing structure was built in 1994, providing smaller paddocks meeting at a central watering point. Sheep and cattle were grouped into one mob and rotated around the paddocks so that pastures could be rested.

Martin continued doing courses on soils, pasture identification and farm management systems and gradually changed practices. "Initially I stopped deep ploughing and developed a skimming and direct sowing pasture establishment technique." Martin says, "In 1995 I realised I was poisoning myself and the landscape via my herbicide use and weed control and have changed to a chemical free property since".

Martin constructively questioned every management decision involving the whole farm team.

However peer group pressure from the traditional views amongst farmers was strong, including that success is measured by the size of your herd. "Some farmers look for ways to increase their herd size irrespective of the long-term effects on pasture and soil quality. When the low rainfall periods come, pastures are over-grazed and hay bought or cattle agisted. This approach inevitably led to cycles of boom and bust, and consequent long-term land degradation."

"I had to learn to laugh with critics and be humble and accept that I have made mistakes along the way."

Of course with change come related challenges, and Martin and Trish had to deal with their fair share.

"There was peer pressure from a lot of my farming colleagues that I was going against what our forefathers had done.

My father felt that I was accusing him of doing the wrong thing." At other times, "Neighbours have felt that we were 'stealing their water'. How else could I have green grass when they didn't?"

Authorities tried to impose different views. The NSW Office of Water questioned the water slowing and erosion control techniques within the gully and Council Weed Inspectors challenged some of the methods of weed control, trying to insist on chemical solutions. The CMA and Landcare wanted to see total stock exclusion from waterways.

The management of riparian areas are now subject to regulatory constraints applied by state government and CMAs. Martin notes, "These new constraints, aimed at water conservation and land protection at a catchment level, can restrict the ability of landowners to apply erosion control methods on third order drainage lines and below. The traditional approach to deal with gully erosion has been to build large concrete structures and to channel flows around problem areas. That approach accelerates water movement off the farm, rather than encouraging infiltration, water conservation and efficient water use."

Challenges such as these were resolved through continued dialogue, inviting agencies and decision makers to field days and tours, detailed monitoring and providing evidence of the success of the programs. Education has played a significant part. Leading innovators in particular fields were often introduced to the relevant authorities to talk about contested issues such as the role of plant succession or better understanding local water cycles.

In dealing with the many challenges of implementing change, Martin says, "I had to learn to laugh with critics and be humble and accept that I have made mistakes along the way."

## The Way It Is Now

The holistic approach adopted by Martin and Trish was founded on the goal of developing a farming system that is economically, environmentally and socially regenerative. It was important for Martin to acknowledge that management decisions caused the erosion, weeds, and economic problems and that only by changing these management decisions could regenerative processes be aided to achieve the desired positive outcomes.

## Stock Management

Consistent with holistic management principles, planned rotational grazing was introduced across the entire property, requiring fencing into some 50 paddocks. All sheep and cattle were combined into one mob. Initially, a 'wagon wheel' paddock configuration that separated valley floors from slopes and ridges was implemented. The preferred layout has since changed to allow cattle to graze from valley floors to ridges at all times

Martin describes why changes were made, "Initially stock were managed in a rotational grazing system with wagon wheels and paddocks fenced to landscape categories, i.e. hilltops, slope and floodplain. We have now changed this so that stock can take fertility up the slope. We need to realise that the stock are more in tune with knowing what different feeds they might need on a daily basis."

"Hence the new fencing layout allows stock to have access to the chain of ponds and then run up the slope to timbered hilltops. This is better for the stock, they can mix their feed during the day from green to different forbs and drier grasses and then sit in the shade at the top of the hill to ruminate, manuring the whole slope to increase its soil fertility."



The fencing layout allows stock to transfer nutrients from boggy floodplains to timbered hilltops





**"If pastures are not allowing stock to improve then stock numbers are reduced, if necessary to nil."**

The cattle are moved approximately every three days so that one-third of the pasture is grazed, one-third trampled and one-third left to regrow. "The more palatable, more nutritious, grasses will therefore be only partially grazed to let them regenerate quickly, while the less palatable grasses will be trampled or left. The aim is for the pasture composition to evolve towards a predominance of more palatable species."

Cattle are given free access to mineral supplements and are much healthier than previously as a result.

Animal management is now focussed on weight gain at all times. "If pastures are not allowing stock to improve then stock numbers are reduced, if necessary to nil. We have had to change to a flexible cattle trading/breeding/agistment management. Rather than focusing on stock numbers, we focus on having 100 per cent ground cover 100 per cent of the time so that soil is always protected. We no longer run sheep."

Because of this cattle trading operation stock occasionally have to be drenched on arrival.

Workloads have changed, and Martin notes, "Cattle soon become accustomed to frequent movement between paddocks, so that they congregate around the gate; moving them only requires opening the gate and closing it behind them. Labour requirements are therefore minimal and Rosie, the old farm dog, gets lots of rest."

## Water Management

Stock are watered via a trough system connected by 3.5km of 50mm pipe from one end of the property to the other, mainly gravity fed from dams high in the catchment.

Eroding head wall cuts were stabilised with natural weirs in line with Natural Sequence Farming techniques. These practices too have come with constant learning. Martin describes, "We commissioned Peter Andrews to advise us on how rehydrating the landscape could spread flood waters back naturally onto the flood plains. We have since built a number of contour channels to rehydrate large areas of the property. Yabbies and fish have been added to most of the weirs and dams to assist in recycling of nutrients and continue building the biodiversity." Wetland



*Erosion gullies have been naturally restored to chains of ponds*

plant species were established in all watercourses and weirs.

Changes to the property are notable. Martin points out, "In 1986, there was an ephemeral erosion gully through the middle of most of the property; this stopped flowing most summers. With the re-introduction of natural riparian regeneration processes it has become a permanently flowing 'chain of ponds' waterway. Shallow drains radiating out from the former gully now divert water across the paddocks."

As well as slowing and dispersing flood flows to prevent gully erosion, such natural flows replenish sub-surface soil water that sustains pasture growth. Steady sub-surface flows now recharge what has become a healthy semi-permanent stream. Martin recalled, "It was flowing constantly even when the nearby Shoalhaven River and all surrounding creeks had stopped flowing in December 2009."



*Contour channels spread water across the property*

## Vegetation Management

Pastures are now managed via rotational grazing and no chemicals are used. Ploughing was replaced with surface cultivation and direct sowing where pastures needed to be regenerated. Close monitoring of the species mix determines what and when and how to graze a paddock. "The aim is that there is always a green plant growing to feed the soil biology thus keeping a year round healthy and growing soil and pasture." With rotational grazing, 95% of the property is in rest and recovery stage at any one time.

Black wattles and some eucalypts have regrown naturally as a result of changed grazing management. Extensive tree lane and clump plantings now connect neighbouring forested hills across the property and to provide cattle shelter. Trees are chosen to best suit the conditions. Martin notes, "Manna gum, the predominant original tree species, is attacked by Christmas beetles and struggles to survive in the changed landscape, and perhaps changed soil conditions. Therefore we plant many different tree and shrub species to help regenerate a flourishing landscape."



*Dense, healthy pastures of native grasses*

Most paddocks now have trees with an understorey where possible. Tree plantings are now designed to encourage stock and birds to move to the top of the hills and to process and recycle nutrients that can then infiltrate the soil and build natural fertility across the property. If he could have his time again, Martin says he would have made tree lanes much wider and planted higher up on the contour to facilitate this.

With the introduction of rotational grazing and other innovations, major weed problem have disappeared on Jillamatong over the last 10 years. Weeds are now seen as part of the soil and landscape repair process where land

has been overgrazed, poisoned or degraded. Stands of thistles are seen as indicators of previous management decisions and can be slashed to prevent seeding but the odd serrated tussock is still chipped out.

Martin notes, "Some of the 'weeds', i.e. thistles and carrot weed, were observed to have very deep tap roots which bring fertility from deeper down in the soil than the shallow rooted rye grasses and clovers. We have now encouraged similar plants like Chicory (*Cichorium intybus*) and Plantain (*Plantago major*) to establish in our pasture to help pump up and recycle nutrients from deeper soils".

Grazing management, weed trampling, combined with pasture rest and high levels of ground cover are the main tools now used for suppressing and managing weeds. Instead of spraying weeds, the spraying of biological fertilisers and building of soil health is now seen as an essential management tool in promoting a healthy pasture. "We also no longer need to spray for red legged earth mite, scarabs, grasshoppers and fungal diseases", Martin points out.

Martin sees biodiversity as the base indicator of the health of the system. Biodiversity assessments are taken along transects noting all the different grasses, forbs and weeds. Martin and Trish have a goal to exceed the present 80 species per transect and increase the proportion of perennial species. Litter levels, ground cover, growth/recovery of plants and insect activity are also monitored. Studies of birds and water quality and monitoring programs of riparian plant and invertebrates species are also underway.

## Soil Management

Trials are underway to see if soil organic matter content and fertility can be improved by placing organic matter in strategic heaps in the paddocks to aid their decay and for nutrients to leach across the paddocks. Liquid fertiliser, from worm casts produced on the property continues to be sprayed onto the pastures, with compost teas.

As a result of the holistic management techniques, soils have dramatically changed to be much more friable and porous with increased soil humus levels. Whereas penetrometers previously only penetrated soil a few millimetres at maximum pressures, they now penetrate the soil to a metre at less than 4,000 kPa (kilopascals) pressures. The in-paddock compost heaps and spraying of biological fertilisers appears to have improved the soil and pasture nutrient balances. Available phosphate levels have doubled without the addition of any superphosphate.





*Wetland plant species are helping to restore riparian areas*

Martin confirms, "We have only applied biological stimulant sprays and changed grazing management focusing on building biodiversity and 100% groundcover 100% of the time".

Salt scalds that were appearing in the 1990s have disappeared due to the increased ground cover and cycling the water and the leaching of salt deeper into the ground.

Available carbon has increased from a range of 0.8% to 2.4% in various paddocks ten years ago, to a high of 2.9% five years ago. Now, best sites have measured close to 7.0% soil organic carbon.

**"If you look after the soil the soil will look after you."**

As evidenced by the now semi-permanent streams, infiltration of water across the property has increased with enhanced soil structure, improving the water cycle and reducing flash floods.

With greater water infiltration there is less surface runoff. With the soil health improvements grass is now able to grow twelve months of the year. Martin reinforces that, "Prior to change management the old saying was 'you don't have cattle feed till the second week of October'. We can now fatten cattle right through the winter".

Improving the health of the soil has improved all areas of production. "If you look after the soil the soil will look after you."

## Lessons Learned

The successes to Martin and Trish on Jillamatong have not come easily. To them it is an integrated process that involves continual monitoring, reassessment and decision making. "As a society we have been trained that when there is a problem we can buy an instant solution in a bag or drum or from an engineer. As the degradation of our landscape testifies, just responding to symptoms via more costly inputs often does not work", Martin states. "This is a lot more satisfying as it involves trying to understand the systems and treating the root cause of the issues rather than the symptoms."

Lessons learned and important components of their success are noted by Martin to include:

- 💧 Be prepared to change.
- 💧 Seek out the best in their field to provide external advice that suits your goals. For Martin this included soil biology, water management, tree planting, stock management, biological fertiliser production, worm farming and leadership.
- 💧 Continue to educate yourself through courses, seminars, conferences, workshops, field days. Martin notes, "In my case this was though conducting tours of the property, delivering talks at conferences, consulting and organising field days for other groups. This helps me learn and improve through the questions people ask and what they can add to my knowledge."
- 💧 Be involved with benchmarking groups.
- 💧 Seek to tick all the boxes for the triple bottom line – work with nature rather than fight against it.
- 💧 Remain focussed on passions and goals rather than getting sidetracked with other enterprises.
- 💧 Understand that there will be resistance from the status quo, but also that it has value in you refining more effective solutions, the evidence to substantiate them and the inevitable changes and benefits that can only come from such local practical innovation.



## No Turning Back – Looking at the Bottom Lines

These innovations on Jillamatong have been undertaken by Martin and Trish with the objective of returning profitability, increasing biodiversity and regenerating the health of their soils and landscapes for the long term. It was, and is, important to Martin and Trish to make a business that is environmentally, socially and economically enjoyable. "Our innovations are intended to put ourselves 'out there' as an example of good farming practice that can be taken to the wider community."

The outcomes from such good farming practice are evident. Cattle can now be fattened all year.

During the drought in the past decade there were periods where neighbours were unable to run any stock for up to 11 months due to lack of feed and water and yet cattle on Jillamatong were still being fattened.

Productivity has increased from 1.73 hectares needed to support one cow in 1986 to 1.13 hectares in early 2012, when the environment is still recovering from ten years of low rainfall.

Independent benchmarking programs with farms in the district have shown that production on Jillamatong per 100mm of rain and per labour input was far higher than for any of the other farms studied.

Cost of production was lower than the average in the group and the weight produced per DSE (dry sheep equivalent) was nearly 50% above the average. This, combined with the below average labour input, resulted in a combined profit per hectare per 100mm of rain being 14 times the regional average.

Capital is now spent on improvements such as changed fencing, water and tree planting as opposed to annual spraying of weeds, artificial fertilisers and animal husbandry costs. This has enabled a marked reduction in capital invested on farm machinery.

Water has been slowed down and plant nutrients recycled into the landscape. There is less surface runoff and the pastures now provide year long green perennial grasses. Dew condensing on the tall perennial grasses each night now provides additional water that helps sustain soil moisture and healthy pasture growth.

Biodiversity in the soil, pasture, trees, insect and animal life has increased. Pastures have developed from five species and a few weeds to more than 80 species of useful plants.



*Native *Microlaena stipoides* seeds are being harvested for sale*

Soils have changed from compacted to friable and porous significantly enhancing their water infiltration, retention and root proliferation to depth significantly aiding the health, productivity but particularly resilience of these landscapes to climate stresses.

Soil organic matter levels are much higher than under previous management practices. While data is limited, the mass erosion of the top 10-15cm of topsoil from these podsols in the 1982 drought is likely to have removed most of that biosystem's already degraded soil organic matter and with it its available plant nutrient stores and water holding capacity.

Despite its former degraded state this erosion event may have removed up to 90 tonnes of carbon per hectare leaving highly leached mineral subsoils with often less than 0.5% soil organic matter. The subsequent high additions of fertiliser and bio-cides would have enhanced the oxidation of any residual and new organic matter making these soils highly input dependent and vulnerable to stress. By restoring natural soil carbon bio-sequestration processes, initially via the pioneer 'weed' species and then the perennial pastures and rotational management, Martin and Trish have been able to significantly increase their soil carbon levels from the very low 1982 baseline to up to 7.0% soil organic carbon in their topsoil. In doing so, they have also rebuilt the structure, nutrition, hydrology, productivity and resilience of their key natural assets, the health of their soils.

In addition to their main cattle enterprise, Martin and Trish have explored other complementary industries to



maintain cash flow, such as harvesting native grass seed, growing truffles and garlic and breeding yabbies in their many water courses. Significant economic benefits have also been secured via the changes to regenerative farming practices.

These include the reduced cost of weed, fertiliser, vet and machinery inputs and labour, and increased income from being able to sustain weight gain on healthier cattle for longer due to improved pasture growth.

Natural capital values have also increased significantly as a result of the improved soil carbon levels, soil structure and health and consequent increased rainfall retention, water harvesting, lower evaporation losses, desiccation stressors, capture of flood flows and prevention of soil and nutrient erosion. The benefits from such increased productive and resilient landscapes should become most marked as climate extremes intensify.

While health benefits to the soils, pastures, animals and the people that consume them have not been quantified, these too may be considerable as are the health benefits to the farm workers and families. These include health benefits from the significantly reduced debt and stress associated with such ecologically based farming systems when compared with the high input, high risk, high stress conventional alternatives.

Similarly, while biodiversity benefits are also difficult to quantify and extend well beyond the farm they too have been significant, and range from improved soil life and nutrient dynamics to more diverse species and cycles in healthier, restored habitats.

Through this regeneration of his landscape, Martin and Trish have also significantly enhanced their social and personal development and wellbeing. Martin has obtained a Degree in Applied Science, participated in Holistic Management and Biodynamics Courses, Prograze, field days, seminars and conferences. He is a member of organisations such as Landcare, Grasslands Society, Soil Food Web, Carbon Coalition, and a holistic management group. Martin is also a Committee Member on various organisations such as NSW/ACT Serrated Tussock Task Force, Rural Lands



*Martin on one of the contour channels used to rehydrate the landscape*

Protection Board, Landcare (Treasurer), Upper Shoalhaven Landcare Council, Braidwood Catchment Action Group, and the Natural Sequence Farming Association as the past acting Chair.

Martin has been duly recognised through national media coverage and numerous awards such as Diversification Farmer of the Year finalist, Environmental Landcare award, Carbon Cocky of the Year, Ideas and Innovation Landcare award. He has also been asked to present papers at the National Landcare Conference, Landcare Conference Yass, in Adelaide, and various Braidwood presentations.

"This has given me a positive outlook on farming during a period when a lot of my peers were feeling negative and despondent with the ongoing drought and terms of trade", Martin says. "It is satisfying to be able to encourage and assist other farmers to change their way of thinking through field days, groups and associations I have chaired or been involved in."

Martin expresses sincere gratitude to all those who have assisted him in his learning and making paradigm shifts in his thinking as well as those organisations that provided continued support, encouragement, and willingness to lead and embrace new ideas.





# Shifting mindset from animals to the land



## GUNNINGRAH

### Farm Facts

20 km north-west of Bombala  
NSW Southern Tablelands

**Enterprise:** Cattle. Sheep. Goats

Angus beef, sheep and goat meat production;  
medium wool Merinos

**Property Size:** 4200 hectares

**Average Annual Rainfall:** 550 mm

**Elevation:** 800-1000 m

### Motivation for Change

- Ecological deterioration and dependence on rainfall for profit

### Innovations

- Constructing leaky weirs across creeks and gullies
- Time-controlled rotational grazing matching stock numbers to land carrying capacity
- Introducing goats for weed control
- Innovations commenced: 1995

### Key Results

- Increased profit stability – even with decreased rainfall
- Labour inputs reduced by 40%, providing increased time to pursue other activities
- Healing erosion gullies
- Greater water retention in pastures
- Flexible stock management



Initially inspired to perform a trial of new management practices to better manage received rainfall, Charlie and Anne Maslin ended up following their instincts - fully changing focus from their animals to the land - and they have never looked back.

Upon assuming management of Gunningrah in 1987, Charlie Maslin observed significant annual variations in rainfall and profit. Examination later revealed the significant impact of rainfall on the cost of production. Additionally, a mid-1990s comparative pasture analysis undertaken by an external agency revealed alarming outcomes in terms of actual ground cover available for stock feed.

Charlie realised that while you cannot change how much rain falls, you can change how you manage the rain you are lucky enough to receive. By changing their mindset to focus on the health of the land, the Maslins found themselves managing poorer years more effectively and not over-using resources in abundant years. Maximising the retention of available rainfall and striving for much improved ground cover has in turn delivered more consistent profits on reduced inputs. In addition, erosion is being controlled, weed invasion has reduced, stock are healthier and management is more flexible.

Charlie sums up their new approach, "Rather than us dictating to the land what stock it has to carry, we try to evaluate what the land has to offer and then attempt to stock it accordingly – and hopefully learn as we go".

Contact Charlie & Anne Maslin: [gunningrah@gmail.com](mailto:gunningrah@gmail.com)

## Gunningrah

The Maslin family have managed Gunningrah for 100 years. A property of 4200 hectares, it is located at the southern end of the Monaro Tablelands of south-eastern New South Wales. Currently, 3700 hectares of the property is grazed with cattle, sheep and goats.

Native grasslands make up approximately 60% per cent of the farm area. In the other 40% per cent, which had been pasture improved, introduced species of grasses coexist with the native grasses, in some cases the introduced dominate, in others, the natives.

Approximately 20% of the property has scattered remnant to heavier tree cover, mostly on the sedimentary soils adjacent to the Meriangah Nature Reserve, located along the western boundary. Soils are approximately 75% derived from basalt, 20% sedimentary rock and 5% granite.

## Embracing Change

After managing the property for almost a decade, Charlie realised that Gunningrah was gradually facing ecological deterioration and profitability was becoming increasingly variable. Two main factors provided the initial impetus for change.

Firstly, a Meat and Livestock Australia trial conducted on the property in the mid 1990s revealed some alarming results. Whilst the property appeared to have sufficient pastures to support stock grazing, actual ground cover levels measured were substantially below perceived coverage. The agricultural assessment of ground cover showed approximately 30% bare ground. This was seen as unsatisfactory.

Secondly, the impact of the varying annual rainfall on the cost of production also presented a stark reality. Charlie reports, "Comparative analysis of inputs showed wool production costs could double, varying from \$2.50 to \$5.00 a kilogram, and beef more than triple, ranging from \$0.40 to \$1.40 a kilogram". These variations were largely dependent on the rainfall received, accounting for supplementary feeding or agistment costs when existing pastures were insufficient.

A neighbouring property to Gunningrah holds continuous rainfall data from 1858 and Charlie accessed this to try to obtain a better understanding rainfall in the region. However, little evidence of rainfall patterns or consistency over months or years was found. Charlie notes, "The only recurring theme appeared to be that for every year of above-average rainfall, there were two years below average".

This information made it clear to the Maslins that effective management of inconsistent rainfall was a key factor in maintaining profitability.

Learning about the principles of *Natural Sequence Farming*, the Maslins identified an opportunity to make the most of the rainfall they received. They found that through this technique the health of watercourses could be significantly restored by slowing the rate of water flow, especially after rain, by a series of physical interventions in the landscape. These would enable the capture of sediment to help repair eroded watercourses, also holding nutrients to improve soil health and feed plant roots. As a result, water would be captured in the soil for longer, better supporting vegetation regeneration and continued pasture growth. This process would also aid in reconnecting streams to natural floodplains and wetlands, reforming the chain of ponds that used to dominate the landscape.



*Capturing sediment through establishing weirs has helped to fill erosion gullies*

The Maslins also learnt about stock rotation from others in the region and through attending grazing courses, such as *Grazing for Profit*. The cell grazing method they chose to adopt is based on the observations and trials of Allan Savory and Terry McCosker. This technique involves dividing the land in some cases into an increased number of smaller paddocks which then are intensively grazed for short periods followed by sufficient recovery periods to allow pasture to regenerate.

Applying the principles required a detailed understanding of pasture management, particularly the ability to accurately assess pasture growth, recovery rates and their differences site by site across the property.



After around six months of deliberation on changing their management methods, the Maslins initially decided to trial the new practices on 20% of their property. However, taking the opportunity to capitalise on an above average rainfall event, they ended up following their instincts that the technique would work, and instead committed to implement across 100% of the property.

**“Measuring and documenting the important variables was essential to our change process...”**

Changes to infrastructure were made incrementally, to allow for the learning process. An extensive capital outlay was needed in water reticulation as the water cycle slowed down and dams could not be relied upon.

Additional expenditure was required for fencing and other necessary structural changes. Whilst these new capital costs were significant, they did not restrict implementation of the new methods.

Overall, the new business plan for Gunninggrah comprised specific aims for managing the land to support production outcomes, focusing on water management and cell grazing methods to improve stock and soil health, vegetation, pasture, and weed control. Indicators were developed to monitor progress in these areas. “Measuring and documenting the important variables was essential to our change process,” says Charlie, “we regularly took photos from strategic points so that changes could be monitored and evaluated”. Though substantial records were kept, Charlie indicates that he would capture even more data and keep better track of changes if he were to undertake the change process again.

## Better Use of the Rain, Where it Falls

Annual rainfall on Gunninggrah averages 550mm and has varied from 250mm to 1000mm over the past 100 years. The main source of water inflow to the property is the Cambalong Creek, which rises around 15km to the north. It flows through the property for 16km, and then 10km downstream flows into the Bombala, Delegate and Snowy Rivers. Three smaller streams also flow into the farm.

In the past, three of the four streams were permanent, however, over the last two decades all have been intermittent at various times.

Ninety per cent of runoff from Gunninggrah land flows down the Cambalong Creek, the remaining 10% flows to the west to the Maclaughlin River.

Prior to the introduction of grazing to the region, the valley floors were resilient, with substantial wetlands along the main creeks and streams. Charlie indicates points across the landscape, “There is clear evidence of many earlier chains of ponds, on convex valley floors – the result of silt build up where water would slowly flow through the landscape. However, due to many years of traditional grazing methods and stock damage along water courses, the streams became incised and the surrounding land, which was once wet, became dry”. Dams and existing water courses were long relied on for watering stock, which had continual access.

To reduce dependency on rainfall for profit, the Maslins adopted three main approaches to more effectively use rainfall and manage water flowing through the landscape. These incorporated the construction of leaky weirs, changing from set stocking to cell grazing and fencing off the most degraded stream corridors.

Charlie explains, “Leaky weirs serve to slow down runoff through water courses, converting intermittent torrents into constant gently flowing streams. Trapped by the weirs, sediment is deposited, reducing erosion and consequently downstream water quality is improved”.

Since the mid 1990s, the Maslins have constructed over 30 weirs across Gunninggrah streambeds and gullies. Charlie points out, “The weirs vary in size and have been constructed with excavators, tractors, and in some instances by hand with whatever resources were available, such as old fencing materials”. The construction of two major weirs in the late 1990s cost \$2500, however, since that time only \$200-\$400 has been spent per weir on most of the remaining structures. The Southern Rivers Catchment Management Authority (CMA) has viewed the water management practices applied.



*Leaky weirs slow the flow of water courses (note pipe)*



With the introduction of rotational cell grazing and by fencing off selected riparian areas, water courses are now only exposed to animal activity for short periods of time, or not at all. This protects banks from damage and further allows sediment build up. Vegetation has been given time to rest and a chance to germinate in the riparian areas. As a result there have been vast changes to bank stability, also providing much greater ability to handle high flood flows.

Application of these approaches has had significant impacts on riparian areas. Whilst in some areas it has taken 10 to 15 years for water courses to heal, other areas showed dramatic improvement in just two years. Charlie notes, "There is abundant evidence of silt deposition in streams with weirs. An estimated 50 tonnes collected in one weir in the first three years after it was built, significantly filling eroded areas. Downstream, a neighbour was puzzled to see a 'clear flood' after rainfall, as opposed to the usual silty runoff". This was a result of the sediment remaining trapped in the weirs, rather than flowing off the landscape.

"In one small stream, a one-off flood filled weirs, and the usual one to two day flow lasted six weeks at 10,000 litres a day. Another larger stream flowed for 12 weeks. This slowing of the water is now a consistent feature on the property." Charlie now has greater access to water for longer, retains more of his soil on his property and his neighbours enjoy the benefits of quality water runoff from Gunningrah.

Vegetation coverage has also improved as a result of the increased water in the landscape, as well as through the cell grazing methods. Growing periods have extended as the water is now held in the pasture for longer, rather than running off straight into the dams, which are no longer a reliable storage for rainfall capture.



*The construction of leaky weirs and protection of degraded stream corridors has lead to significant erosion improvement*

Establishment of cell grazing and reduced dam water did also necessitate other changes to water management, with water provision one of the main logistical issues with having mobs of stock in multiple paddocks. The Maslins constructed additional water points in paddocks without other water courses. All troughs are gravity-fed, so no fuel is required for pumping. Charlie points out, "While costly, establishing the troughing system is ultimately much more water efficient than dams. There is now less evaporation, wastage, land damage, and the stock have access to cleaner water".

## Grazing on Gunningrah

Focusing on the land rather than animals does not reduce the importance of the stock on Gunningrah. Instead, the health of the land and the natural resource base is better understood as the source of profit rather than the animals. The animals still have a very important role to play in maintaining the health of the land.

"We believed that grazing could be profitable and sustainable by shifting the focus from maintaining a set level of stocking to varying the stocking level according to the productive potential of the pasture."

Charlie recalls previous management methods, "Gunningrah was traditionally set stocked with around 75% sheep and 25% cattle. Creeks and dams provided watering points and feed was trucked in during lean years. Rainfall may have varied by 60%, yet stocking by only 30%".



*Evidence of silt build-up upstream of an established weir*



The rotational grazing program was identified as a tool to deliver a number of benefits to Gunningrah. Using this method would help to increase ground cover levels, from a then base of around 70%, ensuring a continual feed supply. This would also help to generate healthy soils by increasing the organic component of the soil and subsequently enhance rainfall infiltration to maintain water in the landscape.

The program would also improve the composition of the pastures from a quite high annual species base, to a predominantly perennial base and reduce weeds. As a result, animal health would improve through more diverse species to graze and the pasture worm burden would be reduced through the spelling of pastures. Additionally, labour efficiencies would be gained through less manual inputs to production operations.

Charlie describes their method, "We chose to match our stock numbers with the carrying capacity of the land, using a formula to determine a stocking bandwidth within which we try to operate".

The formula involves calibrating the relationship between available feed and stock numbers. Rainfall and stock numbers are measured monthly to evaluate stock pressure. Computer software is used to continually monitor the carrying capacity of the property and adjust stocking rates of a mix of sheep, cattle and goats to ensure profitability. The Maslins use a formula of DSE<sup>1</sup> days per hectare per 100mm of rain to determine the carry capacity of their land.

<sup>1</sup>DSE is a stock measurement, 'dry sheep equivalent' based on the feed requirements of a 45kg wether. This can be multiplied for various types of stock, for example a ewe with one lamb is measured as 1.5 DSE, and a dry cow is equivalent to 6-8 DSE.

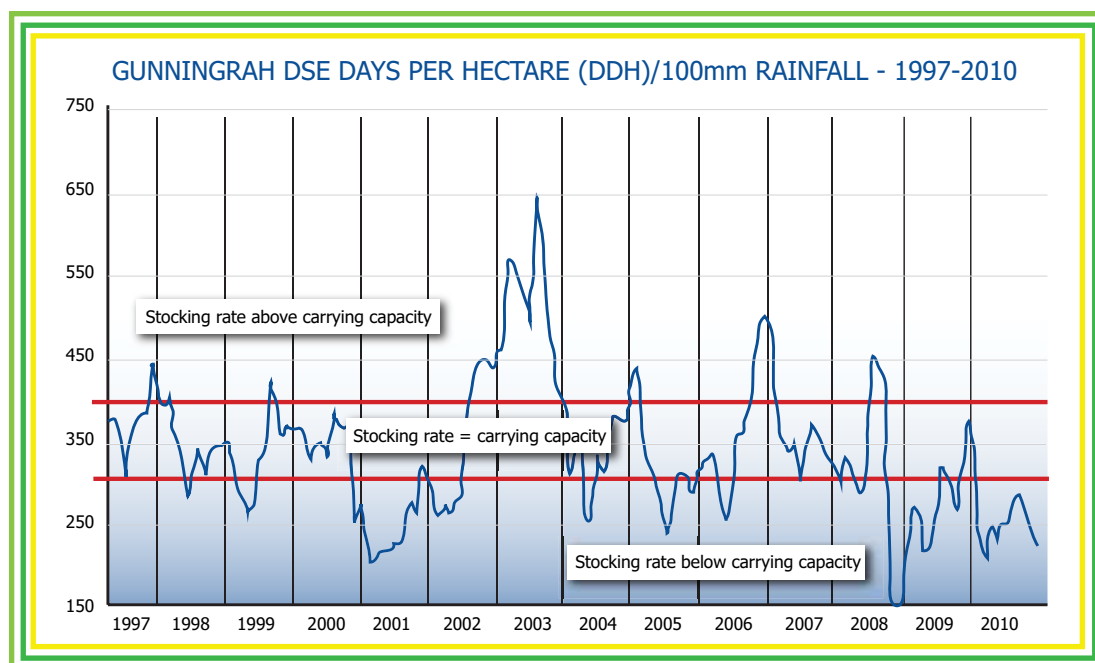
To implement the rotational grazing system, stock were combined into larger herds. This presented a logistical challenge and used all the available infrastructure at the time. Charlie notes, "Refinements were made to overcome problems as they arose, as we continue to do today". Paddocks of approximately 100 hectares were established. Each paddock is intensively grazed for five to seven days, with approximately 10% of land stocked and 90% rested at any one time. In winter this is varied to accommodate requirements with available pasture, with approximately 40% of land stocked and 60% rested.

Charlie speaks positively of the greater flexibility they have experienced in terms of managing their land and animal requirements as a result of adopting rotational cell grazing. This includes the ability to:

- 'finish' stock better, for example, by fattening lambs on best paddock prior to sale;
- prioritise stock for best feed, such as for breeding ewes at joining or twin bearers at lambing;
- adjust rotation times to account for season growth or animal requirements, such as lambing;
- skip paddock rotation for recovery or if different terrain has inherently different recovery rates;
- target certain paddocks to reduce risk of fire or provide greater recovery time; and
- achieve early identification of when feed is getting low and allow selective reduction of stock numbers.



*Stock is grazed at a high density for short periods of time as per the determined carrying capacity*



Stock management is much more informed when numbers are tied to carrying capacity. The Maslins are now better able to manage their stock rates according to the seasons and the resources available in poor or abundant years. Charlie points out, "Stock rotation provides an early warning system of land recovery. If the pasture in the first paddocks is not fully recovered after a rotation cycle has been completed, an informed decision can be made on stocking rates. With set stocking, it was only when stock condition started to deteriorate that pasture problems were identified".

Other benefits the Maslins have experienced include improvements in stock health. "The worm burden has been substantially reduced by the continual stock movement. Animals are now only drenched once or twice annually, as opposed to four times a year previously. Twin lambing pregnancies are 20% higher than two decades ago and stock classing is more consistent."

In terms of inputs, larger mobs enable more efficient management. Movement, drenching and stock checks now require less human input. Stock are becoming easier to handle with more even temperaments due to greater human exposure.

## Improved Natural Resource Base

Vegetation improvement was an inherent outcome of the Maslin's new water and stock management programs. This directly addressed Charlie's initial concern at the results of the Meat and Livestock Australia assessment of ground cover.

Providing all plants with adequate rest to grow well, establish deep roots, to keep in a vegetative state, and to be able seed, is the essence of the stock rotation theory.

As a result of the new practices, the ground cover improved from 70% to around 85% in the first five years. In 2011 some areas had close to 100% ground cover. Native pastures have increased substantially.

Charlie says, "Our aim is to maintain 90% ground cover 90% of the time with as much plant diversity as possible. 100% would be the ideal but with the vagaries of climate this goal is unattainable for the long term, so we are content with the average 85-90% coverage that tends to be the plateau".

The changes to grazing practices at Gunningrah have also benefited the soil in a number of ways. Most importantly, managing stocking to ensure close to complete vegetation cover at all times prevents or minimises erosion by wind and runoff. At the same time, vegetation cover ensures that rainfall infiltrates, and coupled with the leaky weirs, the water cycle has slowed, minimising runoff and reducing or halting sheet and gully erosion. The increased plant biomass also leads to increased soil organic content,







Goats provide weed control and complementary meat production

which improves water holding ability and nutrient cycling. Reducing chemical use has also enhanced the soil health.

The grazing changes and increased ground cover have also assisted in reducing weed invasion.

Gunningrah previously suffered from a range of dominant invasive weeds, including serrated tussock (*Nassella trichotoma*), scotch (*Onopordum acanthium*) and nodding thistle (*Carduus nutans*), horehound (*Marrubium vulgare*), Bathurst burr (*Xanthium spinosum*), sweet briar (*Rosa rubiginosa*), and saffron (*Carthamus lanatus*), black (*Cirsium vulgare*) and variegated (*Silybum marianum*) thistles. Fireweed (*Senecio madagascariensis*), love grass (*Eragrostis curvula*) and Chilean needle grass (*Nassella neesiana*) were seen as having the potential to be problematic in the future.

However, with the increased ground cover and competition, weed problems have declined. This was especially observed with serrated tussock.

Attending a field day to see the use of goats for weed control also provided insight to the Maslins, "We saw goats as an opportunity to reduce labour and the use of chemicals on the property." Understanding the different grazing preference of goats for weeds such as briars and thistles rather than pasture highlighted the possibility

of a complementary enterprise which now comprises approximately 10% of stock. The Maslins happily report, "Goats are strategically grazed to address specific weed problem areas and have now almost completely suppressed the briars and have had a strong impact on thistles, to the point that spraying is rarely required". By selecting a mixed breed to maximise meat production as well as weed control, extra income has also been achieved through the sale of kids.

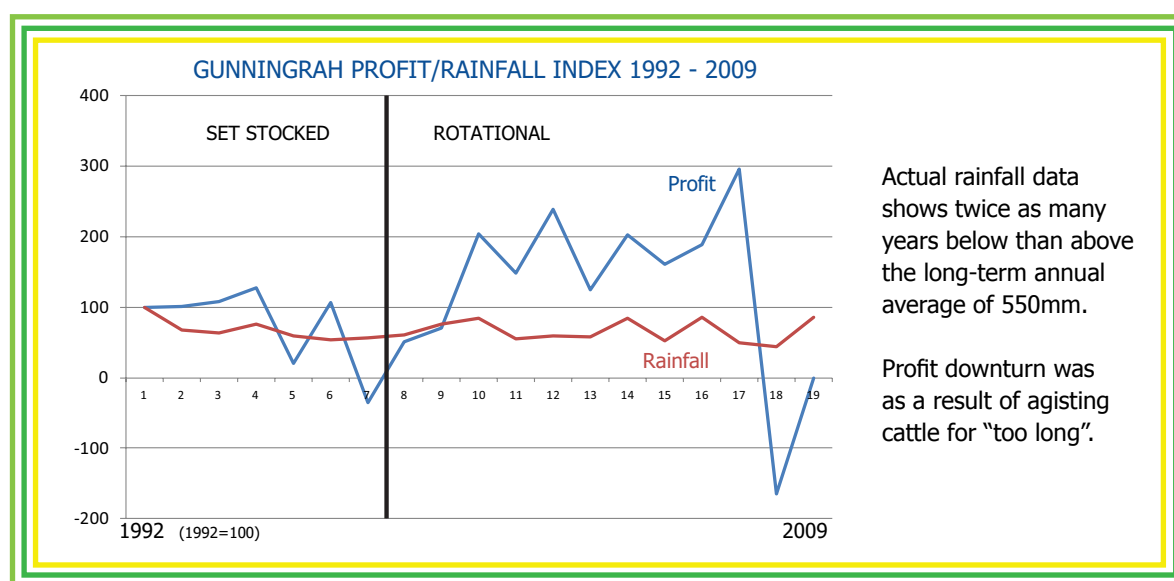
The Maslins have undertaken broad tree planting activities, supported by Landcare. Paddock trees have also been replaced and replanted in main watercourse area with fast-growing species found to thrive in the region as advised by a neighbouring tree nursery, not just with local species of eucalypt.

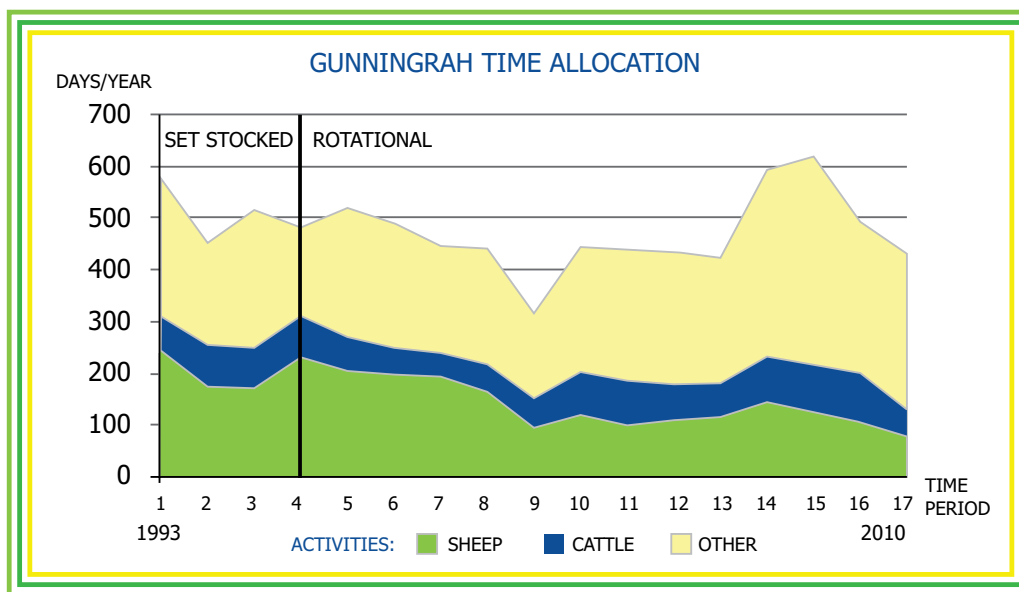
## Innovation Successes

The Maslins have found that grazing can be profitable and sustainable if pastures are maintained by matching stocking rates to carrying capacity.

Charlie describes the success of their innovations, "Gunningrah is only a moderate/conservative producer, so not necessarily comparative to high performers, however there is strong evidence of consistent profit increase with stock rotation methods despite lower rainfall".

"Net farm income has been graphed against rainfall received for the period four years before we changed the grazing and then for 14 years since. While it is a crude measure, and there are a multitude of variables which affect the result, there appears to be an upward trend in profit, and a reduction in variability. There is one year which goes badly





*Stock health and ease of handling has improved on Gunningrah*

against this trend, when we kept cattle away on agistment for too long, but hopefully we learnt something." (See graph, left.)

"Human inputs have been greatly reduced, and labour efficiency has improved around 40 per cent since mobs have been put together. Larger mobs

are easier to move, muster in and assess for fly strike or other activities. As labour comprises approximately 50 per cent of operating costs, these efficiencies are delivering substantial financial results." (See graph, above.)

The land has been the ultimate winner with the changed methods on Gunningrah. Changes to water management and grazing practices made by the Maslins ultimately complemented the other, further enhancing outcomes in relation to water use efficiency, soil health and vegetation cover. Improvements to soil and water quality strongly support increased biodiversity. In addition to increases in pasture and birdlife diversity, platypus are regularly observed in the Cambalong Creek running through Gunningrah.

As an added bonus resulting from the changes they have adopted, the Maslins have also found that more time

has now been freed to do other activities they enjoy; the extra family time in particular has been greatly appreciated.

Furthering their focus on the land they continue to seek learning opportunities to improve their production management. These have included Landcare group activities and projects on issues such as erosion control, shelter belts and connective corridors; holding and attending field days covering topics such as water and streams (run by Peter Andrews and the CMA) and grazing techniques (run by the CMA and small groups of interested farmers).

Charlie and Anne also dedicate some of this spare time to acting as a change agent in the community to support better land management practices. Charlie notes, "Farmers using different management tools are generally keen to share their experiences. Don't be afraid to ring up and ask. There are many simple ways to conduct a trial on how you would like to change things with grazing or with water, which don't involve much risk or cost, to reassure your thought process."

And overall, he advises, "Get together with like-minded people to discuss plans, problem solve and dream – broaden the range of achievable outcomes."

**"Get together with like-minded people to discuss plans, problem solve and dream – broaden the range of achievable outcomes."**



# Partnering farm animals to regenerate the land



## LANA

### Farm Facts

22km west of Uralla,  
NSW Northern Tablelands

**Enterprise:** Sheep. Cattle  
Fine (16 micron) merino wool; Merino cross  
Samm cross white Suffolk fat lambs; cross-bred  
first cross Hereford/Gelbvieh dams joined to  
composite (Devon/Angus/Simmenthal) bulls  
producing steers to 400kg

**Property Size:** 3350 hectares  
(also *Kasamanca*, 780 hectares 50km east)

**Average Annual Rainfall:** 769 mm

**Elevation:** 800-1000 m

### Motivation for Change

- Excessively high costs of production and the opportunity to better use the grazing animal

### Innovations

- Holistic Management against 10 key principles
- Time-controlled rotational grazing using stock for nutrient movement, enhancing soil fertility and vegetation management
- Innovations commenced: 1990

### Key Results

- Carrying capacity increased from 8,000 to 20,000 DSE, even through reduced rainfall and drought
- Wool quality improvement in strength and micron
- Increased lambing and calving rates
- Reduced labour requirements from one person per 5,000 DSE to one per 12,000 DSE



Tim Wright and his son Locke

Ten holistic management principles guide farming operations for Tim and Karen Wright, enabling them to work with nature - and their livestock - to increase production despite reduced rainfall.

The 1990s were a crisis period for Australian agriculture, marked by excessively high production costs and falling profits. The 1990s also brought a realisation for Tim and Karen Wright that they needed to look for a better way to manage their farm. They had an insight that their stock could be used more effectively to provide more than just a source of income. This led to gradual changes across their properties, guided by their own principles for 'Working with Nature'. After a considerable journey of reading and research, the Wrights were motivated to fully adopt a Holistic Management approach for operation of Lana and Kasamanca.

Principles and practices of Holistic Management were introduced to the Wright's properties, including establishing smaller paddocks and rotational grazing of their sheep and cattle. Pasture availability now drives stocking levels and rate of rotation. Pastures are heavily grazed for short periods, but for the majority of the time are in recovery phase. A leader-follower system is used, grazing cattle followed by sheep, to maximise pasture availability. Fences have been orientated with contours to facilitate nutrient movement from high ground sheep camps to across the slope. Soil organic matter content and fertility have been improved by this grazing action and the interaction of livestock nutrient deposits with soil biology.

For the Wrights, their grazing practices have driven fertility, which has increased pasture availability and quality, improving production – even with reduced rainfall and during times of drought. Together with their livestock, Tim and Karen Wright have regenerated their property, and their lifestyle.

Contact Tim & Karen Wright: c/o [info@soilsforlife.org.au](mailto:info@soilsforlife.org.au)



## Adopting Holistic Management Principles

Lana comprises 3350 hectares of moderately treed granite slopes and open riparian zones adjoining two major creeks forming part of the Gwydir River catchment. Tim took over the property from his father, Peter, in 1980, who had farmed it since 1952.

Various strategies of pasture improvement had been used on the property in the past. In 1960, approximately 20% of the property was top-dressed and sown with improved pasture. Later, the whole property was top-dressed with superphosphate and seeded from the air. Oat fodder crops were under-sown with various pasture species, and this pasture improvement enabled stock numbers to be more than doubled between 1981 and 1992.

However, with the expensive inputs, the property barely broke even over a five year cycle. In the 1981 and 1992 droughts, production records revealed that the improved paddocks had lower yields than the unimproved paddocks. The land was too susceptible to drought and profit margins were falling. It made sense to seek a change.

Tim recalls, "In 1990 we were motivated by two key considerations to decide what and how we should change. These were the excessively high cost of production, especially labour, but other inputs as well, and the opportunity for better use of the grazing animal within grazing management".

It was adopting a Holistic Management approach and undertaking both the Holistic Management and Grazing for Profit courses that ultimately made a huge impact and influenced the Wright's decision-making. They learned that, "Holistic Management is about 'thinking'; about cause and effect, about weak links and risk management, about testing concepts and ideas against our holistic goal".

Subsequently, Tim and Karen developed ten principles, which they call 'Working with Nature', to guide their farm operations. All of their management decisions are tested against the ten principles. If the decisions do not align, they are reviewed. "We assume we could be wrong. For example, we ask ourselves if we are targeting the weakest link in the production chain, and whether we're treating the cause or simply a symptom."

### Tim and Karen's 'Working with Nature'

1. Develop a holistic goal that considers personal values, natural resource base and available finances.
2. Match the enterprise to the environment, not the other way around.
3. Match the stocking rate to the assessed carrying capacity of the land and revise assessments frequently.
4. Manage for the full range of plant species and the whole ecosystem.
5. Think of livestock as tools.
6. Design paddocks to suit the topography and the land.
7. Use a flexible grazing plan and monitor the water and mineral cycles, energy flow, and the plant sward to ensure the plan is on track.
8. Supplement stock with minerals but not feed substitutes.
9. Test all decisions against the holistic goal.
10. The highest return on capital comes from education, not regulation. What looks good in the paddock is not necessarily good on the balance sheet.



## Implementing Change

Following their ten principles, the Wrights experimented with cell grazing between 1991 and 1993 and were encouraged by outcomes to move fully to planned grazing in 1995, combining both Holistic Management and cell grazing principles.

### Fencing

In 1980 Lana was originally subdivided into 30 paddocks of generally 100-120 hectares, with varying grazing areas. Since 1990 these have increased to 350 paddocks, averaging 10-15 hectares. Paddock size is seen as crucial to effectively use available pasture in relation to stock density and the stocking rate, which are adjusted accordingly.



*The Lana control board helps keep track of stock rotation*

Tim describes, "We fenced on contours to prevent sheep camps from developing on high ground and to spread nutrients laterally and more evenly".

Permanent fences at approximately \$400 a hectare were installed using steel, and, Tim explains, "We built our own steel end assemblies. We do not use our own timber for on-farm use because, as well as the trees being useful where they are, the cost of labour to cut posts and clear up debris exceeds the cost of buying steel end assemblies".

Each subdivision required about three quarters of a kilometre of fencing, costing about \$800 per kilometre at the time. More recent costs are closer to \$1500 a kilometre. Tim found that two men could build one kilometre of fencing in a day. The bulk of the fencing was built over 15 years and there are plans for further subdivision to

better manage the availability of pasture. Tim says, "It is important to note that the cost of development is returned within two years".

### Water

Heavily eroded watercourses were fenced off and weirs constructed to stop head-wall erosion and divert water from watercourses onto the flood plains. Wetland plant species were established in all watercourses and weirs. Tim notes, "Stream bank erosion is healed and the old irrigation dam is now like an artificial wetland, with reed beds and fringing dense cover".

Creeks and dams were initially relied on for stock water, with dams fed by aquifers and clean runoff. A tank and trough system was constructed to supply water to the new paddocks. Watering with a trough system required installation of 3.5km of 50mm pipe from one end of the property to the other, mainly using gravity feed from dams built high in the catchment and, in some cases, by pumping from creeks to header tanks on high ground. Tim notes, "We don't need troughs in wet seasons, but they are a good drought standby. A mix of dams and troughs gives us the best of both worlds".

The stock watering system ensures that the stock are provided with clean water. Tim points out, "Troughs are good for a leader-follower system where the cattle disturb the dam water. Nebraska Feedlot research has shown that cattle do better on clean water; stock can lose half a kilogram per day on muddy water in a dam. Now the stock are no longer around water courses long enough to damage them and they always have a clean water supply. We also no longer get dung around the dams nor as many nutrients ending up in the water".



*Improved hydrology has converted the old irrigation dam into a wetland*

## Financing

The new fencing was initially funded by reducing other costs, such as fertiliser and hay, and abandoning pasture renovation. Tim achieved return on his capital investment in two years, particularly through significant reduction of vegetable matter in the wool. Vegetable matter in skirtings has reduced from 9% to 2% since 1982, enabling Tim and Karen to decrease the amount of skirtings, increasing the main fleece lines and subsequently the overall value of the wool clip.

Increased production through the ability to raise stocking rates has also covered financing of fencing and water infrastructure.

The properties now carry 7000 sheep and 700 breeding cows at a stocking rate of 5 DSE<sup>1</sup> a hectare in winter and 7-8 DSE a hectare in summer. This is without feeding hay or grain – only using Himalayan Salt and occasionally Bypass Protein Supplement, such as Cotton Seed or Coprameal during drought times.

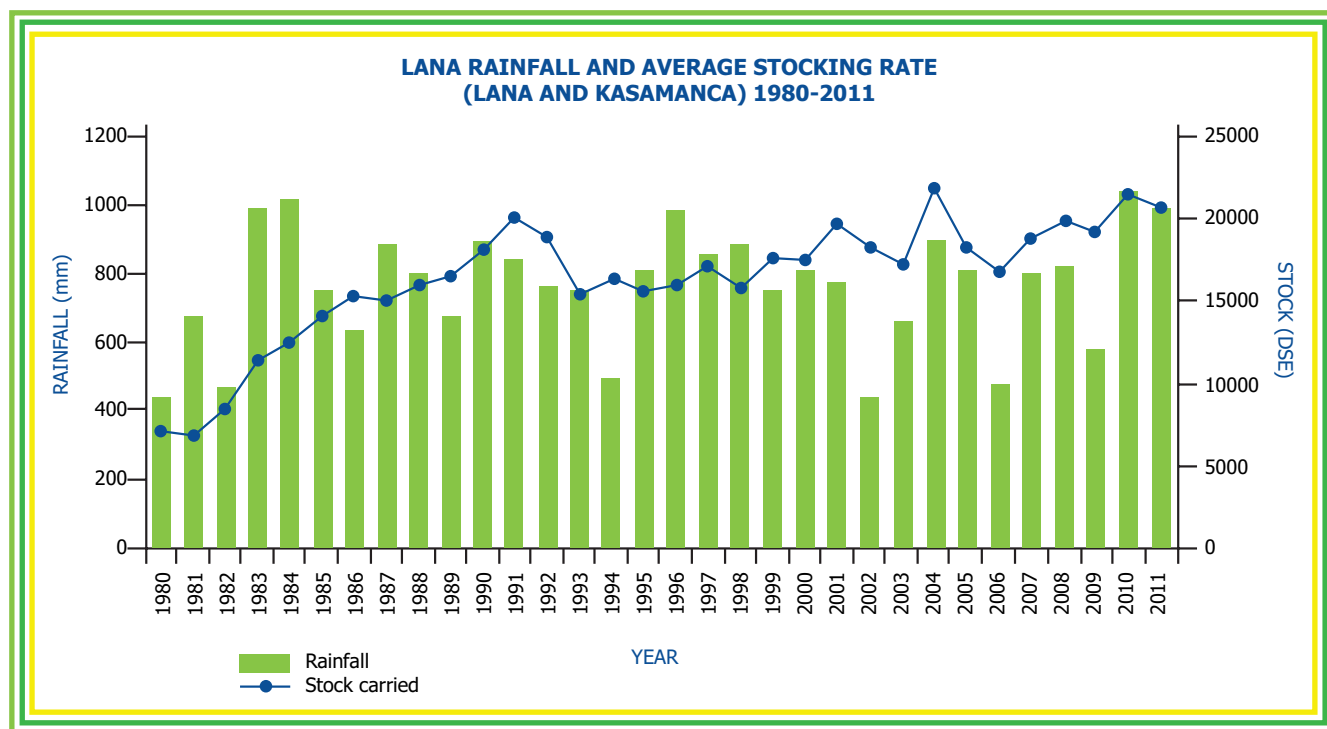
<sup>1</sup>DSE is a stock measurement, 'dry sheep equivalent' based on the feed requirements of a 45kg wether. This can be multiplied for various types of stock, for example a ewe with one lamb is measured as 1.5 DSE, and a dry cow is equivalent to 6-8 DSE.

## Education

Tim and Karen believe that innovative farming cannot be done without knowledge and skills development and an understanding of how the land 'works'. Their investment in knowledge growth, development of skills and the benefits of continuing experience has been necessary for successful innovation in their farming operations.

Tim comments, "There is always a certain amount of pressure arising from ingrained attitudes among farmers, academics and bureaucrats, that are resistant to change. Some farmers continue to manage their production cycles irrespective of the long-term effects on farm landscape. Some academics are tied to the knowledge and literature of the past and some bureaucrats are tied to outdated policies and regulations. There were times when many people thought we were stupid".

"We have received minimal support from government entities, particularly NSW Department of Primary Industry officials, and some scepticism from academics. That is gradually changing as newer thinking takes hold. Training and education are essential at all levels to change attitudes. We manage under the holistic thinking that we assume we could be wrong, and we monitor and replan. This is the holistic feedback loop, which is really important. Tomorrow is another day – nature is changing every minute and we have to change with Mother Nature, and this includes climate change."





Both Tim and Karen continue to read and research and seek mutual support from others going through similar processes. They host regular field days and visiting speakers to the property, provide mentoring to other landholders and maintain an ongoing relationship with the University of New England. They believe that all education provides high return on investment.

## Livestock as Farm Tools

It was the understanding that grazing management needed to change to better use the grazing animal that led the Wrights to develop their fifth principle, 'think of livestock as tools'. They recognised that stock could be used to



*Nutrient transfer on Lana*

transfer nutrients off sheep camps, reduce weeds and intestinal worm infection; in effect, be used as the farm machinery for slashing, fertilising, sowing and managing pasture. Tim emphasises, "Stock density, the herd effect, and planned rest from grazing are as much tools as is a plough".

"We use the farm livestock as the tools to enhance the land as well as their being a source of income. The slasher in their teeth, the plough in their feet and the fertiliser equipment in the rear. Animals distribute nutrients across the grazed areas and build soil. Earthworms, dung beetles and other soil builders are critical to the development of healthy soil. "

Planned grazing based on Holistic Management guidelines involves intensive grazing with a high stock density for short graze periods followed by long rest periods. Tim reiterates that they now "manage the whole ecosystem, using the livestock as 'tools' – no conventional farming methods are practised. We use 'strategic rest from grazing' to enhance the environment. At any one time, 95% of the property is in recovery mode".

Each paddock gets an average of eight to ten days grazing per annum, or two to three days grazing in each season. Livestock are moved more rapidly during fast pasture growth and less rapidly during slow growth periods, for example, winter or times of drought. No hay or grain has been fed to the livestock since 1990, and Tim notes, "We

were only using mineral and bypass protein supplements, as of 2010 we are only using Himalayan salt".

Cattle and sheep on Lana are grazed separately in a 'leader-follower' system. Cattle are grazed first for two days, opening up the pasture for the sheep and reducing the worm burden. Sheep then follow for two days. Intestinal parasite cycles have been broken by rotational grazing. With the flexibility provided, cattle are sometimes grazed with the sheep to stop the cattle getting too fat and to reduce the risk of bloat if there is too much clover. A 'split-leader' system is also used on occasion, for example, with calf heifers first or for fattening special stock for market.

Pastures are now altered by using grazing management and no chemicals are used. Tim notes, "Chemical fertiliser has not been applied for the past five years, yet our carrying capacity is slowly increasing due largely to the improved biological activity in the granite soils". Close monitoring of the different species determines what and when and how to graze a paddock. Tim aims for one-third of the pasture to be eaten, one-third trampled, and one-third left for recovery.

Tim illustrates, "We do not sow in any conventional sense. Our animals spread the seed through dung and the increasing fertility of the soil becomes an ever improving seed bed". The growing availability of pasture is driving further subdivision of paddocks to ensure correct grazing pressure and avoid pasture becoming rank from under-utilisation. The most productive area on Lana has an average of four hectares per paddock, with an average stocking rate of 20 DSE per hectare and density of up



*Sheep and cattle are grazed separately or together depending on desired outcomes*

to 500-600 DSE per hectare. Tim believes that, “The productivity is largely due to the smaller paddock size resulting in improved soil biological activity due to greater animal impact”.

The stock provide all the ‘farming’ required to maintain and enhance pasture and the soil. “We focus on having 100 per cent ground cover 100 per cent of the time so that soil is always protected. Litter is money in the bank. Softer soils attract fertility and generate regrowth. We rely on an increasing variety of native pastures to provide carrying capacity all year round. We rely on the stock to manage the fertility of soils and the availability of pasture.”

The cattle breeding herd on Lana now comprises 70% spring calving and 30% autumn calving. As Tim points out, “The increase in cool season native perennial grasses has resulted in improved native pasture growth to allow more nutritional pastures during the winter”.

The grazing operations have had a positive impact on watercourses, riparian zones, dams and wetlands. There is no erosion of stream banks. Regeneration of vegetation in riparian zones is increasing from natural seeding. Water quality is high and dam levels are maintained from soil hydrology well after rainfall event runoff ceases. This is due largely to the effects of adopting a holistic grazing plan, resulting in an improved water and mineral cycle, community dynamics and sunlight conversion. The Wrights consider these their four foundation blocks.

## Soil and Vegetation

Soils across Lana are well-drained coarse and fine granites. In the 1990s, Christine Jones from the Botany Department of the University of New England helped look at the mineral cycle during grazing trials being performed. A four to five times increase in available phosphorus was found in areas that hadn’t been fertilised over a three year period, along with increases in total nitrogen and potassium. The findings confirmed that the Wrights were on the right track, as the soil health was due to:

- the rest factor – the pasture roots were growing deeper, drawing up the previously unavailable nutrients;
- the pasture was in recovery phase 95% of the time, meaning more litter is being laid down, enriching the topsoil with organic matter and building soil organic carbon without additional artificial fertilisers; and
- the transfer of nutrients off the sheep camps. It takes about ten days for nutrients to pass through the animal, and by moving stock every two to three days, nutrients were being passed into a number of other paddocks.

Prior to farming, the land was open native grass woodland with Blakely’s red gum (*Eucalyptus blakelyi*), yellow box (*Eucalyptus melliodora*), white box (*Eucalyptus albens*),



Pasture on Lana prior to Holistic Management and rotational grazing



Dense pasture now provides full ground cover and crowds out weeds

rough-barked apple (*Angophora floribunda*), apple box (*Eucalyptus bridgesiana*), stringybark (*Eucalyptus caliginosa*) and mountain gum (*Eucalyptus dalrympleana*). In contrast to earlier management practices, timber regrowth is now welcomed and encouraged. About one third of Lana is timbered. Trees provide shelter in hot and cold weather and the mild temperatures in tree belts shelter some species of grass in winter. Trees also support wildlife and species diversity. Kangaroos are widespread and there are wallabies in the hills. Koalas have been observed in some areas, as well as brush tailed possums and sugar gliders. The property also has numerous species of birds, including water birds, and platypus and water rats inhabit a number of creeks. Lana has been a gazetted wildlife refuge since the 1960s.

"Trees are an integral part of our ground cover and of our ecology. We encourage tree growth to extend shelter corridors and to provide habitat for wildlife. Seedlings come from natural seeding and survive because of the low impact on seedlings from rotational grazing. If there is over production of some species in a particular area, selective thinning may be required, but this is rare."

Pastures are no longer sown, and the property is managed for biodiversity, particularly of native species.

In terms of pasture variety, there is some vestigial sub-clover, phalaris and fescue from previous improved pastures that survived the drought. Lana receives an average annual rainfall of 769mm, though an all-time low of 397mm was experienced in the drought of 2002. No hay or grain needed to be fed during that period. Overwhelmingly, native pastures now dominate, with a continuing variety of species regenerating. Natives, such as weeping rice grass (*Microlaena stipoides*), crowd out not only weeds, but also remnant exotics.

Prior to present management, saffron thistles (*Carthamus lanatus*), blackberries (*Rubus fruticosus*) and briars were commonplace. Large quantities of herbicides were used to control these. Chemical spraying of thistles was stopped around 15 years ago, and with the introduction of rotational grazing and other innovations, there has been no major weed problem for the last ten years

In the 1990s, Tim had originally tried pasture cropping, but, with the increased ground cover from the native pastures, the operation was not viable, and, in due course, the need for a pasture crop was overtaken by adequate winter pasture from native species. It was an activity worth trying, but was ultimately not necessary to achieve the desired outcomes.





## Now and Beyond

On Lana and Kasamanca, Tim and Karen have focussed on having their grazing practices drive fertility. "Fertility drives pasture availability. Pasture availability drives production. Stocking rates have improved steadily and continuously, even during drought. We have also managed to diversify and widen production lines."

Since adopting Holistic Management practices, their production, workload and lifestyle has changed. Production has increased and inputs have decreased.

On average, carrying capacity has increased from around 8000 DSE to 20,000 DSE. Management practices have improved the natural resource to such an extent that this has been possible even through reduced rainfall and period of drought.

Production improvements have seen wool staple strength increasing from an average 40 N/Ktx (Newtons per kilotext) to 48 N/Ktx. Average fibre diameter has improved from 17.5 micron to 16 micron. Merino lambing has increased from 80% to 90% and quality is improving allowing Lana to produce 1st and 2nd cross prime lambs. Calving rate has also increased from 80% to 90%, most likely due to the improved nutritional value of the stock feed.

Over the last ten years, permanent labour requirements on the farm have reduced from one person per 5,000 DSE to one person per 12,000 DSE. Tim and Karen have more time for family and off-farm social, community and consulting activities. Labour is less intense except for key periods such as lambing and shearing.

"We can be, and are, involved in off farm activities to a greater extent, but we must cover the need to open and close gates to rotate stock and we must be here for key activities like lambing."

Overall, the Wrights believe that successful farmers must have a flexible grazing plan to support long term management of pastures, livestock, biodiversity and personal wellbeing. "There is a need to read, consult and understand how the pieces of the grazing plan come together. Define goals,

decide on actions, identify weak links, manage risk, and be prepared to change if things don't work out. Everything is connected to everything else."

"The threat of drought is always with us and we must plan that into our farming strategies. Old ideas of drought

subsidies are not sustainable. Farmers must manage the impact of drought on their businesses."

The Wrights also believe that there should be incremental, modular certificate and diploma courses in applied farming techniques aimed at working farmers at University of New England and other agricultural campuses. They believe that this training could be sponsored by Landcare and the federal Department of Agriculture, Fisheries and Forestry.

Farmers talking to farmers and sharing knowledge and experience is also seen as vital to spreading better practice in farming.

Tim and Karen understand that everyone has their own situation, but feel that their model can be broadly applied, "We have ten principles that underpin our Holistic Management strategy. Our principles work for us, but they may not suit everyone. It depends on your own holistic goal and the resource base you are dealing with. We test all our decisions against the holistic goal. If the test fails, the decision is faulty".

"Change requires knowledge and understanding. We hope that all land managers will one day appreciate the need for life-long learning and demonstrate an awareness of the importance of sustainable land management. This would help reduce the burden of extensive regulation and legislation for future generations."

**"Change requires knowledge and understanding. We hope that all land managers will one day appreciate the need for life-long learning and demonstrate an awareness of the importance of sustainable land management."**



# Productive greener pastures through restoring landscape hydrology



## TALLAWANG

### Farm Facts

Willow Tree, 60km south-west of Quirindi,  
NSW North West Slopes and Plains

**Enterprise:** Cattle. Sheep

Beef cattle and sheep trading

**Property Size:** 445 hectares

**Average Annual Rainfall:** 800 mm

**Elevation:** 400-500 m

### Motivation for Change

- Disenchantment with 'traditional' grazing methods in producing a healthy landscape and adequate returns

### Innovations

- Construction of leaky weirs and swales to slow water flow
- Rotational grazing in wagon-wheel design
- Stock trading
- Innovations commenced: 2002

### Key Results

- 250% increase in carrying capacity
- 15-23% profit margin on cattle production
- Constant river outflow regardless of inflow
- Improved landscape hydrology
- Increased native biodiversity



Craig Carter and his partner Nicky Chirlian aspire to a balance of low farming inputs, comfortable returns and a healthy diverse landscape. Implementing a combination of water management and grazing practices has restored their landscape hydrology, delivering the productive, greener pastures to support their goal.

Craig and Nicky both returned to their farming backgrounds after pursuing other careers for a period of time – for Craig, running a financial planning business in Sydney, while Nicky worked in disability services in Armidale. Nicky now runs a private speech pathology practice in Quirindi and surrounding districts.

On arrival at Tallawang in 2001, Craig was concerned about the poor condition of the land – erosion, soil compaction and impoverished pastures – and the severely eroded creek and gullies. He had become disenchanted with his family history of "traditional" land use and set stock grazing on other properties. It was apparent that traditional grazing methods had not produced a healthy landscape nor provided adequate returns. To achieve these outcomes, Craig combined the principles of two newer methods he had encountered, rotational grazing techniques learned through the *Grazing for Profit* course and water management based on Peter Andrews' *Natural Sequence Farming* methods.

Contact Craig Carter & Nicky Chirlian: [craig@tallawang.com](mailto:craig@tallawang.com)

## Blending Principles to Attain Effective Hydrology

When he purchased Tallawang in 2001, Craig's objective was to establish a low cost, regenerative grazing operation. In terms of obstacles in moving from the traditional farming methods he had grown up with, Craig says, "the main impediment to change is between the ears".

Drawing from the more contemporary farm management practices he had encountered over the years, Craig and Nicky now apply a blend of the principles of Grazing for Profit and Natural Sequence Farming. These combined techniques have been used to implement a philosophy of low input cost for significant return, using cattle trading and breeding.

**"The main impediment to change is between the ears."**

Craig notes, "We have used a range of management tools that are all designed to be low cost, low impact bumps on mother nature's side to assist her to rebuild the function of a damaged environment. This is a constant learning process".

In summary, cell grazing was introduced to Tallawang in 2002. Accessing available grant monies, Yarramanbah Creek, which runs through the property, was fenced and tree corridors were planted. In 2005 a series of leaky weirs was constructed along the length of the creek to retard water flow and enable the original chain of ponds to become re-established.

The existing contour banks in higher country were modified in 2009, by blocking them at intervals, to form swales that retain and more effectively use water in the upper parts of the landscape. This process has enabled surface water to infiltrate higher in the landscape, thus maintaining the quality and quantity of the pasture longer in the drier times. By enabling more water to be absorbed into the soil, the pastures are more lush resulting in the cattle tending to walk less to find the water trough, which is located lower down the slope.

Some slashing has been used since 2010 in combination with cell grazing on creek flats to increase soil organic matter and encourage regeneration of native grasses.

As a result, water is retained in the landscape for longer, being readily available for plants and animals. Combined with increased vegetation and soil organic matter, overall landscape hydrology has improved. Craig and Nicky are monitoring these results.

Craig notes, "As we experiment with new tools and expand our skills with old favourites, we aim to record what we have done and the observed responses. Hopefully the landscape function and productivity are improving under our watch".

## Converting the Waterways

Yarramanbah Creek bisects Tallawang, winding for 4.5km through the property. Average annual rainfall in the region is approximately 800mm, falling mainly from December to February and June to July.

Prior to the 1960s Tallawang was grazed with sheep and cattle. A central bore supplied two small tanks from where water was reticulated to 25 troughs. Yarramanbah Creek had also been used for stock water and was fenced into small paddocks along its length. The banks of the creek and tributaries were incised, with gullies and contour banks further draining water off the property, increasing susceptibility to drought. The creek had eroded down to a base of basalt rocks and stones for its length. Vegetation associated with the creek was characterised by remnant she-oak (*Casuarina cunninghamiana*) and rough-barked apple (*Angophora floribunda*) trees. Little regeneration was observed and many of the trees were over-mature and senescent.

Craig employed Peter Andrews to design creek structures, at a project cost of \$17,000, establishing a series of leaky weirs in the creek. These were constructed mainly using dead trees in conjunction with later plantings of common flag reed (*Phragmites australis*). Potential opposition to this work from the government authorities soon dissipated when the positive environmental effect on retarding flow and creating ponds became evident.



*Erosion along the creek had exposed the underlying base of basalt rocks*



Six years later, the previously bare soils and gravel beds are covered with regenerating plants – including prolific pioneer plants or weeds but also dense patches of river she-oak seedlings. Considerable siltation is evident as the vegetation traps sediment carried from properties upstream.

Yarramanbah Creek is now a 'chain of ponds' with inflow varying according to local rainfall, but constant outflow. Craig's paddock layout provides cattle water points high in the landscape, which discourages stock from accessing the creek for water and causing any damage to banks.

In 2009 Craig modified the existing contour banks in the higher country by blocking them at intervals to form swales. He also constructed additional swales to further intercept runoff and increase rainfall infiltration in the upper slopes.

Craig states, "Through our work in converting the contour banks constructed in the 1960s into water holding swales, we are restoring the watershed. This process is beginning to restore the hydrological function of the landscape".

Improved hydrological function ensures maximum infiltration, extending the growing season of the grasses and providing greener pastures. As a result, Tallawang has become significantly wetter along the upper and mid slopes with increased palatable vegetation later in the drier seasons. Wells that were empty on Craig's arrival to the property are now full. Previously dry soils along the creek flats are now swampy meadows and wetland plants that did not exist on the property prior to the commencement of the work are in abundance. Rainfall is now available to be used effectively where it falls, rather than being whisked away quickly by poor ground cover with eroded creek lines acting as drains.



*Healing erosion along banks*



*Grassed up basalt rock creek bed forming chain of ponds*



*Casurina regrowth and pioneer species covering old creek bed*



*Phragmites australis regenerating along the creek bed*

## From Breeding to Trading

The first cattle to graze in the Cattle Creek locality were brought there in 1826 from the Hunter Valley by Benjamin Singleton (after whom the Hunter Valley town is named) and his son-in-law Otto Baldwin. The locality was included in the Warrah Estate, a property of some 100,000 hectares granted to the Australian Agricultural Company in 1833. The land occupied by Tallawang formed one of the paddocks of the Warrah Estate.

When introducing cell grazing in 2002, Craig elected to use a 'wagon wheel' fencing design, where paddocks are arranged radiating from a water point at the centre, and single-wire electric fencing for cost-effective grazing management.

To the casual visitor, one of the most obvious differences at Tallawang compared to other cattle properties is the style of fencing used to manage the herd. Gone are the gates – one simply lifts and drives under, or drives over the fences. The internal permanent fences that were present in 2001, that is, closely spaced fence posts and considerable amounts of wire, have been removed.

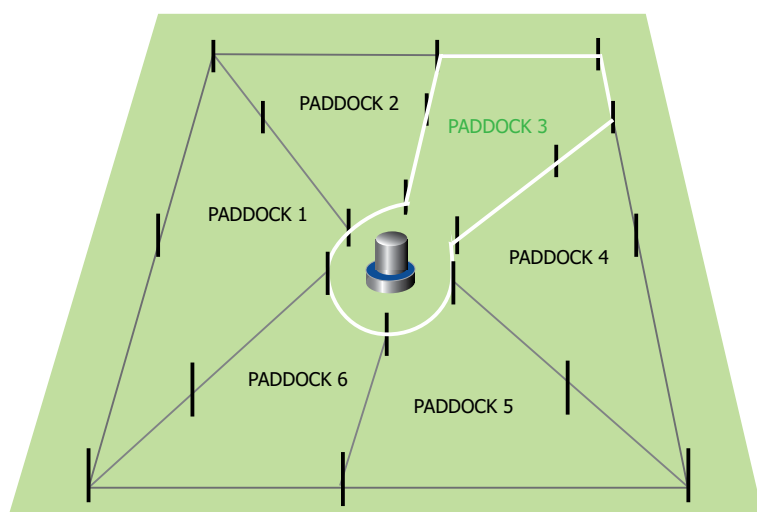
There are now around 100 small triangular shaped paddocks arranged in six cells. At first glance the fences are rather skimpy, comprising sparsely spaced steel posts and a single strand of high-tensile electric wire, running 3000-4000 volts. The simple construction allows fencing layouts to be easily moved or modified to suit landscape needs. Fences are only turned on around individual paddocks being grazed, and the cattle know when the



*Stock have access to a central waterpoint from multiple paddocks using the wagon wheel design*

fences are turned on; otherwise they just walk right over the wire. As a general rule each paddock is grazed for no more than three days out of every 90 days.

Craig manages his property to meet production and landscape outcomes, "Across Tallawang we have gradually increased the stocking rate, based on availability of regenerating native grasses. Cattle are not hand fed [when pastures become depleted] – numbers are managed according to available biomass and rainfall". To facilitate this, Craig has changed the business from a breeding focus to a trading focus, which entails greater flexibility with stocking rates. Trading cattle enables stocking to be varied as needed to suit seasonal conditions.



*This figure illustrates a cell of paddocks in a wagon wheel design. It depicts Paddock 3 being grazed, with access to the waterpoint. and electric fence turned on.*

"This initiative comes from my experience as a share trader at the Sydney Stock Exchange. At the start of winter, I look to the New England tablelands almost 200km away, where the winters are much harder on pastures than they are on the Liverpool Ranges. At that time cattle producers on the New England are looking to sell their stock to protect their pastures over the harsh cold winter; at the same time I can be looking to buy in cattle to help manage excess grass cover. It is a sound business model for us", Craig explains.

The stock carrying capacity has increased dramatically with the introduction of time-controlled cell grazing and the restoration of native pastures. In 2002, Tallawang was carrying 218 dairy heifers with an average weight of 300kg. In early 2012, the stock



comprises 300 breeding cows plus progeny, as well as 360 ewes with lambs and a further 150 ewes due to lamb in the following month.

“The main tool we have used over the last decade is grazing management. By varying the numbers of stock and using a short graze and long rest period and the paddock size, we are able to encourage the more palatable grasses while the less desirable ones get trampled and can’t compete. The key variable is the timing, frequency and amount of rain”, Craig points out. Craig maintains rolling monthly rainfall data to inform his grazing management, with records for comparison back to 1883 (see graph pg. 135).

“Livestock are integral to this process. Like all tools they can be used badly or effectively. Overgrazing has been a cause of a significant amount of degradation in the landscape, merely amending that has had some dramatic positive impacts.”

## Re-hydrating the Soil

In the lower slopes and narrow riparian plains where Tallawang is located, soils are deep, heavy clay soils (vertisols) derived on weathered basalt. The vertisols, which are widespread in the Liverpool plains region, have high natural fertility. However, when Craig purchased the property in late 2001, Tallawang was typical of most heavy basalt soils, with deficiencies in nitrogen, sulphur and selenium.

Reviewing past practices shows how Craig’s approach has improved the hydrology of soil. Anecdotal evidence suggests that cropping was introduced in the 1960s and it is understood that introduction of cropping coincided with extensive earth works. Earth banks were constructed at a slight decline towards the gullies to remove excess soil water and enable cropping. The increased runoff to the drainage lines may have exacerbated the already severe gully and streambed erosion. By 2000, water retention along the upper and mid slopes was poor, increasing the property’s susceptibility to drought.

The effects of the cropping practices prior to 2001 can be seen by a recent comparison of a native pasture site on the property with a cropped site, as shown in the following table. Both sites had the same general history of grazing from the 1820s until the 1960s. The cropped site was cropped from the 1960s to 2000, and even with over ten years of improved management practices, still shows poorer results in terms of ground cover, carbon and nitrogen stores.



*Increased silt deposits have allowed reed beds and swampy meadows to form along the creek*

Site (2011)	Native pasture	Cropped
Ground cover	95%	73%
Total carbon	4.9%	2.4%
Total nitrogen	0.3%	0.2%

Increased soil carbon, ground cover, and slowing the flow of water through the leaky weirs has all contributed to improved soil hydrology. Craig notes, “The property has become significantly wetter in higher country with increased vegetation following implementation of swales, and swampy meadows establishing on creek flats”.

Paralleling improvements in the hydrological function has been a steady increase in organic matter in soil. Much of the increased soil carbon has been due to cell grazing over ten years with inputs from cattle manure and humus associated with short term high rotation of cattle. Soil tests from one paddock of native pasture show continuing improvement over time, as presented in the table below.

Year	2008	2011
Total carbon	2.86%	4.90%
Total nitrogen	0.27%	0.30%
pH (1:5 water)	7.18	6.6



## Productive Greener Pastures

The original native vegetation of the area surrounding Tallawang was grassy box woodland with sparse eucalypts.

At the time of purchase, Tallawang appeared run down and overgrazed. The property comprised 20% lucerne (for grazing and hay), 5% grazing oats and 75% native and naturalised pasture. Previous management had relied excessively on lucerne for grazing and supplementary feeding of all stock had been required each winter.

By changing the grazing management, Craig has transformed the landscape. There is extensive regeneration of kangaroo grass (*Themeda triandra*), tall oat grass (*Themeda avenacea*), lobed blue grass (*Bothriochloa biloba*) and silky brown top (*Eulalia aurea*). A gradual decrease in lucerne has been observed through use of cell grazing and some slashing of plains grass, combined with broadcast legumes in 2009. Native trees and shrubs are naturally regenerating.



Pastures with visible exposed bare ground in 2002 (top) now have 95% ground cover and a significantly increased carrying capacity (below)

## BIODIVERSITY ON TALLAWANG

Plant life observed on the property includes:

### Perennial Grasses

silky brown top (*Eulalia aurea*)  
 kangaroo grass (*Themeda triandra*)  
 tall oat grass (*Themeda avenacea*)  
 blue grass (*Dichanthium sericeum* subsp. *sericeum*)  
 wallaby grass (*Austrodanthonia bipartita*)  
 Warrego summer grass (*Paspalidium jubiflorum*)  
 water couch (*Paspalum distichum*)  
 wild sorghum (*Sorghum leiocladum*)  
 plains grass (*Austrostipa aristiglumis*)  
 cotton panic (*Digitaria brownie*)  
 hairy panic (*Panicum effusum*)  
 slender bamboo grass (*Austrostipa verticillata*)  
 tall Chloris (*Chloris ventricosa*)  
 lobed blue grass (*Bothriochloa biloba*)  
 red grass (*Bothriochloa macra*)

### Wetland Plants

spiny-headed mat-rush (*Lomandra longifolia*)  
 spike sedge (*Bolboscheonus* spp.)  
 common flag reed (*Phragmites australis*)  
 cigar rush (*Lepironia articulata*)  
 club rush (*Schoenoplectus* spp.)  
 marsh club rush (*Bolboschoenus fluviatilis*)

### Trees

white box (*Eucalyptus albens*)  
 river red gum (*Eucalyptus camaldulensis*)  
 Blakely's red gum (*Eucalyptus blakelyi*)  
 rough-barked apple (*Angophora floribunda*)  
 kurrajong (*Brachychiton populneus*)  
 river she-oak (*Casuarina cunninghamiana*)  
 hickory wattle (*Acacia implexa*)  
 Cooba (*Acacia salicina*)  
 native olive (*Notelaea microcarpa*)



“The main tool we have used over the last decade is grazing management.”

By creating the environment to re-establish the chain of ponds along the Yarramanbah Creek there has been observed significant recruitment of varieties of sedges and rushes, notably cigar rush (*Lepironia articulata*), club

rush (*Schoenoplectus spp.*)

and marsh club rush (*Bolboschoenus fluviatilis*), as well as considerable recruitment of river she-oak, rough-barked apple and native olive (*Notelaea microcarpa*).

Weeds on Tallawang are not seen as an area of concern for Craig and no chemicals are used for weed management. His experience has shown that weeds follow a natural sequence, with reductions in weeds, such as Bathurst burr (*Xanthium spinosum*) and stickybeak (*Bidens pilosa*), occurring as native pastures increase. Across the property, prickly pear (*Opuntia stricta*) and sweet briar (*Rosa rubiginosa*) are the more persistent perennial weeds and these are removed manually. Nearby roadside verges do have some infestation of African love grass (*Eragrostis curvula*), Coolatai grass (*Hyparrhenia hirta*), Noogoora burr (*Xanthium spp.*) and a small amount of St John's wort (*Hypericum perforatum*), but these are not problematic on Tallawang.

## Attaining Balance

Craig's management practices have transformed the two main soil-landscape types on Tallawang; riparian systems and gently sloping grassy box gum woodlands. Compared to 2001, Tallawang now has more ecological function, restoring what is naturally inherent in grassy woodlands landscapes.

The innovations have resulted in a rehydrated landscape, and the restored ecological function is evidenced by increased ground cover, biomass and soil carbon. The property is becoming increasingly “drought proofed”. There is a broadened diversity of native grasses as they re-emerge from the seed, stabilised creek banks, regenerating riparian vegetation and increased biodiversity.

Numbers and species of small birds and parrots, spiders, frogs and echidnas have increased across the property as a result of the management changes and increase of vegetation cover, particularly native vegetation. Reptiles – geckos, lizards and lace monitors – are seen more frequently. Firetail gudgeons, a small native fish, have been observed in the creek. There are more wetland plants including spiny-headed mat-rush, other rushes, common flag reed and significant regeneration of river she-oak, rough-barked apple and native olive.

In 2012 Tallawang now aims for a 15 to 23% profit on cattle production through breeding and trading programs. Organic matter is increasing and cattle numbers can be managed with very little input costs.

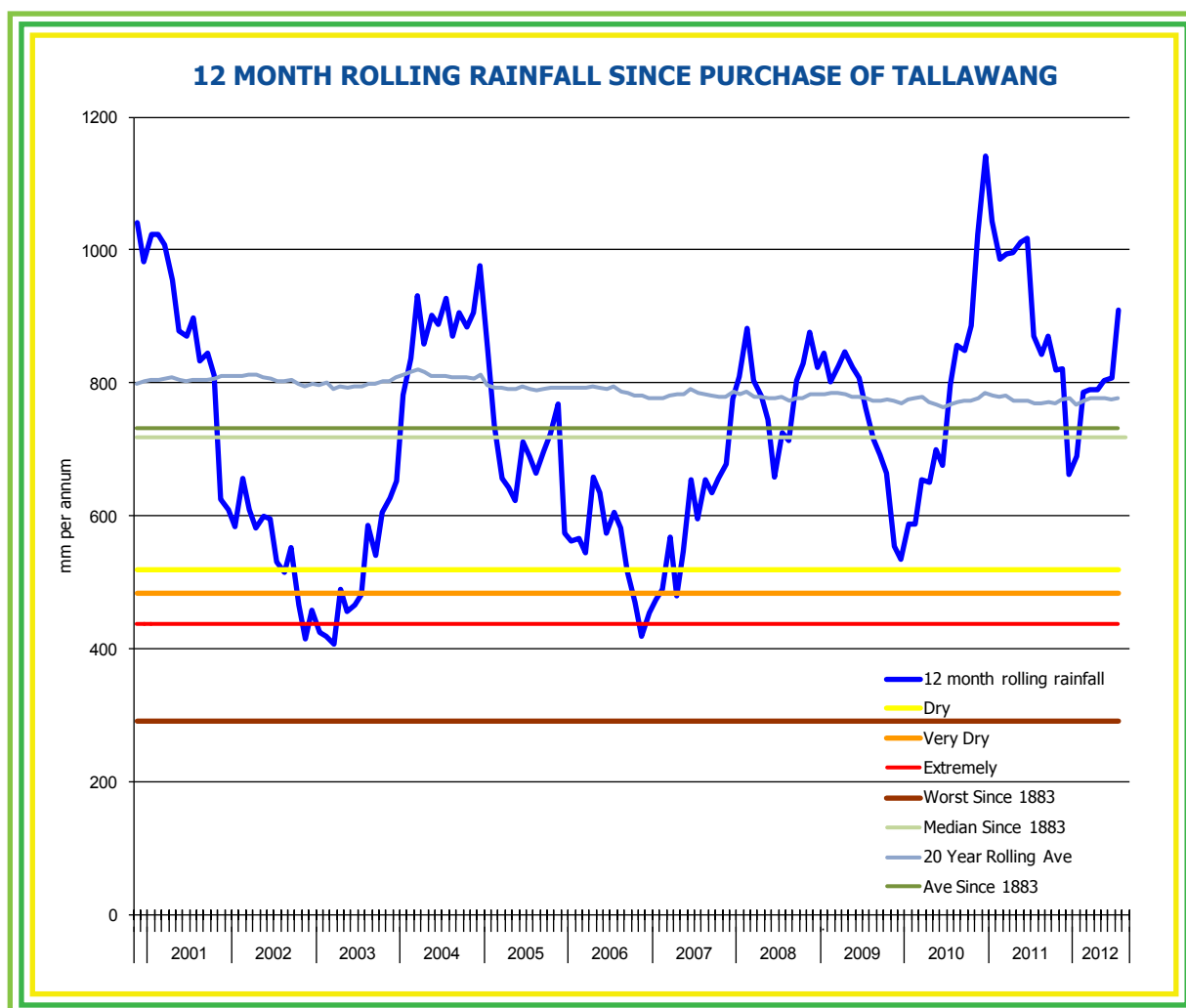
Craig has presented on Natural Sequence Farming at various venues and has become a member of the Sydney University Faculty of Agriculture, Food and Natural Resources 'CANEn' project – Connecting Agriculture, Nutrition and Environment.

Craig and Nicky have established a personal philosophy for health and life balances. Together they have learned to read their country and landscape and to work with this to enable them to tread lightly on the environment. To ensure the ongoing health of their landscape and their lives they aim, “to be continuously open to new ideas and have the courage to implement them as avenues to meet ongoing goals”.



Native grasses have been extensively regenerated through grazing management practices







# Reducing dryland salinity and achieving resilience by design



## TALAHENI

### Farm Facts

Near Murrumbateman, 40km north of Canberra, NSW Southern Tablelands

**Enterprise:** Sheep. Cattle. Native Trees.

Ultra-fine Sharlea wool; Angus beef cattle; farm forestry

**Property Size:** 250 hectares

**Average Annual Rainfall:** 625 mm

**Elevation:** 600 m

### Motivation for Change

- ◆ Non-viability of previous management and identifying the opportunity to apply practical ecological science

### Innovations

- ◆ Revegetation to manage salinity
- ◆ Strategic paddock design
- ◆ Planned grazing strategies, particularly addressing fodder supply and drought conditions
- ◆ Innovations commenced: 1980

### Key Results

- ◆ Increased available productive land through reduced water table levels eliminating saline seeps
- ◆ Specialist provider of ultrafine Sharlea wethers
- ◆ Revegetation of over 200,000 native trees



Using a deep understanding of their environment, John and Robyn Ive have used strategic paddock design and management to build resilience into their landscape, and have revegetated ridges to reduce a severe dryland salinity problem, enabling them to meet their niche production outcomes.

The Ive family purchased Talaheni in 1980. At the time, the property was suffering from major dryland salinity caused by over clearing and exploitative land management practices. As a would-be ecologist, John saw the opportunity to repair the degraded landscape through revegetating the ridges and fixing the soil fertility problems that had built up over previous decades.

John and Robyn prepared a comprehensive plan to repair the land and achieve a profit from Talaheni. This addressed the fundamental need to understand the implications of variation in slope, aspect, soil depth, geology, vegetation and climate on achieving success.

Production improvements were experienced from 1983. Now, over 200,000 new trees and a niche production line later, the Ives manage the salinity as well as regular regional droughts with a healthy, resilient landscape. By taking a strategic approach and working with the land and the seasons, John and Robyn have transformed an "environmental and farming basket-case" into an enterprise that has received local, national and international recognition.

Contact John & Robyn Ive: [talaheni@webone.com.au](mailto:talaheni@webone.com.au)

## Comprehensive Planning

In 1980 John and Robyn purchased the 250 hectare property in the Yass Valley, an area renowned for its dryland salinity problems. Their family farming background supplemented by agricultural college and tertiary qualifications in agricultural science and economics provided a sound basis for undertaking the makeover of Talaheni over the following three decades.

John and Robyn both realised at the time of purchase that previous management had been exploitive and would be non-viable into the future. However, they recognised an opportunity to apply sound practical ecological science to an unprofitable enterprise that had depleted the resource base.

To improve the landscape on Talaheni, John and Robyn drafted a plan that recognised major impediments to achieving production potential. Management practices were then identified to address key resource condition issues, such as the dryland salinity. Management of the elevated water tables was identified as a key priority in achieving this.

The plan was then progressively implemented as time and resources permitted, ensuring regular review and updating in response to progress.

A solid monitoring program was at the core of implementation to ensure that the farm plan was achieving intentions. Where possible this was introduced before changing management so that the effect of changing practice could be quantified. As John says, "If you do not measure it you cannot manage it".

Various factors are regularly monitored, including vegetation transects, salinity levels in dams and weekly measurements of the water table. The Ives have now achieved ISO14001 accreditation for their Environmental Management System.

Combined with their farm plan addressing production limitations, John and Robyn set out to develop a production niche suited to the ecological function of the area.

The niche identified was ultra-fine wool production and the development of a sharlea wether market. Sharlea wool is produced by Saxon Merino sheep which are housed in specially constructed sheep care sheds where all aspects of proper sheep husbandry, nutrition and feeding, health, wool growth, quality and cleanliness are exercised between each shearing. The movement from a normal regional fine Merino flock to a highly respected ultra-fine flock has diminished threats to Talaheni's viability, and, as John reports, "As a result we are now a sought after specialist provider of sharlea wethers for shedded sheep operators in southern Australia".

John and Robyn have developed marketing strategies to ensure price returns meet their financial requirements. Angus steers are also produced for the beef cattle feedlot market.

By strategically planning production, including specifically-designed grazing and vegetation management techniques, John and Robyn have regenerated Talaheni, and built resilience into their landscape. They believe that environmental restoration is a necessary precursor to achieving production potential.



*The Talaheni landscape*

Advice has been sought from a wide range of sources throughout the regeneration process, such as from farming colleagues and agencies, but not always adopted. John and Robyn were initially told that overcoming their salinity problem by revegetating the ridges was impractical. They nevertheless went ahead with the plan, which has been demonstrated to be highly successful.

Improvements have been undertaken in a prioritised manner as funds have become available. Almost all work on Talaheni, such as fencing, pasture establishment, yard and building construction, has been undertaken by family members. Off-farm labour has only been used for shearing, fertiliser spreading and major earthworks for dams and contour banks.

John and Robyn also have an eye to considering wider issues for their farm, "In order to be better prepared for future climate change we have calculated that a two degree increase in average temperature, which might not seem much, would increase the average time above plant wilting point threshold [when they can no longer draw moisture from the soil] from 52 to 62 per cent of the time. Faced with this likelihood, we are trialling pastures that are more drought resistant".



## History of Talaheni

The area where Talaheni is located (Nanima), was first settled in the 1840s or 1850s. A gold mine, Xanadu, operated by Chinese people, was worked later in the 19th century. The gold was in narrow quartz veins and extraction required a steam-driven mill. Trees were felled for fuel for the boilers and an aqueduct was constructed to carry water to the site from the Yass River.

When gold mining was no longer economical, the miners turned to ring-barking and clearing the regrowth resulting from their felling.

By the turn of the century there was a dairy farm working next door to what is now Talaheni. Milk was carried by horse back to Canberra.

Since the early 1900s wool production in the area proved to be profitable, with graziers over numerous decades achieving record prices due to the excellent quality of the fine wool produced from the area.

defined paddocks. Only one fence remains on its original alignment, the rest being pulled out and realigned to achieve the landscape separation we sought. A central laneway provides an efficient way to move stock around the property”.

Each paddock is now relatively uniform in landscape and soil characteristics such as slope, aspect and soil depth. Paddocks on the lower slopes and flats with deeper soils and more favourable soil moisture conditions now support productive exotic perennial species, primarily *Phalaris aquatica* pasture. The mid-slopes of the property support native perennial species, particularly pastures of weeping meadow grass (*Microlaena stipoides*). The hilltops, which 25 years ago only held a few aging trees that had survived earlier clearing, now have native tree vegetation cover.

This strategic design makes for easier decision making when selecting the best vegetation system and management for each paddock. In one case, fencing of a prominent hill to recognise different aspects has provided around four weeks extra green fodder for stock by preventing them abandoning the northerly area at the first sign of haying-off in preference for the increasingly more attractive southerly aspect.

John elaborates, “We divided a large paddock surrounding a hill into several smaller fenced sectors. Strategic grazing for short periods extends the productive grazing of the pastures by several weeks. Rather than allowing the stock to selectively and repeatedly graze the greener pastures, we can keep the stock on the more exposed side of the hill early in the season and move them sector by sector towards the more protected slopes as the pasture dries off”.

## Strategic Paddock Design and Management

The Talaheni landscape is composed of highly folded and deeply dipping Ordovician metasediments with rocky hills interspaced by contrasting weathered valleys. With this landscape, John and Robyn believed that good management called for the different landscape elements, for instance hills and valleys, to be fenced separately, so that management could be correctly targeted throughout the year to maximise pasture growth and grazing opportunities. John and Robyn have subsequently more than quadrupled the number of paddocks originally at Talaheni. Each paddock was strategically planned taking into consideration variation in slope, aspect, soil depth, geology and vegetation. Now with their own water supply, each of these is carefully managed.

John describes, “At Talaheni we have gone from a chequerboard layout of nine paddocks to 38 resource-



Sheep grazing patterns have been exploited to help regenerate hilltops during periods of drought



Strategic grazing enables pasture productivity to be optimised to match the seasonal conditions and herd and flock husbandry needs. The Ives employ brief heavy grazing, resting at least 25% of property at any one time.

John and Robyn's approach to managing drought is particularly interesting. They consciously determine which parts of Talaheni are least likely to degrade during these trying times.

John explains, "The silent partner [the land] suffers when the business is failing. This is particularly the case with drought. During drought periods, we move the sheep from the erosion prone areas, which are the more productive flats and mid-slopes, to hilltop paddocks that become 'sacrificial areas'. Here the stock are concentrated and hand fed throughout the drought. During this time the stock also eat out any remaining forage on these areas".

"The logic of our approach is that these areas are not as vulnerable to erosion because of their high-in-the-landscape position and stony nature even when almost bare, they are however the sites of high recharge potential and cannot support productive pastures. This may seem a detrimental management practice. Our decision to protect the more productive pastures on erodible soils from grazing pressure during these hard times enables them to respond quickly once the drought breaks."

With the onset of drought-breaking rains fuelling good pasture growth on the flats and mid-slopes, the hilltops are then destocked and stock moved down to these recovering areas.

"Grazing on the hilltops removes competition from grasses and forbs, leaving the seeds produced by the few remaining hilltop trees - which appear to have an innate ability to produce lots of seed in such periods - to germinate and establish with minimal competition. Given this setting, our experience is that eucalypt germination events are 'like the hairs on a dog's back'."

With stock numbers reduced due to the drought, such areas can then be spelled possibly for many months as flocks and herds rebuild away from these areas, allowing the young trees to become well established without any setback from grazing. If grazing is required from these areas then John and Robyn prefer to pulse graze with stock introduced at very high stocking rates for relatively short periods so they graze the re-establishing grasses and forbs but are removed before any permanent damage occurs to the trees.

## Reducing Salinity through Revegetating the Ridges

Talaheni comprises 250 hectares of rolling to hilly terrain. Prior to conversion to intensive grazing, the land cover was forest and grassy woodland. The main tree species were red box (*Eucalyptus polyanthemos*), red stringybark (*Eucalyptus macrorhyncha*), and brittle gum (*Eucalyptus mannifera*). The majority of pastures are native perennial grasses

John and Robyn believed from early on that they could reduce their salinity problems by lowering the water table through utilising more water higher on their property. Revegetating the ridges was seen as the way to reduce rainfall infiltrating to the water table. The water table would then be lowered to below the level where saline groundwater could seep to the surface on the potentially productive lower flats.

Over time, this technique has reversed the extensive dryland salinity that had appeared on the property over the previous decades. Without the surface saline seeps, the loss of vegetation cover has been repaired and sheet and gully erosion has reduced.



In 1982 (top), Talaheni was bare with visible saline seeps; in 2012 (below) revegetation has reduced salinity and pastures are healthy. Initial swales are visible across the lower right of the 2012 image



*Where there were insufficient seeds for natural regeneration, tree seedlings were planted, including species for possible timber production*

As part of their grazing strategy, the revegetation has been achieved by intensively grazing ridge areas to maximise ground disturbance and then removing the sheep for one to two years. Tree seeds can germinate readily on disturbed ground and have a chance to establish if the sheep are kept off for long enough.

Where there were insufficient remaining trees to provide seed, seedlings were planted in multiple row strips. The ground was prepared by ripping with a bulldozer to break open the rocky and compacted soils and to enable tree roots to penetrate. Species with potential for quality timber production were included in these tree belts so that, in the long-term, there would be scope for a potential additional source of revenue from timber.

Understanding the land and climate has helped John and Robyn exploit conditions, such as drought, to achieve their goals through grazing management. "While there is little one can do to influence the progress of a drought, we must remain vigilant and take full advantage of any benefits. For landholders wanting to increase tree cover on their properties, drought can get the green revegetation wheel rolling with very little effort when resources are

sorely stretched. This has been our experience during the dry times over the past 25 years. We estimate that we have established more than 200,000 locally native trees by exploiting seed production through the drought, with very little effort on our part", John says.

Any growth is also managed with strategic goals in mind. John explains, "Where we observe excessive re-establishment of tree seedlings on areas with pasture potential then these areas may be managed to remove or reduce tree cover. The approach used depends upon the size of the area and timing. Tools in the armoury include mattocking, spot spraying with herbicide, bull blading and stem injection of herbicide, either singly or in combination to spread the workload over time. Areas are assessed to identify the better soils and flagging tape used to distinguish 'good' from 'bad' areas for easier spotting when removing trees. Where more than one species has re-established, the composition of the stand can be influenced also at this stage. In our case, red box, when present, is preferred to red stringybark. Later still, selective thinning is employed to achieve a vigorous and more sustainable stand density while providing sturdy poles and timber for farm and off-farm use".

"Using this approach we have 'established' more than 200,000 trees at very little cost on most inhospitable sites. This compares with about 20,000 seedlings planted by hand, representing a labour intensive and timing critical process over the same period."

The hilltop trees now cover the areas with the highest recharge potential and as they grow they continue to "tighten the screw on the recharge tap" and reduce the incidence of dryland salinity on the lower and more productive flats enabling successful establishment of vigorous exotic perennial pastures.

It is estimated that each hectare of ridge top that was revegetated has led to a beneficial lowering of the watertable over 50 hectares of nearby adjoining flats, much of which is on neighbouring properties.



*The Ive's ridgeline regeneration success is apparent at their fenceline with neighbouring properties*

## Talaheni Soil

When John and Robyn purchased Talaheni 30 years ago the soil health was poor. Nutrient levels were low, as was pH, at around 3.6 in some areas. Soil carbon levels of below 1% meant infiltration and water holding capacity were poor. Aluminium levels were high. High groundwater levels led to saline seeps across a substantial proportion of the property and as a consequence, much of the property suffered from sheet and gully erosion.

Some of these aspects are a natural feature of Talaheni soils, which have been derived from nutrient poor Ordovician metasediments. Landscape cross sections range from ridge top lithosols passing through gravelly shallow red podzolics, to shallow to moderately deep red podzolics to soloths and solodics on the flats.

To improve the soil health, the Ives have added sulphur-enriched reactive rock phosphate and Canberra sewage ash and lime have been used to address pH levels. Poultry manure and gypsum have been applied to assist in improving soil physical properties. Combined with the benefits of increased ground cover and vegetation, soil phosphorus and sulphur levels have increased, as have soil carbon levels. In some of the healthiest areas, soil carbon has recently been measured at 4%. John and Robyn maintain soil nutrient status records, and have over 30 years of periodic sampling data.

## Talaheni Water

Talaheni has no permanent or ephemeral streams so water supplies depend on a network of dams and tanks on buildings. Construction of the dams was often associated with complementary contour and graded banks. Dams were frequently installed at points where serious gullies were previously active and have been made as deep as possible with as small a surface area as possible to minimise evaporation losses. Contour and graded banks control water movement through the landscape and reduce risk of soil erosion while increasing the opportunity for retaining water on property. Where limited cultivation has been undertaken, this has been done on the contour. Areas with high runoff potential on steep slopes have been ripped at intervals to a depth of 70cm to assist rainfall infiltration and ultimately pasture growth where salinity risk was low.

The low plant-available soil moisture holding capacity, averaging around 60mm, made it a priority to retain as much moisture in the profile where it falls for use by pasture. Accordingly, continuous groundcover has been

sought where possible. John notes, "A daily soil water balance - WATERBANK - model has been developed to give a greater understanding of the fate of rainfall and to aid routine management and timing of operations".

Improved soils and water monitoring helps the Ives to manage their variable annual rainfall, which, in the last ten years, has ranged from 363mm in 2006 to 967mm in 2010.

Saline seeps were previously common across Talaheni. High recharge on rocky ridge tops lead to expression of dryland salinity on potentially more productive lower flats. Consequently, water management was initially viewed as the most vital management challenge by John and Robyn. Now, their management of water tables has all but eliminated saline seeps.

The significant revegetation of Talaheni ridges has reduced rainfall deep drainage to the water table, lowering it to below the level where saline groundwater can seep to the surface. The installation of a network of piezometers (devices which measure groundwater pressure and water table height) more than 20 years ago and weekly monitoring has provided a great understanding of the response to this and other on-farm actions to reduce recharge. Documented evidence shows the significant decline in watertable levels and an equally impressive decline in salinity levels of groundwater.



*To minimise evaporation, dams were made as deep as possible with small surface areas*





Angus beef provides a supplementary production line to ultrafine wool

## Success At Home and Abroad

Production increases began to be experienced only a few years after John and Robyn commenced implementation of their plan to repair Talaheni. John summarises, "We started implementing the plan in 1980, and in terms of stock numbers there has been a steady rise since 1983 (trend line 0.15 DSE/ha per year increase). Wool production increase - taking into account wool cut and fibre diameter - has a trend line increase since 1985 at 38 units a year. Cattle weaning weight, adjusted for age, birth date, sex, age of cow trend line has increased at 1kg a year since 1985. These trends continue to the present, when seasonal impacts are removed. Visually change was apparent in 1984. With an above average season we managed to get good groundcover with gullies having been filled and contour and graded banks functioning to slow water movement through landscape".

A feature of Talaheni has been the protection of remnants of dry sclerophyll woodland, native forests which typically consist of multi-aged stands of eucalypts with an understorey dominated by hard leafed shrubs, grasses, sedges or bracken fern. The health of native vegetation has improved with major recruitment of new trees as result of the Ive's innovative management practices. Where seed trees do not exist, hand planting has been successful in establishing a corridor network of linking native vegetation.

Overall, around 20,000 native species trees have been planted over the past 30 years, plus an estimated 200,000 trees have been established naturally by the strategic grazing and rest management exploiting variable seasonal conditions. This technique has been documented and subsequently adopted by other landholders.

Measurement and monitoring are important features of the implementation of the Ive's plan for Talaheni. Transects have been established and vegetation periodically monitored. Regular bird surveys have been undertaken resulting in a current and growing inventory of 125 species. Third-party studies of native ant populations, which are bio-indicators, reveal healthy conditions. Fencing out of remnants and exclusion of domestic grazing together with establishment of linking native vegetation corridors continues to enhance the quality of animal and plant life in the region, and previously moribund trees have recovered.

**"One needs to develop the skills to read one's own landscape..."**

Initial large areas of serrated tussock (*Nassella trichotoma*) and black thistle (*Cirsium vulgare*) indicated degraded pastures. However over the years the Ive family have worked to improve the per cent of ground covered by pastures and to control major weeds using a targeted spraying program. In addition, every farm vehicle always carries a small mattock and a culture of digging out plants where ever seen during normal farm activities anytime throughout the year has been established.

Using this approach, major weeds found in the district such as serrated tussock, black thistle, fleabane (*Conyza sumatrensis*) and St Johns wort (*Hypericum perforatum*) are a relatively minor problem. John notes, "Although these weeds are not totally eradicated, due largely to wind-blown seed migrating from adjoining properties, control these days is a minor task".

The success of Talaheni has been widely recognised locally, regionally, nationally and internationally. Results from a number of collaborative on-farm trials with different agencies continue to be used to promote new or amended practices throughout the region and are the focus for regular on-farm field days.

John and Robyn have experienced the steady receipt of some 27 awards for farming achievements over the past 30 years - the most recent was National Carbon Cocky Award in September 2011. National and international press have carried stories of Talaheni - one article appeared simultaneously in New York Times and Chinese Peoples Daily.

As a result of such achievements, John and Robyn are regularly asked to provide on and off farm presentations to groups from across south eastern Australia and overseas.

They also serve on a number of industry and state committees dealing with resource issues, such as the AWI Wool Carbon Alliance.

John summarises, "The journey has been an immensely gratifying one as Talaheni has been transformed from an environmental and farming basket-case to an enterprise that attracts interest from near and far and continues to be recognised with the receipt of awards and invitations to present to farming and agency audiences across southern Australia".

### Words of Advice

John points out the importance of embracing change in improving land management practices, "People are reluctant to consider and embrace new approaches because of ingrained attitudes. In our view, change is inevitable. Successful land managers adapt by adopting production and land management systems appropriate to the circumstances, the markets and the environment. By resisting change and sticking with the old ways the silent partner, that is, the land, suffers".

John and Robyn believe that there is no single right way to improve land management. "Our desire is that people reading about Talaheni shouldn't consider Talaheni as a place for rote learning, but should study the principles and apply them to their circumstances." They recommend that, "One needs to develop the skills to read one's own landscape and the processes involved and then seek to address the limiting and declining factors supported by a sound monitoring program. Although this may draw upon experiences and recommendations of others, the adoption of established management approaches in a rote-like manner is fraught with danger and not encouraged".

Likewise the term 'best practice' is not encouraged by John and Robyn due to the finality it implies. They say, "Rather, practices should be seen more in the dynamic vane of a rainbow - although always in sight, they remain elusive but tantalisingly achievable as new and better understanding moves the destination".



# Pasture cropping the way to health



Winona, NSW

## WINONA

### Farm Facts

20km north of Gulgong, NSW Central Highlands

**Enterprise:** Sheep. Crops. Native Grass Seed. Kelpie Dogs.

Merino sheep, rams and wool; grain crops

**Property Size:** 840 hectares

**Average Annual Rainfall:** 650 mm

**Elevation:** 460-580 m

### Motivation for Change

- Loss after major bushfire necessitating establishment of a low-input agricultural system

### Innovations

- Developing and implementing 'pasture cropping'
- Time-controlled rotational grazing
- 'Vertical Stacking' of enterprises – cropping, native grass seed, sheep wool and meat
- Innovations commenced: Time controlled grazing **1989**/Pasture cropping **1993**

### Key Results

- Annual input costs reduced by over \$120,000
- Soil carbon increased by 203% in 10 years
- Delivering three production lines from each paddock
- Improved wool quality



Colin Seis faced adversity and then struck 'gold' in developing a new way to look after the land and his bottom line - building tonnes of soil along the way.

The management of Winona from 1930 to 1980 turned out to be an ecological disaster. Loss of land to salinity, declining soil quality, dead and dying trees, insect attack, fungal and animal diseases, plus the high cost of fertilisers, herbicides and other inputs showed the suffering of an unhealthy system. In 1979 a devastating bushfire left no choice but to change the way things were done.

In developing 'Pasture Cropping' Colin Seis found a way to work his pastures, crops and sheep together and healed his land. Now, Winona produces similar volumes of wool and grain to that achieved under previous management methods, but annual costs have decreased by over \$120,000 and the condition of the land is improving, not degrading.

By applying regenerative forms of cropping and grazing, Colin has achieved a 203% increase in soil carbon in just ten years. The vast majority of the soil carbon is highly stable (non-labile), meaning it is significantly less subject to degradation, and carbon is being built and measured to a depth of 500mm

In addition to being able to pass on a productive and sustainable farm to the next generation, Colin feels a well-deserved sense of achievement at having developed an innovative farming method that is being adopted by thousands of other farmers in similar climates and soil landscapes all over the world.

Contact Colin Seis: [colin@winona.net.au](mailto:colin@winona.net.au)



### Pasture Cropping

Pasture cropping is a technique developed by Colin Seis and Daryl Cluff in 1993 which involves sowing crops into living perennial pastures and growing them symbiotically. In a mixed farm enterprise it seeks to combine cropping and grazing into one land management method where each one benefits the other.

In 1993, the original concept of sowing crops into a dormant stand of summer growing native grass, red grass (*Bothriochloa macra*), was thought of as an inexpensive way of sowing oats for stock feed. While this certainly turned out to be true, many side benefits were also identified. The grazing crops performed so well that it was obvious that good grain yields could also be achieved. The initial concept was only touching the surface of a land management technique that is proving to be revolutionary.

Conventional cropping methods require that all vegetation be killed prior to sowing and while the crop is growing. With pasture cropping, there is no need to kill competing ground cover vegetation for cultivation, and adequate productivity can still be achieved. Groundcover is maintained at all times so that erosion by wind and water is avoided, soil structure is not destroyed by cultivation and chemical input requirements are only a fraction of those used in traditional crop production methods. 'No till' cropping, in contrast, also minimises soil disturbance, often with direct drilling of seed, however it is not performed in combination with a perennial pasture, but more usually into the stubble of previous crops.

Sowing a crop using the pasture cropping method also stimulates perennial grass seedlings to grow in numbers and diversity. This then produces more stock feed after the crop is harvested and totally eliminates the need to re-sow pastures.

Economically, this technique provides good potential for profit as input costs are a fraction of conventional cropping methods. The added benefit in a mixed farm situation is that up to six months extra grazing is achieved with pasture cropping as no grazing time is lost due to traditional ground preparation and weed control requirements.

There is growing evidence, scientific and anecdotal, to support pasture cropping's contribution to improvements in soil health, improved water use efficiency and general improvement in ecosystem function. By retaining perennial native grass in grazing and cropping systems and having full ground cover all of the time, large increase in plant biomass can be achieved when compared to conventional methods. When combined with plant root functions, this

biomass can dramatically increase soil carbon levels and improve nutrient cycling within the soil.

This technique has been trialled, practiced or adopted across Australia and in other countries where regions share similar climate and soil landscapes. Colin reports, "There are now over 2000 farmers "pasture cropping" cereal crops into summer (C4) and winter (C3) perennial native grass in NSW, South Australia, Victoria Queensland, West Australia and Tasmania as well as other areas around the world".

Pasture cropping is also being used to restore native grasslands in many areas of Australia.



Pasture Cropping: emerging grain seedlings in dormant perennial pasture, the growing crop and harvesting

## How It All Began

The Seis family has farmed at Winona since the 1860s. Colin's great grandfather initially selected a small allotment to which other allotments were added over the years to eventually form the current 840 hectares. Colin took over management of the Winona from his father in the 1970s, and now, Colin's son Nick performs much of the day-to-day management.

Ranging from valley floors and gentle slopes rising to granite outcrops on hilltops and ridges, the predominant soils on Winona are well-drained coarse and fine sands derived from granite. There are yellow sodic (high sodium) soils along drainage lines and eucrozems (deep red clay loams) that developed on an area of basalt at the southern end of the property.

When the Seis family selected the first allotment in 1860, survey reports described the area as woodland, suggesting that the land cover was grassland with scattered trees. It is likely that there were over 100 native grass, forb and herb species, with the grassland dominated by kangaroo grass (*Themeda australis*). While little tree clearing was probably required to develop the land for farming, the change in management soon led to widespread tree regeneration. Title deeds dated 1906 record the presence of stringybark saplings. Colin's father recalled considerable ring-barking occurring when he was a boy in the 1920s, indeed, one paddock is still referred to today by the name of the man employed at the time to ring-bark trees. Colin's father also recalled that there were sparsely scattered large trees within the saplings. The large trees were retained and some remain today.

From the 1930s to 1980, the farm was used for wheat, oats, wool and sheep production. Pastures of introduced grasses, mostly annual species (sub clover, rye grass, small areas of lucerne), were established. Set or continuous stock grazing practices were used. Crops were sown every three to five years, depending on soil moisture, by ploughing and working the soil up to five times. Crop yields during this period were good, with yields of over three tonnes a hectare being achieved.

## Declining Health

Associated with these management practices the soils were showing excesses of aluminium, iron and sodium. Soil carbon levels were around 1% in the 0-10cm range with observed inefficient nutrient cycling. To sustain agricultural productivity it was necessary to apply high rates fertiliser to correct phosphorus, molybdenum and calcium deficiencies.

**"Inappropriate grazing techniques have done major damage to Australia's grasslands and rangelands over the last 200 years. Animals can be beneficial, if they are grazed well."**



Top: Grazing on Winona 1938  
Below: Grazing on Winona 2009

Colin recalls, "While superphosphate was cheap and subsidised by government during the 1950s and 1960s this high input method was very productive, but at great ecological cost such as declining soil health, soil carbon loss, soil structure decline, saline areas and dysfunctional landscape".

He notes, "As superphosphate became more expensive and the government subsidy removed this high input system could no longer be afforded. The high cost of fertilising pasture and farm inputs was around \$121,000 annually - in 2011 dollars, including wages".

Chemical inputs were high. Constant drenching was practiced to remedy worms in sheep. Coccidiosis and pulpy kidney in lambs were also common and sheath rot and scours were an ongoing concern caused by high nitrate levels in the pasture. Insect attack on crops and fungal disease were common in crops and pastures and were controlled by using insecticide and fungicide.

Over these years, mature trees were dead or dying and perennial grass species were declining in numbers in the intensively managed lower slopes. Annual weeds such as Paterson's curse (*Echium plantagineum*), capeweed (*Arctotheca calendula*), Bathurst burr (*Xanthium spinosum*) and saffron thistle (*Carthamus lanatus*), were invading, symptomatic of the poorly structured, bare soil. Introduced birds such as sparrows and starlings were commonplace and there was a lack of native birds.

Ultimately the management practices destroyed the native grassland and led to serious salinity problems. The lack of perennial vegetation allowed groundwater levels to rise, bringing salt to the surface in lower lying parts of the farm. The resulting in high soil salinity degraded the soil structure and restricted plant growth, leading to major gully erosion.

## No Choice

In 1979 a major bushfire resulted in the loss of over 3000 sheep and most of the farm infrastructure - house, sheds and fencing. The lack of income prevented re-establishing the previous high input cost cropping method. So, after the fire, Colin started looking for a low input agricultural system. He set about understanding the ecological function of the landscape he had inherited and had managed using practices learned from his father. Faced with the challenge of matching inputs to outputs, Colin began exploring alternatives to the traditional farming system and the likely impacts on his farm's economics.

He realised that native grassland did not require high levels of phosphorus and started to develop methods that would stimulate seedling recruitment of native grass species. He sought to restore Winona to native grassland that did not require inputs like superphosphate and would function in an ecologically sound manner. Colin summarises, "If you get out of the way and let nature fix it, it works better and is much easier".

Colin notes that tradition was arguably the greatest impediment to change. In spite of requesting assistance from scientific and research organisations, they were not interested in developing a pasture cropping management

system. Representatives of these organisations told Colin that it was impossible to grow crops in this manner.

Instead, over a period of 20 years Colin developed the pasture cropping technique by trial and error on Winona. He has spent much of his time perfecting this technique and can now grow many different types of winter and summer growing crops, without destroying the perennial pasture base.

## Pasture Cropping on Winona

Colin originally started time control grazing in 1989 to better manage pastures, but it was not until he and Daryl Cluff developed pasture cropping in 1993 that Colin saw dramatic improvement in the regeneration of native perennial pasture species.

Colin now sows commercial crops into the dominant pasture by direct drilling to minimise soil disturbance. Sheep are used to prepare paddocks to pasture crop and crops are sown, usually with no herbicide and 70% less fertiliser than conventional methods. Only relatively small amounts of liquid organic fertiliser are added at the time of sowing, using the same machine, so that tractor costs and soil compaction are minimised.

Livestock are an intrinsic part of Colin's pasture cropping system on Winona. Before sowing, when perennial pasture species are dormant, short term time-control grazing with a large mob of sheep (100-150 a hectare) is used to graze and trample perennial pasture down to a height of

"...get out of the way and let nature fix it..."



Native pastures on Winona are grazed by sheep and, when dormant, direct drilled with crops







Single trees are being planted in paddocks to restore original vegetation cover

around 100mm. This practice prepares the paddock for cropping by reducing the starting biomass and physically breaking down weeds, creating a litter and mulch layer and adding nutrients from manure and urine.

Sheep can lightly graze the growing grain crop after it has become established but before it begins to develop seed.

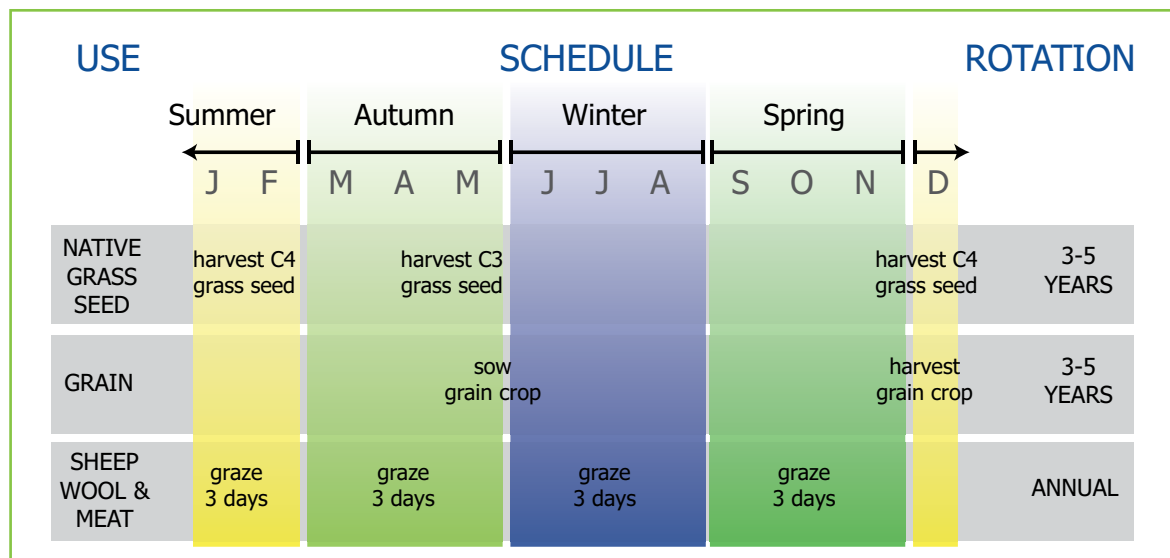
Once the crop is harvested sheep are reintroduced for a short period to take advantage of the native pasture that has been re-growing while the crop was maturing. Grazing tolerant native grass species such as red grass

(*Bothriochloa macra*) and spear grass (*Austrostipa spp*) are gradually being replaced by more productive species such as warrego summer-grass (*Paspalidium spp*) and wallaby grass (*Austrodanthonia spp*). Significant areas of winter active species such as common wheat grass (*Elymus scaber*) and weeping grass (*Microlaena stipoides*) are returning.

Pasture cropping enables integration of sheep and crop production, optimising production of both while minimising chemical inputs and machinery use and improving soil structure and fertility.

Sheep are managed in two main mobs of 2000 head and rotated around 75 paddocks in a time-control grazing technique. Introducing time-control grazing necessitated a denser pattern of fencing to increase the number of paddocks from 10 to 75. A central laneway provides an efficient way to move sheep around the property. Over 70 small dams supply stock water as there are no creeks

## VERTICAL STACKING OF ENTERPRISES ON WINONA



Vertical stacking enables three uses of the native grassland in each paddock - native seed harvesting, grain cropping (oats and wheat) and grazing sheep for wool and meat. The three land uses are rotated seasonally, annually and every 3-5 years, depending of the prevailing seasonal conditions such as soil moisture, rainfall and temperature.

Native grass seed is harvested in summer (C4 species) and autumn (C3 species). Grain crops are direct drilled into the winter dormant native pasture at the end of autumn and harvested in summer. Sheep graze each paddock once each season, approximately 3 days every 90 days, the highest frequency of the land use rotations.

or rivers on Winona. These dams have high water levels and are maintained mainly through lateral underground flow. The combination of the soil type and maintaining a complete groundcover ensures that all rainfall infiltrates.

Colin recognises that trees provide stock shelter and that it is essential to replace the old paddock trees that are nearing the end of their life span. He has planted over 2000 single paddock trees, aiming to restore the original 1860s cover, estimated to be about two trees a hectare. As they establish, the single trees are protected from stock with guards. In addition, around 15,000 local native trees and shrubs have been planted in belts to form wildlife corridors and to link areas of remnant native vegetation.

Colin is deservedly proud of the technique he developed, noting its strengths, "With pasture cropping it is now possible to produce an annual crop like wheat and a perennial grain crop for human consumption off the same area within a twelve month period. Added to this is the grazing value of sheep meat and wool as well as native grass seed and carbon sequestration".

"I believe that this technique of using 'vertical stacking' of enterprises on the same area over the same time period has potential for addressing world food shortages into the future."

#### SOIL CARBON LEVELS ON WINONA

Increase in soil microbial numbers and species diversity has resulted in better nutrient cycling and greater potential for increasing soil carbon. Soil tests conducted in September 2010 revealed the following carbon levels at the various depths:

Depth	Soil Carbon Level
0-10 cm	2.65%
10-20 cm	1.35%
20-30 cm	1.18%
30-40 cm	0.53%
40-50 cm	0.26%

## Health Restored, Benefits Accrued

Extensive soil testing on Winona has shown that eliminating all cultivation other than the direct drilling for pasture cropping, together with rotational grazing, has enabled dramatic improvements in soil condition. Soil carbon has increased by 203% to 90 tonnes a hectare over a ten-year period. This equates to storage of around 170 tonnes of CO<sub>2</sub> (equivalent) a hectare.

Seventy-eight per cent of newly sequestered carbon is in the humic fraction of the soil<sup>1</sup>. This is non-labile, therefore much more stable and significantly less subject to degradation.

All soil nutrients have increased by an average of 172% in available and total amounts, except for aluminium, iron and sodium, which have decreased. Compared to regular cropping, pasture cropping soils show an increase in actinomycete (bacteria which have a role in decomposition of organic materials) and fungal abundance consistent with less disturbance and/or with greater perennial basal cover and litter cover. These impressive results have been validated through a paired site analysis by Sydney University and CSIRO/Department of Primary Industries<sup>2</sup>.



*Soil from a conventionally grazed and cropped paddock (right) and from a time-controlled grazed and pasture cropped paddock (left) which contains significantly more microbial life, soil carbon and subsequently greater water holding capacity*



Colin notes that his landscape has developed a real resilience, with relatively stable production regardless of rainfall. "Over the last ten years, we have experienced five years of above average rainfall and five years below. A new rainfall pattern has emerged that sees 70% of our rain falling in the summer months, whereas before it was closer to 50%. In the poorer years, no 'drought' feeding has been required, due to the resilience in the pastures from the improving soil conditions."

Many biodiversity improvements are apparent since the changes to management of Winona. Vegetation changes are being monitored on six 100 metre long survey lines (transects). Winona was once dominated by annual weeds and the transect counts from 1999 showed 60% weeds and 10% native perennial species in the pasture. Transects now show 80% perennial native species and 5% weeds. Winona is now a diverse, functioning native grassland with over 50 native species.

As Colin points out, this change was created, not with herbicides, but with groundcover. "Providing the conditions for perennial pasture species to thrive will steadily suppress the weeds. Using herbicides can help in some circumstances but can also kill desirable species, such as the perennial pasture species."

Tree health has improved and the remaining naturally established trees are regenerating.

Monitored bird numbers and diversity includes around 100 species. Sparrows and starlings that were common prior to 1990s are no longer observed on Winona. Few marsupial species were observed prior to 1990s and now marsupial diversity has also increased, including grey kangaroos, swamp and red necked wallabies and wallaroos.

A large increase of spiders in pastures has delivered a more stable balance to the insect populations and provided biological control of problem insects like red leg earth mite.

Whilst crop production on Winona has remained about the same, averaging two tonnes a hectare but producing up to four tonnes a hectare, the cost of growing the crops has reduced significantly; in the order of \$120,000 a year.

Additionally, Winona now produces and sells about one tonne of native grass seed annually to farmers and for landscape rehabilitation. Colin is also investigating the economics of harvesting and marketing of two native grass seeds for human food consumption.



*Healthy soils are clearly apparent under the diverse native vegetation cover on Winona*

Pasture cropping enables extra grazing of up to six months on Winona's mixed farm enterprise. No longer having to re-sow pastures saves \$100 - \$150 a hectare per year

Wool and sheep production has also remained about the same, however wool tensile strength has improved by 60% and vegetable matter such as burr and seed in the wool has declined by around 70% making both the wool and sheep more valuable.

Colin says that being able to measure and monitor on his farm has been very important, "Carbon and soil nutrients, plant and ground cover transects as well as sheep and crop monitoring has been very beneficial in observing the positive change forward".

Education is also seen essential to bringing positive change. Colin states, "We require more farmer educators. Farmers should empower themselves with knowledge." Colin devotes a lot of his own time running courses, workshops and providing training on pasture cropping across the country, encouraging experimentation with or adoption of this innovative technique.

Overall, the development and implementation of pasture cropping has restored the landscape health on Winona. Re-establishing native grasslands through methods working with nature, ensuring ground cover at all times, rather than trying to control it through use of herbicides and fertilisers has delivered its rewards to Colin Seis.

In his words, "As we farm closer to how nature had it originally designed, the easier the workload becomes and the more profitable it can be."

<sup>1</sup> Jones, C.E. (2011). *Carbon that counts*. New England and North West Landcare Adventure, Guyra, NSW,

<sup>2</sup> Ampt, P. and Doornbos, S. (2010) *Communities in Landscape Project: Benchmark Study of Innovators, Gulgong, Central West Catchment NSW*, <http://cil.landcarens.org.au/prs/reports>





# Putting life back into the soil - humus compost



## MILGADARA

### Farm Facts

20km east of Young, NSW South West Slopes

**Enterprise:** Crops. Sheep. Compost.

Cereal, canola and legume crops; prime lamb production; humus compost

**Property Size:** 1182 hectares

**Average Annual Rainfall:** 600 mm

**Elevation:** 386 m

### Motivation for Change

- Health concerns and disillusion with 'chemical' farming

### Innovations

- Development and application of humus compost
- Focus on soil structure, biology and mineral balance
- Legume under-sowing of crops
- Innovations commenced: 2001

### Key Results

- Restored soil health
- Increased wool staple strength and lambing percentages of up to 150%
- Increased crop yields with reduced inputs; pest and disease free
- Established compost business with client base of over 2000



**B**ill and Rhonda Daly are producing sweet smelling and fertile soils after investing in understanding their landscape and producing humus compost to attain profitable biological agriculture.

Bill and Rhonda Daly transitioned from a farming system that was well known to them but causing a deal of discomfort, to one that is building the natural resource base and delivering great personal rewards. The Dalys rely on an extensive understanding of the potential of the landscape, in particular a profound respect for their soils. In 'reading' what is happening on their property, through the health of their animals, pastures, cropping activity, soil, water courses and vegetation, they now find they can be proactive in their management and anticipate what needs to be tackled to achieve their aims. This is a big step from their approach to farming prior to 2001 when they acknowledge that they were essentially reacting to weed and pest problems, increasing inputs with limited productivity gain and sensing that they were doing more harm than good to their environment.

Bill and Rhonda have invested in educating themselves in grazing management, minimum till cropping and, in particular, the role of humus compost in promoting beneficial soil life. Production increases were experienced within six to nine months of adopting changes on their property. The Dalys have now included a commercial composting operation on their farm and have helped others establish their own composting operations in over 42 regions across Australia and New Zealand. In addition to providing diversity in their income stream, the results from using humus compost on their farm are clearly positive and for all to see.

Contact Bill and Rhonda Daly: [rhonda.daly@yladlivingsoils.com.au](mailto:rhonda.daly@yladlivingsoils.com.au)

## About Milgadara

The Dalys are the fourth generation on Milgadara, which is located about 20 minutes outside of Young, NSW. The 1182 hectare property has a south westerly aspect and the landscape consists of soft rolling hills. Their north eastern boundary is bordered by the Douglas Range which forms 200 hectares of the property.

The open country is lightly timbered with trees consisting of stringy bark (*Eucalyptus macroryncha*), white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*), red gum (*Eucalyptus blakelyi*) and rough-barked apple (*Angophora floribunda*). Thirty hectares have been reforested to form shelter belts for stock and increase biodiversity for protection of native fauna.

Prior to cultivation the landscape had outcrops of eucalyptus with native grasses such as red grass (*Bothriochloa macra*) and wallaby grass (*Austrodanthonia spp.*). Pastures comprised annual rye grass (*Lolium multiflorum*), sub clover (*Trifolium subterraneum*), some *phalaris* and cape weed (*Arctotheca calendula*), and species diversity was low. There was relatively low weed pressure, only a few thistles, marshmallow (*Malva parviflora*) and cape weed. Army worm, red legged earth mite and other pests and weeds were sprayed with chemicals for control.

The property relies on natural rainfall and dams for water supply. There are natural underground water streams, accessed by windmills and bores.



'Milgadara'

## Previous Production Practices

Prior to 2001 Bill and Rhonda ran a mixed farming enterprise of a self-replacing merino flock, prime lamb production and backgrounding of steers. They used set stocking and their regime included autumn lambing and early spring shearing.

Crops were managed as a rotation of oats, wheat, lupins, wheat, and canola, using four passes of cultivation and sowing with a tyned instrument. Fertiliser programs were based on using 100kg of mono-ammonium phosphate (MAP), 100kg of anhydrous ammonia gas and urea a hectare and stubble burning. Rhonda describes that production practices were reliant on "an overuse of chemicals".

**"Fertility was just geared to growing a crop, not sustainably managing the soil to improve overall fertility for future generations."**

"This business model led to the mining of our natural resources, destruction of soil structure - greatly diminishing the capacity of the soil to support soil life - as well as making roots unable to penetrate and deliver nutrients to the plant. Minerals were imbalanced and there was low enumeration of microbes", remarks Rhonda. "Fertility was just geared to growing a crop, not sustainably managing the soil to improve overall fertility for future generations."

She continues, "Lack of diversity did not allow for natural cycles. An increase in applied fertilisers led to a 'watery' plant, increasing both pest and disease issues. There were declining fertility parameters, particularly soil humus and ever-increasing soluble minerals inputs. Ever-increasing amounts of chemicals were being used to control weeds, disease and pests. Nutrient lock-up, leaching and evaporation of nutrients were all occurring".

In time, the Dalys reliance on inputs of fertiliser, particularly nitrogen and phosphorus, resulted in increasing problems of more weeds, diseases and pests and correspondingly, low yields and profitability. There was a total dependence on feeding the crop and pasture rather than recycling nutrients and fixing atmospheric nitrogen.

Bill and Rhonda suffered increased personal stress due to the higher impact from drought, lower yields and animal health problems. They both note that it was "a downward spiral".





## Making the Change

The Dalys initially began questioning the direction of conventional farming in the mid 1990s. In searching for alternative approaches, Bill attended a bio-dynamic course in 1995. However, bio-dynamics was considered very 'new thinking' and it was not until 2001 when Rhonda was diagnosed with chronic meningitis and heavy metal poisoning that their questioning of what they were doing came to a head. The Dalys say that it was, "A guided message 'to heal the soil and help others'" that was the catalyst for change.

A combination of thoughts contributed to their desire to change their practices. These included concern about how much farm waste was being burnt rather than being utilised to produce fertiliser for use back onto local soils; disillusion with chemical farming and ever increasing fear surrounding its use; and a sense that they were being sold more 'bandaids' to fix things that did not work, rather than address the underlying cause of the problem.

Rhonda says, "We needed to get the eco back into agriculture, not agribusiness. Fundamentally we were greatly concerned about the future sustainability of our farm and children and wanted to adopt a more 'holistic' approach".

Their overall approach was founded on achieving success on three levels - environmental, financial and social – and they now strive to achieve this balance across everything they do.



*Healthy waterways are now a feature on Milgadara*

## Restoring the Soils

The soils on Milgadara are granodiorite soils, with sandy loam and a cation-exchange capacity (CEC) varying from three to seven. Soil organic matter had previously been measured at 1.5 to 2.5%.

Due to over-tillage and other conventional farming practices, soil humus levels had declined to a point where soils had become compacted and lifeless. A hardpan had been created at a depth of around 20cm. Low ground cover and the tight compacted soils created runoff and low water infiltration. Contour banks were built to stop excessive runoff and erosion. Practices such as stubble burning and the use of nitrogen gas resulted in no visible signs of earthworms and soils did not smell sweet, meaning low microbial activity in the soil.

In March 2001, 14 soil tests of cropping paddocks were undertaken and independently analysed. The results indicated that the soil nutrients were imbalanced.

**Soil Nutrient Balance 2001**

Low	High
Calcium	Potassium
Magnesium	Iron
Phosphorus	Aluminium
Zinc	Hydrogen
Copper	
Boron	
Sulfur	

The Dalys undertook extensive education to understand how to balance soils, creating greater soil pore space for oxygen and water, enabling the chemical and biological aspects to function to their potential. This also provided an understanding of the function of trace minerals in enzyme production and animal health. Their expertise in 'reading' soil health had begun.

Further study was undertaken in the United States in the Advanced Composting System (Humus Technology®) to produce humus compost and extracted compost tea from local waste.

This set the new direction in overall farm management.

Cropping management was overhauled to change to 'thoughtful tillage' or No-Till, stubble retention, reduction and buffering of soluble 'down the tube' fertilisers,

introduction of Microbial Liquid Injection system and introduction of biological fertilisers and inoculums.

The Dalys moved away from monoculture crops on the 350 cropped hectares of the property, and instead began under-sowing legumes such as clover under crops to supply nitrogen. A focused effort was made to reduce chemical use. Instead, they considered what had led to the problem and what might provide alternatives to using chemicals.

The key innovation implemented intended to restore humus back into the soils and restore the natural biological balance to soils. Rather than what seemed to be a total focus on the chemical dimension of soil fertility, they set about developing humus compost to build productive soils by impacting all three aspects: chemical, physical, and microbiological.

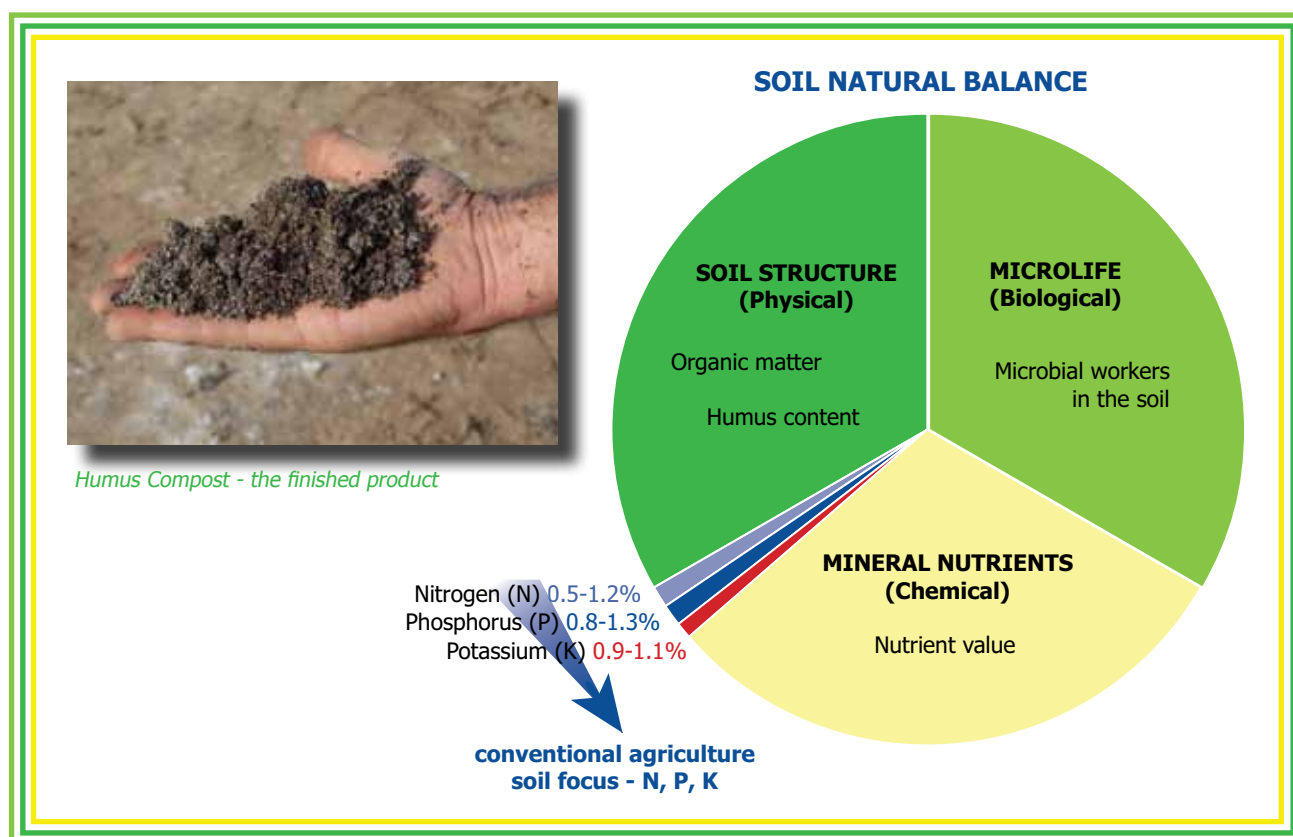
The Dalys follow a specific process in making their compost. Compost materials are combined to ensure a carbon to nitrogen ratio of 25-30:1. This ratio enables the correct temperature and carbon dioxide cycle, ensuring pasteurisation of any e-coli, salmonella and weed seeds.

Feedstocks are tested for heavy metals prior to use and excluded if measurements are too high.

Application rates of humus compost for broadacre farming are around 500kg a hectare. The improvement in soil structure and plant health does not come from the quantity of compost applied, instead, it is a catalyst that supports natural system functioning. The humus compost application rate for vineyards, fruit production or vegetable production is greater, at two tonnes a hectare as these crops have higher requirements.

Rhonda points out, "Humus improves soil structure by aggregating soil particles and stimulating soil microbes to do the same. Improved structure allows air and water to enter the soil, and allows roots to access more water and nutrients".

"Humus buffers the reactions of minerals and nutrients in the soil, preventing losses through tie up, leaching and volatilisation. Minerals are made available to the plant and microbes in the right quantities, leading to healthy balanced plants and efficient use of inputs. Humus also reduces the effects of salts and toxic chemicals in the soil."



Rhonda describes the humus compost as being packed with a diverse range of soil microbes, along with their food source and their home. The Dalys have experienced that, with a little encouragement, the soil microbes perform a wide range of functions that will improve crops and pasture health – nutrient availability, nitrogen fixation and disease suppression.

The success of their compost regimes on Milgadara enthused the Bill and Rhonda to establish a commercial composting operation, *YLAD Living Soils*. Involving up to two full time compost makers, the Dalys now have a client base of over 2000 people.

## Soil Outcomes

Since 2002 Milgadara has seen a significant improvement in soil structure to a tilthy, well aggregated soil with higher humus levels. Rainfall that is received penetrates further into the soil profile and is retained in the soil for longer. Any excess now flows through the profile without taking nutrients with it. This provides a strong example of how water can be best conserved and used by plants and animals where it falls, reducing the amount lost to run off or evaporation. Increased infiltration and retention is also important, as average rainfall in recent years has varied from as little as 187mm in 2006, to 680mm in 2011.

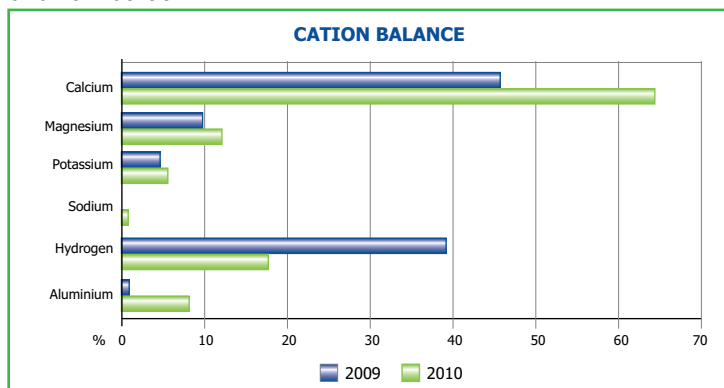
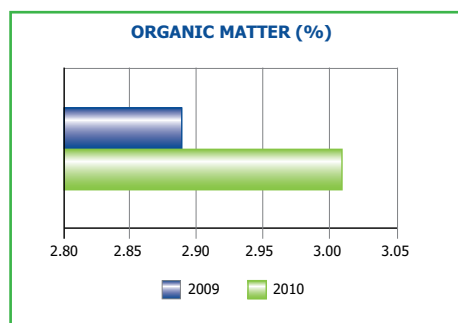


*Crop stubble is now retained to be broken down on the soil  
Inset: Soil fungi at work*

## PINE HILL TRIALS

Pine Hill is a paddock on Milgadara that runs off the Black Range with a westerly aspect. The light sandy low CEC soil (CEC 4.03) prior to the trial was compacted, lifeless with low fertility. Pastures were very sparse and of low nutrient value to animals.

Within two years of spreading YLAD Compost Mineral Blend, using the YLAD Down the Tube granular fertiliser blend at 94kg/ha and biological liquid injection and full stubble retention, the soils have now become soft and well structured with no hardpan, and with visible earthworm and fungal activity. Independent soil tests indicate that mineral balance has improved. The sewn pastures are thriving and full of nutrition.







*Soil on Milgadara has a vastly improved structure, mineral and biological balance*

Rhonda says, "By balancing soils with humus compost mineral blends we have been able to achieve the ideal mineral balance, creating aggregated living soils. As humus has the greatest magnetic attraction to minerals known to man, when minerals are blended with humus compost, nutrients do not leach or lock up but stay available for plant uptake".

"The addition of trace minerals is essential for enzymatic reactions in the soil. Overall mineral balances have nearly reached ideal balance. Earthworm activity has increased and visible signs of soil fungi present. Soils are now sweet smelling and stubble residues are breaking down rapidly. Organic matter levels have increased to two to four per cent."

"The cation-exchange capacity of the soil has increased creating a greater store of nutrients."

## Production Outcomes

Complementary to their education on soil and humus compost, Bill and Rhonda attended the RCS course on stock management and grazing practice. Now, in addition to the overhaul of the cropping management, closer monitoring of pasture is now performed to determine stock movements. The Dalys run a self-replacing merino flock on Grogansworth bloodlines and undertake prime lamb production using crossbred ewes and merino ewes with Dorset Sire. Lambing has now been changed to early spring with shearing in late winter. Bill and Rhonda also background weaner cattle from time to time.

The carrying capacity of the farm has increased. Lambing percentages are up to 150% in cross bred ewes and 120% in Merino ewes. Staple strength of wool has improved with nothing measuring under 36 Newtons per kilotex (N/tex). Wool buyers are now sourcing the Daly wool due to its increased quality.

Bill points out, "We now have more diverse pasture species, including bi-annual and perennial. Species include cocksfoot, fescues, perennial rye, lucerne, clover, plantain, and chicory. With rotational grazing management pastures are now becoming stronger and more diverse with less weeds".

With the reduced use of pesticides, fungicides and herbicides, an increase in the biodiversity of beneficial insect populations as well as native fauna has been observed. Mulching of weeds prior to seed set has reduced weed pressure. Soil structure improvements have changed the environment making the conditions not conducive to certain weeds, particularly tap rooted weeds. There is now minimal spraying for weeds, only to manage annual rye grass in cropping, and no spraying for pests.



*Lambing rates and wool quality have both improved*



The Dalys cite some of their other production highlights as:

- ◆ Producing crops with less soluble fertilisers with higher yields and higher quality.
- ◆ Crop yields have increased with no spring application of urea, however protein levels are higher than under the previous conventional approaches of the 1990s.
- ◆ Canola yields up to 3t/ha and 47% oil using only 14 units of N as well as biological nitrogen fixing products.
- ◆ Wheat crops now yielding 5-6 t/ha with less fertilisers.
- ◆ Independent trials have shown an increase in biomass, tiller count, yield and protein using microbial liquid injection at sowing.
- ◆ No signs of disease in any crops, no striped rust, black leg, rhizoctonia or sclerotinia.
- ◆ No pests or insects that are causing damage or reducing production.



*The commercial compost operation*

## The Value of Humus

The Dalys experience has demonstrated the ability of humus compost to restore and expand biological activity in the soil, further enhancing the physical and chemical properties while reducing soluble fertilisers and chemical inputs. They believe that improving their soils has been their major achievement.

In 2011, the overall profits of the business had increased over 30% in the previous twelve months. Bill notes, "With nine years of drought from 2001 to 2010 the business profits were still increasing each year. More enjoyment is now gained from farming".

The opportunity to help others in understanding how their farming enterprise can be enhanced and how to bring soils to life provides a sense of fulfilment for the Dalys. The social importance and community benefits that come from the ability to produce more nutrient dense food with less soluble fertilisers and chemicals is also a satisfying outcome.

"If necessary we could totally produce all required fertiliser inputs on our farm, for our farm, by turning local waste into humus compost. Knowing we can be self reliant is very satisfying", Bill says.

A lot has been invested into the management changes at Milgadara, and learning the technology to produce humus compost and humus soil fertility has required concerted effort. Education has continued over the past ten years and would amount to over \$100,000 including over 15 trips to the United States for study, and courses including RCS, Soil Foodweb and Nutri-Tech Solutions.



*Pasture diversity in the sown pastures*

**“We succeeded through courage, passion, trial and error and never giving up.”**

“By increasing our knowledge we have been able to pass on ‘know how’ to other farmers at much less cost to them”, Rhonda notes. Bill and Rhonda introduced Humus Technology® into

Australia in 2006 and have now set up 42 composting operations throughout Australia.

On farm, Bill and Rhonda have also invested around \$150,000 in purchasing an Aeromaster PT-170 Compost Turner and Water System to establish their commercial composting operation.

One of the biggest challenges to Bill and Rhonda has been having the courage to stay true to their beliefs regardless of others’ opinions. “We succeeded through courage, passion, trial and error and never giving up.”

Performing trial work to evaluate the benefits of the system and innovation was important. “Ideally we would have started earlier and not bothered about buying more land to expand, just improving what we currently own to increase productivity”, Rhonda notes.

The Dalys would encourage others to consider the benefits of nurturing soil microbiology for increased production. They strongly acknowledge the benefits they have attained through creating their own fertility product from local waste residues to support local food production naturally.

“We could not be happier with the improvements and successes we have introduced. Of course changed management practices have enabled all systems to work together”, Rhonda says.

“By allowing plants to grow and reach their full potential without forcing them has shown profound benefits that can be adopted by all farmers around Australia in any enterprise.”





# Higher quality food through regenerated soils and reduced inputs



## INVERARAY DOWNS

### Farm Facts

10km south of Spring Ridge,  
NSW North West Slopes and Plains

**Enterprise:** Crops. Cattle. Compost  
Irrigated grain, seed and legume crops; cattle  
agistment; organic compost

**Property Size:** 1250 hectares,  
810 hectares irrigated crop production

**Average Annual Rainfall:** 680 mm

**Elevation:** 330 m

### Motivation for Change

- ◆ Prohibitively high-input crop production system

### Innovations

- ◆ Changing crop rotation to better support soil biology
- ◆ Changing from inorganic to organic fertilisers
- ◆ Application of compost fertiliser to increase soil organic matter
- ◆ Integrating grazing with cropping
- ◆ Innovations commenced: 2000

### Key Results

- ◆ Regeneration of soil and nutrient dynamics
- ◆ Improved crop quality, increased weight and more even yields across the property
- ◆ Reduced input costs
- ◆ Additional revenue from compost sale and cattle agistment



To overcome productivity declines in some of Australia's best soils, Cam and Roxane McKellar have re-designed ecological cropping practices, successfully regenerating the structure and nutrient dynamics in their soils. As a result, they now produce better quality and more healthy and nutritious food more sustainably and with lower inputs.

On Inveraray Downs, Cam and Roxane grow grains – wheat, sorghum, various types of corn, sunflower and barley – and other crops, such as chick peas, mung beans and soy beans. Decades of standard management practices such as cultivation, inorganic fertiliser and bio-cide use had degraded the quality and productivity of some of Australia's best soils on the Liverpool Plains. Essential biological processes and cycles for supplying nutrients to crops had been degraded, pest infestations were high and input costs were increasing.

Cam and Roxane started investigating alternatives to the high-input crop production system, investing time and money to eventually determine that the solution was to work with the soil's biological activity rather than against it. To achieve this, Cam re-designed ecological cropping systems and successions to restore the soil's natural high carbon levels, healthy structures, nutrient availabilities and hydrological resilience. Organic matter and nutrients from clean agricultural wastes are also being recycled back into the soils via the on-farm production and use of high quality composts.

Combined with their organic composts and crop rotation the McKellars have also introduced cattle into their systems to break down crop stubble, recycle green manure crops and add fertiliser. As a result Inveraray Downs' production costs have decreased, crop yields and qualities have improved and the structure, fertility and resilience of soils are being restored.

Contact Cam & Roxane McKellar: [c/o info@soilsforlife.org.au](mailto:c/o info@soilsforlife.org.au)

## The Old Way: from Stock to Crops

Inveraray Downs is a small part of the Warrah Estate, a land holding of some 100,000 hectares that was granted to the Australian Agricultural Company in 1833. The McKellar family bought Inveraray Downs in 1962 and Cam McKellar is the second generation of the family to manage the property.

The deep, heavy clay soils (vertisols) which are widespread in the Liverpool Plains region, have high natural fertility. Derived on basalt plains, the vertisols had long been treeless. Denser forests of cypress pine (*Callitris endlicheri*) with scattered eucalypts typically occur on the sandier soils on the ridges and slopes rising from the plains

The plains native vegetation is ideal for sheep grazing, which was the main farm business up to the 1960s. Severe drought followed by a period of anecdotally cooler weather in the mid 1960s caused massive loss of sheep. This, together with the declining returns from grazing, forced a re-thinking of the farm business. A bore found readily accessible water for crop irrigation. Additionally, by this time, tractors capable of cultivating the heavy clay soils were readily available. Grazing was phased out and re-development of the property for irrigated crop production proceeded through the late 1960s.

Flood irrigation was introduced in 1970. Whilst the total property area is 1250 hectares, about 810 hectares can be irrigated for crop production. Water, from either or both a bore and the intermittently flowing Yarraman Creek that runs through the property, when flow is sufficient, is pumped into a large 'turkey nest' earth tank. From here it can flow by gravity to the crops via earth channels. The average slope across the property is about 1:600. Water from the channels is diverted into the crops down furrows, ploughed at two metre spacing, down the length of each crop field. The furrows are sufficiently close together that sideways infiltration wets the plant root zone.

Cam says, "No fertiliser was used until the early 70s as it was naturally very fertile". However, in line with common cropping techniques, chemical fertiliser, pesticide and herbicide use eventually became common practice.

The farming practices typical of the period from the 1970s can be illustrated using a three-year cropping calendar. The main features of this former calendar include in years one and three growing corn over summer and autumn, burning the stubble in autumn and growing a legume during winter and spring. In the second year a legume is grown in summer and autumn followed by a fallow in winter.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Year 1	Main crop: corn				Harvest corn	Burn corn stubble. Sow chick peas with synthetic chemicals and weed killer	Main crop: chick peas				Harvest chick peas	Sow soy beans
Year 2	Main crop: soy beans				Harvest soy beans	Fallow				Sow corn		
Year 3	Main crop: corn				Harvest corn	Burn corn stubble. Sow chick peas with synthetic chemicals and weed killer	Main crop: chick peas				Harvest chick peas	Sow soy beans



Summer and winter cropping continued for the following decades, using the “best management practices” of the day. However, years of cultivation, inorganic fertiliser and bio-cide use resulted in productivity declines in what were some of Australia’s best soils. Essential biological processes and cycles for supplying nutrients to their crops had degraded. By 1985, Cam suspects that the soil organic matter level had declined from an original level of perhaps 5% to 0.5%. It took Cam a further ten or so years to realise that “... it was stuffed! The worms had gone. Pests were rife. We were on a high input treadmill and couldn’t get off”.

At the same time, the costs of inputs – fertilisers, fuel, pesticides and herbicides – were becoming prohibitive. Cam recalls, “We were going broke. Everyone but me was making money out of the farm!”

## Swapping Chemical for Organic Fertiliser

The McKellars started investigating alternatives to the high-input crop production system. Cam invested thousands of dollars in education, in Australia and overseas. This included a Holistic Management Course and an Arden Anderson Soil Course, various composting courses and seminars. Cam received a Nuffield Scholarship in 1991 and this enabled him further opportunity to study and develop ideas for innovative cultivation and cropping practices.

Cam identified that, “Fundamentally we need to work with nature, not against her. The soil health holds the key, and that is enhanced by the biological activity occurring in the soil and its interaction with the plants/crops”.

As a major innovation, Cam gradually started adopting new practices, changing from costly inorganic fertilisers to organic fertilisers. He slowly reduced the reliance on traditional fertilisers and swapped them for other options, such as kelp, fish emulsions and composts. He experimented by purchasing or obtaining for the cost of transport a range of materials, such as wastes from cattle feedlots, horse stables and chicken breeders, decayed hay and whatever other organic matter was available. It took a lot of effort to learn the methods used to produce compost fertiliser from organic wastes and by-products.

Cam summarises the rationale, “Through improved structure and organic matter content, the soil holds more water, being available to plants and animals for longer”.

Now, these organic materials are brought to the compost production facility, which comprises about four hectares of gently sloping ground, an overhead tank for water supply,



*Compost heaps under Gore-Tex sheets*

a tractor to tow the compost turner to form compost heaps and a front-end loader to move the materials around.

The various raw materials are mixed in carefully managed proportions to achieve the carbon to nitrogen ratio necessary to facilitate aerobic microbiological decomposition. The mix is formed into beds about a metre high, two metres wide and one hundred metres long. These are covered with Gore-Tex sheets that enable water to evaporate while preventing rainfall from infiltrating, so that moisture content in the bed is controlled. The temperature and CO<sub>2</sub> levels within the beds are monitored daily and the whole bed turned over and re-formed when benchmark levels are reached. The on-farm composting capability is managed by one full time employee.

The resulting compost is spread across the crop fields at a rate of 4 tonnes per hectare each year.

Through this activity Cam and Roxane have also generated an additional source of income. Cam reports, “I can sell compost by the ute load or the truck load to those who are keen to try it for themselves”.



*Grazing Belted Galloway cattle in front of compost heaps*



## The New Way: Mixing Crops with Stock

The other major innovation on Inveraray Downs was to change crop rotation practices and to opportunistically use cattle after cropping to break down stubble and to recycle green manure crops. The Belted Galloway cattle were reintroduced to the enterprise in 2000 and now provide an additional source of fertiliser and revenue.

"I am using cattle as quick stubble digesters – they are eating the sorghum and corn stubble, which keeps the soil microbes thriving while we get ready to sow the next crop." Agisting cattle, rather than maintaining a herd on the property, allows them to be used when it suits the crop production cycle.

Cam re-designed ecological cropping systems and successions to restore the natural high soil carbon levels, soil structures, nutrient availability and the hydrological resilience of these soils. These practices include direct drilling of crops, use of green manure and the recycling of organic matter and nutrients from clean agricultural wastes back into the soils via the on farm production and use of high quality composts.

The farming practices that are now typical of the McKellar's farming system since 2006 can be summarised using a

three-year cropping calendar. The obvious difference with the earlier calendar is that stubble burning has been replaced by incorporating the stubble and compost into the soil. Green manure crops are now grown in the first and third years. Every year in spring or early summer a brief two-month fallow is provided. The fallow periods provide time for the soil microbes to decompose the green manure, and therefore for the nutrients to be released for use by the next crop.



*Chicory (Cichorium intybus) tap roots penetrate deep, drawing nutrients from lower in the soil*

"When you compare the two cropping calendars, before 2000 with after 2006, you see more flexibility in what we are doing now. Our farming practices are much kinder on the organisms living in the soil", Cam explains.

Because irrigation farms don't usually need the fencing necessary on grazing properties, Cam had to find a way to

TYPICAL CROPPING CALENDAR AFTER 2006												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Year 1	Main crop: corn			Harvest corn, slash stubble	Add compost and other treatments	Disc in corn stubble and additives. Sow green manure	Main crop: green manure		Disc in green manure	Fallow		Sow soy beans
Year 2	Main crop: soy beans				Harvest soy beans	Add compost and other treatments	Disc in bean stubble and additives	Fallow		Sow corn	Main crop: corn	
Year 3	Main crop: corn			Harvest corn, slash stubble	Add compost and other treatments	Disc in corn stubble and additives. Sow green manure	Main crop: green manure		Disc in green manure	Fallow		Sow soy beans

**Note:** Compost and other treatments include fish emulsion, molasses and sulphate of ammonia. Green manure crops include oats, medics, clovers and possibly faba beans. These are interchangeable to some extent. The main crop, corn, is interchangeable to some extent with sorghum or reversing to a winter grain crop.





*Wheat stubble from the previous grain crop is still visible among the ready to harvest mung beans*



*Distribution of organic liquid fertiliser*

control the stock without getting in the way of cropping. Portable electric fencing was found to be the most cost-effective way. To get the maximum stubble recycling and trampling benefit from grazing, he uses a grid of electric tapes to confine the herd to one-hectare cells. The herd is moved to the next cell each day. This ensures that the cows either recycle the stubble and turn it into manure or pound it into the soil, where the soil biota such as insects, micro-fauna, worms, bacteria, fungi and other microbes can do their work of breaking down the organic matter to release the nutrients.



*A penetrometer test shows deep, friable soil*

The same high intensity grazing approach is used to treat green manure crops. These crops are legumes grown for their nitrogen-fixing capacity, rather than as a cash crop. Before they go to seed, cattle are used to turn the foliage into manure and to break down the residues into mulch, in the same way that crop stubble is treated.

The effect after several seasons is a vastly improved soil structure, organic matter content and balance within the cation exchange capacity, and a soil that provides a better growing medium and holds more water. The evidence of soil structure improvement can be easily seen with a simple probe test.

**“Our farming practices are much kinder on the organisms living in the soil.”**

This process has meant that, in the McKellar’s experience, insecticides and fungicides have virtually been eliminated from the cropping cycle. Cam recognises that “weeds do have a role to play as both indicators and a ‘home’ for microbiological activity. The improved resilience of the soils allows for the weeds to be left longer before being managed”.

Now, the preferred method to control pests and weeds is to use the winter-summer crop rotation and cultivation that breaks the weed regeneration cycle. It has not been practical to eliminate use of chemical herbicides completely, but the volume used has considerably reduced. Cam notes, “Weed spectrum changes with farming culture, however, summer and winter broad leaves and grasses are main challenge, especially [those that are] Glyphosate resistant”.

## Into the Future

Cam and Roxane's re-designed ecological cropping practices that have successfully regenerated what were some of Australia's best soils, particularly the soil structure and nutrient dynamics in their soils. As a result, they now produce better quality and more healthy and nutritious food more sustainably and with fewer inputs.

The crop rotation system now used on Inveraray Downs is more complex than the traditional one, however, organic fertiliser made on the property has replaced chemical fertilisers and herbicide and pesticide use is much reduced. The cash inputs required have therefore decreased substantially.

Of what has been the greatest impact of these changed practices, Cam says, "Definitely building soil carbon (organic matter), enhanced microbial activity to enhance the robustness of crops and pastures and more efficient water holding capacity".

As a result of the changes made on Inveraray Downs, grain quality has improved, the colour and 'plumpness' is noticeably better and bushel weight has increased. Yields are even across the property and there is less disease. As Cam says, "It's about increasing the fertility of the soil, improving yields and producing better quality food".

Cam and Roxane feel that overall the changes on Inveraray Downs have been very positive, but acknowledge that there is more to do. Priority activities include:

- continue to build soil humus levels
- re-mineralise the soil
- improve plant and animal nutrition
- increase livestock numbers

Looking into the future Cam notes, "My biggest risk in the enterprise remains the markets for my crops. As these fluctuate, I must seek to find efficiencies in the inputs applied. To that end, I am routinely applying biological amendments that are cheaper per hectare than conventional equivalents,".

In recent years Cam has left a buffer strip along the creek, which is no longer cropped. "I refer to this as my biodiversity patch. Over time I have observed new and different types of plants in the strip. Every few months I turn the cattle in there for a few days just to knock down some of the weeds."

These buffer zones around the perimeter of the farm are now managed for timber and biodiversity. Numerous signs of increased biodiversity can be observed across the property. Macro and micro soil life has returned. Insects are abundant. Kites, kestrels, hawks and eagles have returned, showing that there are ample small animals around to support them.

Soil microbial activity has been enhanced through the cycle of decomposition of organic matter that releases and makes these nutrients available. Cam notes, "I use worms as an indicator of how healthy my soils are. Worms can now be found anywhere you dig".

Cam concludes, "I should have moved to a more natural system of farming a lot earlier in my life. It is not hard. Start small, experiment, then expand".

**"I should have moved to a more natural system of farming a lot earlier in my life. It is not hard."**





# Using raised beds and beneficial fungi to restore soil health



## BRIANDRA

### Farm Facts

Mingay, 16km north of Lismore, 170km west of Melbourne, VIC Western Plains

**Enterprise:** Crops. Sheep.

Cereal, oilseed and pulse crops; Merino sheep grazing

**Property Size:** 1073 hectares, 700 cropped

**Average Annual Rainfall:** 650 mm

**Elevation:** 20 m

### Motivation for Change

- ◆ Needing to diversify to maintain production and address waterlogged soils

### Innovations

- ◆ Raising crop beds
- ◆ Using brewed cellulose-digesting bacteria and fungi combined with grazing to manage cereal stubbles
- ◆ Spreading biological blend on soils
- ◆ Innovations commenced: Raised beds 1996  
Biological blend 2002

### Key Results

- ◆ Increased the area available for cropping through improved drainage
- ◆ Adoption of practices across a community
- ◆ Improved soil health and fertility
- ◆ Increased sheep weight gain



Upon learning the links between soil health and waterlogging, Brian and Sandra Wilson concentrated on improving their soils, adopting a technique to improve drainage and biologically managing stubble.

By creating raised narrow beds of soil Brian and Sandra Wilson achieved major improvements in drainage and the structure of their soil. This led to more reliable crop yields and the production of considerable amounts of stubble.

A stubble digestion program was initiated to manage cereal stubbles, using brewed cellulose-digesting bacteria and fungi combined with grazing. The wheat stubble is now incorporated into the soil and is used to renovate the beds.

A biological blend, a mixture of brewed microbes, humates, basalt, soft rock phosphate and various trace elements, was spread to rectify soil deficiencies.

As a result of the various techniques applied, the changes to the soil both physically and chemically are remarkable, transforming from hard setting grey clay to a red/brown non-sticky loam. The ratio of calcium to magnesium moved towards a desirable 5:1, improving the availability of phosphorus, potassium, sulphur and other nutrients. This compared to conventional practices of applying up to eight tonnes per hectare of lime, and correcting pH to around 6, which had not improved calcium levels.

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## Briandra

Briandra was originally part of the 'Gala' estate, which was settled by a Scot named John Brown, probably in the early 1840s. This estate was broken into smaller properties later in the 19th century and the government acquired part for soldier settlement blocks in 1919<sup>1</sup>.

The policy to subdivide large pastoral properties into soldier settlement blocks assumed that smaller-scale farming would be viable<sup>2</sup>. This was often not the case on Western Victoria's basalt plain. Although rainfall is generally reliable, poor drainage caused by the heavy clay soil was a problem during the winter months.

The climate in the region is temperate and average yearly rainfall is around 650mm. The local topography is flat to undulating, with some deeply incised drainage lines where streams have cut through the basalt plain to underlying sedimentary strata. A watercourse, Brown's Water Holes, runs from north to south through Briandra, continues to the town of Lismore and terminates in Lake Gnarpurt, one of the western district of Victoria's saline lakes. Soils are typically heavy, deep hard-setting clay that has developed on basalt.



*Sugar gum shelterbelt originally sown in the late 19th century*

Sugar gum (*Eucalyptus cladocalyx*) shelterbelts run along several road and paddock boundaries. The shelterbelts are about 50 metres wide and occupy a total area of about 10 hectares. They were originally established in the late 19th century because there was little tree cover or timber available.

The people from whom Brian and Sandra

bought the property had held it since 1912. When they were first in the area, the Brown's Water Holes watercourse was a flood plain through the tussocks, which could be crossed by horse and cart anywhere along its length.

During the 1950s, most of the native pasture was replaced with phalaris and sub clover. The former owners felt that these grasses were becoming too invasive on the higher fertility soil, and they had ceased using any phosphorus fertilisers some fourteen years before. As a consequence,

the pastures were very phalaris dominant, and together with their conservative stocking rate, were also very rank. Cropping was only performed in a limited area, mainly oats for sheep feed and wheat, and was not very successful due to high prevalence of waterlogging. The flock was mainly Corriedale, which was common in the district at the time.

The Wilson family, Brian, Sandra and four children, moved to Mingay from South Australia in 1985. The children have since left the farm and Brian and Sandra run the farm with the help of an employee, who lives on an adjoining smaller property. About 700 hectares of the property are cropped and 330 hectares is permanent pasture.

## Waterlogged

By the time the Wilson family moved to Briandra, the wool industry had been in decline for many years. The creek had eroded to a depth of up to three metres in places and bridges were needed to cross it.

"Pasture pugging and waterlogging gave us little confidence of achieving good outcomes in crops and pasture growth", Brian recalls. "We had come from a merino sheep and mixed cropping operation, in 432mm rainfall and sandy soils. It was quite a learning experience to manage waterlogged soils."

In 1987, after a few wet years, the Wilsons ceased cropping and fully dedicated themselves to wool growing. Failed crops and high wool prices made this a good decision, until the collapse of the wool reserve price scheme.

"We realised that if we were to survive we had to diversify our production so that we would be less subjected to the vagaries of the market."

"We realised that we did not know how the basalt plains functioned as an ecosystem and why it was in such poor condition. We lacked detailed technical information. It was not until we went and talked to a wide range of experts that we began to understand why the soil condition and the waterlogging problems were related."

Brian and Sandra commenced their journey to improve the soil health and fertility over the long term. They sought expert advice, paid for a digital elevation model and collected soil samples and had them analysed and explained. They realised that they would have to restore soil health to address the waterlogging before they could produce productive crops. To achieve these goals Brian and Sandra decided that they would have to do things differently from their neighbours and the way the land had been managed previously.



## Raising the Beds

In November 1990 Brian and Sandra installed 40 hectares of sub surface drainage in an endeavour to prevent waterlogging, and to see if they could successfully grow crops. They found that they could produce high yielding autumn/winter sown crops without the constraint of waterlogging. This doubled the potential yield of spring sown crops and was much more reliable.

Brian recalls, "The 1992 wheat crop was planted early May, some of it to the experimental red winter wheat 'Lawson'. In a very high rainfall spring and summer, this crop survived, and though weather damaged, yielded well with the Lawson giving seven tonnes a hectare. Satisfied that with drainage crops could be grown successfully, we installed a further 40 hectares of underground drains in 1995." However with the cost of establishing the drains over \$1000 a hectare, this was prohibitive, and the Wilsons were unable to convert larger areas.

Around 1994, a small group of farmers met with the director of agriculture in Ballarat to investigate the possibility of improving crop production in the region. Brian was invited to attend, and also had joined the Geelong crop improvement group to learn from others. From this background, the *Southern Farming Systems* group was formed in 1995. The initial management committee leased land at Gnarwarre for experimental work to trial various methods to improve cropping outcomes in the high rainfall zone.

In 1996 the committee trialled two hectares each of sub surface,

wide, and narrow raised beds. Even with an extremely wet winter, canola yields of 3.5 tonnes a hectare proved their worth. Brian points out, "The outcome from this was that yields were similar on all sites, but at \$200 per hectare with narrow raised beds, the cost could be factored into the first crop's gross margin. The crop was more even than the wide raised beds, where the fertile top soil was moved from the drain to the top of the beds".

At \$200 a hectare for narrow beds compared with over \$1000 for sub-surface drains, the committee decided to concentrate on the narrow beds. It is estimated that around 500,000 hectares in south-west Victoria now use this practice.

By adopting raised narrow beds of soil on Briandra, the Wilsons achieved major improvements in drainage and the tilth (condition of tilled soil, especially in respect to suitability for sowing seeds) of the soil. They also actively avoid compacting the soil.

"Since moving to raised bed farming we no longer drive machinery or vehicles on the beds. Our own tests have shown that this compacts the soil and reduces biological activity. To overcome this problem in the long term we have moved to control track farming where the tractors and harvesters only move in the furrows. To ensure this happens, machinery is fitted with high spatial precision tracking systems."

When the paddocks are not cropped they are established and managed as phalaris/sub clover based perennial pastures.



Raised beds on Briandra, with stubble (left) and after grazing (right)  
Inset: raised crop bed former



## Breaking Down the Stubble

While the narrow raised beds were effective in managing waterlogging, with increased productivity the Wilsons found they had to deal with higher stubble loads of up to 10 tonnes a hectare. Stubble burning was a commonly accepted practice in the district, however the Wilsons felt that this was not sustainable in the long term.

Attempts to mulch the stubble and sow directly into them was defeated not by physical restraints, but by chemical limitations. Excess stubble was resulting in allelopathy – exudates from wet straw were poisoning the following crop. In 2001 Brian met Adrian Lawrie at the Wimmera field days. His small biological products company *LawrieCo* was promoting cellulose-digesting fungi to break down straw.

In 2002 Brian purchased enough product to treat 17 hectares. This was not overly successful, possibly due to poor brewing technique. In 2003, he installed a tank and brewing pump to properly multiply the fungi and applied it to another 17 hectare plot. This time a better result was achieved, so the Wilsons expanded the area treated. The results were successful.

"In 2005 we treated the barley stubble in Weir South on one side of the creek only. Sheep had access to both sides, but only grazed the treated side. Brian removed them in score 3 condition when it was felt that the paddock was bare enough; around 1000kg a hectare dry matter. The untreated side had only been 'picked at'", notes Sandra.

"The results of the biological program trialled over small areas were so encouraging that the management of the whole farm is now using that system."

Brewed cellulose fungi and grazing has now become standard practice to manage cereal stubbles on Briandra.

The high biomass produced by pea and barley stubbles tends to clump together with wind, but these are now reduced by grazing. The biological stubble digestion program makes them more digestible to stock, and they become a valuable food source. As the health of the soils improved, Brian and Sandra found the need to incorporate the wheat stubble, which is not eaten as effectively as barley, into the soil to get it to breakdown quickly enough. To overcome the biomass problems the Wilsons invested in specialist machinery to incorporate the wheat stubbles at a shallow level, and then reform the beds.

## Adjusting Soil Chemistry, Biology and Structure

"While we were successfully growing high yielding crops, with high inputs of fertiliser, it seemed that pathogens were an increasing problem. Lucerne flea attacking wheat crops at the 2 to 3 leaf stage became more common, and barley yellow dwarf virus (BYDV) also prevalent. *LawrieCo* suggested trying the nutri-blend product [now called 'biologic blend']. This dramatically changed the chemical analysis of our soils."

Previous soil tests on Briandra had shown high levels of iron and magnesium, resulting in tie up of nutrients and poor soil structure. After adding the biologic blend, the Wilsons found that the phosphate available for plant uptake, measured through Olson P levels, had increased dramatically. "Pasture paddocks where Olson P had stabilised in the 12-15 range despite annual dressings of 20+ P increased to 19 with the addition of only 10 P in the form of soft rock phosphate, together with 5kg a hectare of boron humates", Brian explains.

Calcium levels had also increased. This improved the calcium to magnesium ratios, moving it towards a desirable 5:1, from a previous 1.5:1, thus improving the availability of phosphorus, potassium, sulphur and other nutrients. This compared to previous conventional practices of applying up to eight tonnes per hectare of lime, and correcting pH to around 6, which had not improved calcium levels.

Soil structure, already improved by minimising waterlogging, changed from light grey clay, to a reddish brown loam. It was less sticky and had increased infiltration rates.



Top: Poor structure of overworked, low organic matter soil

Right: Soil from the same area, now friable after several years of treatment

### TYPICAL CROP ROTATION AND GRAZING - 90 HECTARE PADDOCK OVER FOUR YEARS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Year 1	Spray cellulose-digesting fungi	Incorporate stubble	Renovate beds		Sow	Main crop: Canola							Harvest
Year 2	Harvest	Graze with ewes				Sow	Main crop: Barley						Harvest
Year 3	Spray cellulose-digesting fungi	Graze with ewes			Sow	Main crop: Field Peas or						Harvest	Graze with lambs
					Sow	Main crop: Beans							
Year 4	Graze with lambs				Sow	Main crop: Wheat							Harvest
	Harvest	Graze with lambs											

Brian notes, "The results of the biological soil improvement program trialled over small areas initially, then across the whole farm have been very rewarding. Without the improvements we have made in improving the soil health and fertility over the long term, our soils would continue to be waterlogged, anaerobic, hard setting, sodic and acidic soils".

The Wilsons are proud to note, "We have shared the lessons we have learnt at Briandra. Over many years of serving on local and regional bodies we have been able to influence the focus of several groups on soil health. In 2012 soil has been listed in the top six assets of the regional catchment strategy".

### Production Highlights

Crop rotations over four years follow the sequence of canola, barley, pulse, wheat, as shown above. The pulse is either broad beans or field peas, which provide valuable stubbles, giving high protein supplements to lambs (weaner sheep) and ewes. Brian and Sandra have found that an obvious benefit is weight gain, with lambs reaching 50kg or more live weight by joining at 19 months, with conception rates in hoggets comparable to the older ewes as well; usually 90% in one cycle.

Crop production has remained about the same level as before biological inputs were applied on Briandra. The Wilsons spend around the same amount on fertiliser inputs but are finding that the crops appear greener and more robust. Urea applications have been reduced to about 40% of what they were previously.

Brian points out that recent extreme years of 2006 and 2010, when growing season rainfall was 220mm and 714mm respectively, have made it difficult to assess how much production has been influenced by management change, and how much by weather influences. He does note however, "Suffice to say, the best performed paddocks on those extreme years, have been those where the most biology has been added".

In 2006 barley yielded 6t/ha compared with an average 4t/ha over the rest of farm. In 2010 the beans yielded 4t/ha without any fungicide applications.

It would appear that the immune system of the crops and pasture plants have been enhanced as lower levels of pathogenic attack have been experienced. The need for both insecticide and fungicide use have been dramatically reduced, mostly confined to seed dressings. This has made integrated pest management strategies easier to

implement, and beneficial insects are now the Wilson's main control measure.

While production assessments are ongoing, Brian and Sandra report that, generally, cash profits are about the same as they were after the drainage was installed and before the biological amendments were applied. However, they are confident that long term outcomes are better.

Most profits are reinvested in improving the farm. Brian notes, "My business model has the philosophy to use ten per cent of farm gross income in experimentation, starting over small areas, and the encouraging results are expanded, and may develop into standard practice. Any failures, and there have been many, are discarded".

He advises, "Be prepared to try new methods on your own farm. Use on small scale first. Don't be afraid to ask questions. Learn from others. Join farm groups".

The Wilsons are content with what they have achieved on their property and in their region in relation to soil health. "We have personal satisfaction that the soils on the property are much healthier now than we first arrived. We have passed the lessons we have learned on to the wider community and region through our involvement in regional NRM bodies."

**"Without the improvements we have made in improving the soil health and fertility over the long term, our soils would continue to be waterlogged, anaerobic, hard setting, sodic and acidic..."**

"We now observe a gradual awareness and adoption of innovative solutions for solving seemingly intractable management problems such as waterlogging and pugging on our region's soils."

No doubt, the establishment of *Southern Farming Systems* as an organisation providing farmers in high rainfall areas with 'real world research and information' has provided the framework for these innovations and their adoption.



<sup>1,2</sup> Keneley, M. (2000) *Land of Hope: Soldier Settlement in the Western District of Victoria 1918-1930*, School of Economics, Deakin University, Warrnambool.





# Against all odds: turning sand into profit



Prospect Pastoral Company, WA

## PROSPECT PASTORAL COMPANY

### Farm Facts

Wyalkatchem, Dowerin, Cunderdin and Meckering districts, around 190 km north east of Perth, WA Central Wheatbelt

**Enterprise:** Crops. Sheep.

Cereal grains and cereal hay crops; specially-bred sheep for wool and premium grade fat lambs

**Property Size:** 8000 hectares

**Average Annual Rainfall:** 200-300 mm (home farm)

**Elevation:** 320 m (home farm)

### Motivation for Change

- Reducing rainfall and rising input costs

### Innovations

- Introduction of biological fertilisers and zero tillage to improve soil function and structure
- Integration of grazing with cropping to enhance nutrient cycling and soil structure
- Revegetation to limit spread of salt
- Innovations commenced: 1994

### Key Results

- Successful crop production on 100mm rainfall
- Increased soil water-holding capacity
- Sheep bred to adapt to local environment lambing at 90%-150% and producing high quality 17-20 micron wool



Initially investing in 660 hectares of marginal and degraded wheat country, Ian and Dianne Haggerty have built up a successful production area of 8000 hectares producing cereals and sheep on limited rainfall and sandy salt-affected soils.

Ian and Dianne Haggerty, and their son James, run a holistic and integrated program of cropping and grazing. The program is underpinned by their shared deep commitment to the regeneration of the fertility of the marginal soils of their area. This is achieved through use of biological fertilisers, zero tillage and the consequent growth of healthy cereal plants to deliver high tonnages of premium grain per hectare. The healthy ground cover of the cropping and pasture also provides the key to maintaining high levels of soil moisture and ensuring weed control.

Over the years, Ian and Dianne have developed their own Merino stud and a working sheep flock from local and South Australian bloodlines. This indigenous flock has been bred to be totally acclimatised to the land farmed by the Haggertys.

Their production area is now spread over a number of holdings equalling 8000 hectares of their own property, leased land and share-farming enterprises. This diversity has enabled more effective management across various landscape conditions and rainfall availability.

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## Settling In

Ian and Dianne came to the original property in Wyalkatchem in 1994 after having run a successful business at Derby in the north west of Western Australia. They had a long shared desire to be farmers and naturally gravitated towards their origins in the Eastern Wheat belt of Western Australia.

The original property purchased by Ian and Dianne lies on undulating semi-arid country to the north of Wyalkatchem WA, bordering on Wallambin Salt Lake. Due to the size and location of the property, farm advisors originally suggested the best alternative was to get out before they got started, however this only challenged the Haggertys to make a good go of things. For the first few years they made a start with the help of machinery from Dianne's father who owns a neighbouring property.



*Local landscape with salt lake in the distance*

During the remainder of the 1990s rainfall proved relatively reliable with mostly average rainfall seasons, some excellent seasons and a couple of dry seasons. Following conventional best practise at this time proved profitable and enabled Ian and Dianne to begin acquiring their own machinery.

However, through experiencing the couple of dry seasons, the Haggertys realised the vulnerability of the farming system they were following, as the production decline in these years was significant. Observations of poorly developed root systems and the low resilience of plants to short springs encouraged Ian and Dianne to explore what might be limiting these factors within the soil. This

instigated an ongoing pursuit of knowledge regarding soil health and soil productivity.

In addition, rising input costs without a corresponding rise in productivity also provided cause for concern. From this grew a desire to enable the soil to produce an optimum outcome with whatever seasonal conditions unfolded - without expensive inputs.

With the coming of the new decade the rainfall patterns made a determined turn for the worse, with mostly below-average rainfall patterns or significant "dry spells". This gave the Haggertys a clear indicator that moisture was king, and rainfall preservation and optimal use would be the most powerful profit driver for the enterprise.

Whilst in Derby, Ian and Dianne had made contact with Robyn Tredwell<sup>1</sup>, manager of Birdwood Downs Station. It was here that they learnt the principles of using livestock as "weeders, seeders and feeders" in regenerating pastures with appropriate management. This experience was an early trigger for Ian and Dianne to investigate many of nature's processes; how careful management could enable successful utilisation of nature's efficiencies at minimal cost. This view was also supported by Dr Elaine Ingham and Dr Arden Andersen with whom the Haggertys commenced their education in biological agriculture. Understanding of livestock management and interaction with the soil environment was further enhanced by learning with Jane Hinge of South Australia.

The original 660 hectare purchase has since been expanded over the years by leasing and share farming enterprises throughout the districts of Wyalkatchem, Dowerin and Meckering. These additional properties are not adjacent, so distance is a constant factor in farming management.

## Holistic Management

Each of the properties managed by the Haggertys produce cereal grains (wheat, oats and barley), cereal hay and sheep for wool and meat. The inclusion of leased land and share-farming enterprises in various locations in their operations has given Ian and Dianne the option of cropping and grazing on different soil types and in different rainfall zones. They can also move sheep to optimise feed on offer and water supply and can choose the location and intensity of cropping operations against landscape conditions and rainfall availability from one part of the enterprise to another.



Ian and Dianne are careful to ensure that each practice that comprises the holistic management of their cropping and grazing operations contributes to the whole. Only the highest quality components underpin the individual and carefully thought out farming practices.

## Cropping

To grow cereals, Ian and Dianne use a process of no-tillage direct drilling of grain seed, supported by application of biological fertilisers, based on high grade worm liquid and compost extract at a cost of \$30 a hectare. Cereal stubble and areas of perennial shrubs - *Rhagodia spp.*, saltbush (*Atriplex spp.*) and tagasaste (*Chamaecytisus palmensis*), or tree lucerne, - provide grazing for sheep in summer and autumn. Winter and spring grazing is provided by annual volunteer plants, grasses and legumes.

Enhanced microbial activity in the soil and the use of specially-bred sheep as the 'farm machinery' above the surface has lifted the resilience and fertility of the land, improving the soil function, structure and water-holding capacity and continuing to value-add to the productivity of the landscape.

"We truck our worm juice and compost from the Victoria and New South Wales suppliers with a proven record of providing only the highest grade products. The compost extract is produced by our own centrifuge which was sourced from the United States", Ian notes.

The Haggertys have a preference for older varieties of grain that were in common use before the introduction of farming methods which rely on high levels of chemical intervention. They are constantly on the lookout for additions to their seed bank.



The seed drill micro-biologically coats the seed and applies liquid fertiliser to stimulate growth



Seeds are micro-biologically coated before sowing. Ian has integrated a low pressure liquid fertiliser circuit into their seeder so that the micro-biologically coated seed is drilled into a microbial environment stimulated by the liquid fertiliser. This ensures that the plant is supported from germination to early growth.

When Ian digs over a shovel full of heavy red soil in the paddock it becomes obvious how each plant growing in it acts as a carbon pump. The plant root growth has broken up sub-surface hard pan in these heavier soils affected by earlier farming methods. By not providing water soluble fertilisers with the seed, extensive root system growth is stimulated and the plant is able to reach wider and more deeply for moisture and nutrition.

Similarly, observation of root growth in the poorer sandy soils in other paddocks being cropped, show the extensive root growth which adds carbon and nutrients to the soils. These roots hold the soils together and spread the microbial environment within the soil.

As Ian describes, "Healthy flourishing plants slow down runoff from the meagre rainfall, that can be as little as 100mm during the growing period, the microbial activity and associated improvement in soil structure maximises the retention of moisture in the soil".



Grain head size is seen as a reliable indicator of soils health



"Crop quality is checked by periodic testing of tissue nutrient levels and inspection of grain head development during growth. We find this is a more reliable measure of what is available to plants from the soil, rather than testing the soil itself."



*Extensive root growth is a sign of a healthy nutrient system*

### Grazing

"Once grain is harvested, the stubble of the crop grown in this high microbial environment provides nutritious grazing fodder for the sheep. In due course, remnant stubble is trampled down and is broken down by fungi to add to the organic carbon in the soil. Together with the dung provided by the sheep and their stimulation of the soil surface by walking on it, the soils become a gift that keeps on giving."

Ian and Dianne have carefully bred their line of sheep to be adaptive to their local environment. Through a combination of their breeding and grazing practices, including short, controlled periods of grazing in individual paddocks, the sheep are resistant to stomach parasites and do not require drenching. The sheep have been bred for clean legs, faces and crutches; the Haggertys do not practice mulesing but maintain regular crutching.

The sheep thrive on cereal stubble and native shrubs and grasses as their rumen flora is totally adapted to

maximising nutrient extraction from roughage. The livestock do not receive any grain supplementation. The sheep are shorn every eight months and produce lambs at a rate between 90 and 150% per annum. As the Haggertys say, "We couldn't afford to replace our ewes. They have developed into hardy, efficient producers with minimal artificial support highly adapted to our local environment. They could not be replaced easily".

Alpacas run with each flock of sheep to reduce the threat from foxes

Dianne points out, "The grazing operations are integral to the whole. The cropping and hay production contribute to our production of premium wool and lamb, but the sheep are playing their part in fertilising the land and working the soil for us".

The sheep produce high quality 17-20 micron wool (8-9kg average per fleece adjusted for 12 months growth) and premium grade fat lambs. Some of the Haggerty's stud rams are sold to other farmers looking for robust, economical performance.



*The sheep have been specifically bred to suit the environment*

### The Whole

The Haggertys note, "The spread of our operations throughout the district enables us to maximise the virtues of each piece of land and minimise its shortcomings. We have learnt what each paddock can contribute to our operations season by season and what we need to do for that paddock to ensure the continuation of its productivity".

"None of this would be completely effective without our understanding of the land as a living organism and our connection to its life cycle. As we contribute to it, we live from it, we live with it - we must understand its nature and its inner life, what it gives to us and what it needs from us to work on our behalf."



*Pregnant ewes amongst wheat stubble*





*Predicted seasons and conditions are strongly considered when choosing land for cropping. The potential for productivity when biological processes are introduced can be clearly seen on these sandy soils*

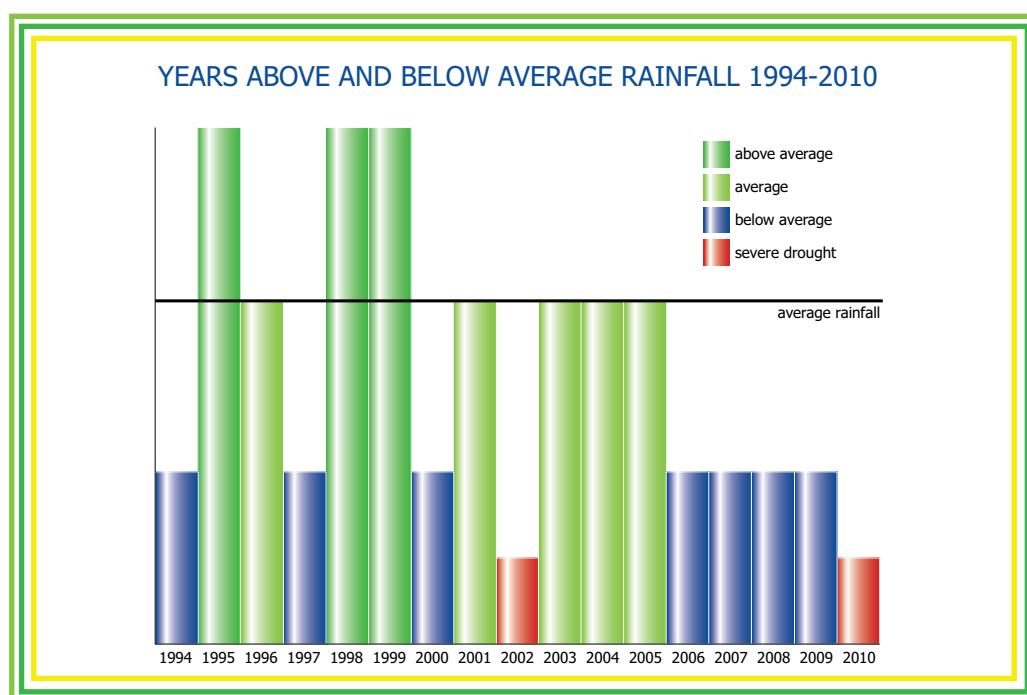
## With What Water?

The farming operations continue to deliver high quality grains and cereal hay at significant yields even when the rainfall during the growing season has been as low as 100mm. Average annual rainfall has been only 200-300mm since 2000.

Because of the low average rainfall and the predominance of lower rainfall and drought years over higher than average years, Ian and Dianne plan for operations in drier conditions as being the norm. Their cropping strategies and practices emphasise retention of water in the soils

through soil quality management and by minimising runoff and evaporation. In this context, they choose cropping land with the best potential for a high yield in the predicted season ahead.

The runoff in all paddocks is so minimal that they do not rely to any great degree on dams for stock water, although at least one dam in one of the cropping/pasture paddocks is fed by ground water. The mainstay of stock watering is water from the wheat belt watering scheme that pipes water from Mundaring Dam.



## On What Soil?

With the varied properties, the enterprise is spread over diverse soil types. These include the heavier red clay loam known locally as 'Morrell' soil, light acidic sands known as 'Wodgil' soil, deep leached sand, sand over clay and ironstone gravels. The biological and no-till strategies and practices adopted by Ian and Dianne are aimed at:

- ◆ breaking through shallow, sub-surface hard pan in heavy soils caused by previous high till, high chemical farming
- ◆ breaking up clay mosaics
- ◆ opening the soil's surface to water penetration
- ◆ building up soil structure that allows roots to penetrate deeply and widely
- ◆ efficient breakdown of stubble and litter by microbes and fungi
- ◆ weaning newly acquired land from chemicals while maintaining production

Ian and Dianne are faced with considerable dry land salinity, particularly on land close to Lake Wallambin where salt is picked up by wind and deposited on their land. They have planted lanes of saltbush and acacia in these areas. They use sheep to graze these areas and contribute to soil fertility through dung deposit. In the more saline areas they sometimes put out hay to attract the sheep to these areas and concentrate dung around the feeding point.



*Fungi growing in the crop*

Below the surface, the action of microbes, fungi, worms and dung beetles is obvious in any shovel full of paddock soil. Above the surface, trees, shrubs and ground cover sustain other micro bio-diverse environments that support insect life and reptiles, including a few hardy frogs.

There are numerous bird species and macro fauna using these areas. This biodiversity can be traced back to the strategies and practices Ian and Dianne have developed under their vision for biological farming.



*The sandy soil (on spade) is visibly improved with organic matter after only two crops*

## Vegetation Management

The saltbush lanes help to control the movement of salt from the salt lake. Ian and Dianne have also planted a number of different species of annuals and perennials to help manage the spread of salt. Many failed, and they learned from that experience that the annual pasture legume, yellow serradella, has proven a good survivor. It does well in acidic soils, has deep roots and is a prolific seed producer.

Native grasses are returning to cropping paddocks and grow well if there is summer rain. However, the prime source of grazing fodder in summer and autumn is cereal stubble.

Ian and Dianne are careful not to impact on the residual paddock trees or clumps of bushland. They have also planted salmon gums (*Eucalyptus salmonophloia*) and other species to foster the growth of stock shelter and wildlife corridors, and to reduce the impact of salt from the nearby Lake Wallambin. Use of a tree planter allows for large numbers of seedlings to be planted quickly. In one location they have fenced off a particularly representative plot of ancient residual Mallee to preserve its integrity.

As they work up and develop the potential of a newly acquired piece of land, Ian and Dianne will immediately use the livestock to begin the process of biologically inoculating soil that may not have had biological activity encouraged for some time. They are quickly able to reduce rates of chemical use by altering the soil surface and not providing the excess nitrogen and phosphorous that weeds seem to thrive on. The main species of weeds are barley grass (*Hordeum spp.*), annual rye grass (*Lolium*





*rigidum*) and wild radish (*Raphanus raphanistrum*). The former respond to herbicides, but, in some cases of heavy radish infestation, which is hard to kill with herbicides, Ian prefers to slash whole paddocks and then turns them over to grazing significantly reducing seed set for the following crop season.

## The Team Works

Ian and Dianne are working together in a close partnership, Ian managing cropping and Dianne managing animal production, but working together to integrate both production streams. Eldest son James is also working on the property, having graduated from agricultural college. Other members of their families are located on nearby properties.

Together, the Haggertys are continuing and improving regeneration of farming landscape in every part of the enterprise in terms of both soil fertility and soil water-holding capacity, whilst minimising the impact of ground salinity. Their production is showing a continuing trend to higher yields per millimetre of rainfall and higher quality of cereal grains and cereal hay. The home grown Merino stud and flock ewes acclimatised to the property are producing high grade wool and fat lambs for 'boutique' butchers.

Ian and Dianne keep detailed records of inputs to their enterprises and have an encyclopaedic knowledge of the success and failures over the years. They believe that landholders must monitor carefully the transitions in their own land and their financial capacity to enact change. They note that there is always good advice out there somewhere but, even when you find it, external input can only help you so far. Ultimately, the farmer is responsible for their own learning and farm development.

The Haggertys also reinforce that farmers must be prepared to try things that may not necessarily work. Ian and Dianne have been involved in trialling many species of perennial pastures, both grasses and shrubs, to extend the 'green grazing window' throughout the prolonged dry summer and autumn period which is typical in Western Australia. To date some introduced species are managing to survive including Rhodes grass (*Chloris gayana*), Gatton panic



Ian Haggerty showing the healthy root development of plants grown in sandy soil

(*Panicum maximum*) and tall wheat grass (*Thinopyrum ponticum*), however the most reliable performers in dry seasons are the saltbush, Rhagodia, native wattle and tagasaste shrubs. Encouraging the right environment for native perennial grasses to flourish in the event of summer rain is a priority

The Prospect Pastoral Company is very much a busy family enterprise and a personal priority. Ian and Dianne work closely together to integrate cropping and grazing with the geography of their operation enabling much opportunity along with a large commitment of time to monitor and manage. Nonetheless, they are always willing to share their knowledge and experience with others, attending field days on a wide range of topics and themes and maintaining involvement with the local Landcare group.

<sup>1</sup> Robyn Tredwell was the Australian Rural Woman of the Year 1995



# The influence of effluent - the power to do good



## PINE LODGE

### Farm Facts

Shepparton, VIC Central North

**Enterprise:** Dairy

Organic irrigated dairy

**Property Size:** 261 hectares

**Average Annual Rainfall:** 500 mm

**Elevation:** 110 m

### Motivation for Change

- Health concerns and the desire to try natural farming methods

### Innovations

- Using beneficial bacteria to treat dairy effluent for use as fertiliser
- Laser levelling of paddocks and enhancing the water reticulation system
- Composting, foliar and bio-fertilisation
- All organic practices
- Innovations commenced: 1996

### Key Results

- Irrigation requirements reduced by 30%
- On-farm waste producing cost-effective fertiliser, improving soil health
- 10% price premium on product
- Reduced veterinary costs



Ian and Wendy Klein have taken recycling to a new level, treating dairy effluent to provide rich fertiliser and effectively managing their on-farm water supplies to operate a profitable and organic farm.

After 24 years of conventional dairying, Ian and Wendy began using organic farming methods, actively turning away from the use of chemical or artificial fertilisers, drugs, antibiotics and hormones that are common in today's food production. Their underlying principles were to not pollute the environment or use toxic chemicals and to reduce their environmental footprint – while producing a wholesome food and remaining profitable.

The Kleins no longer have problems with excessive amounts of harmful or toxic nutrients and offensive odours from the dairy effluent. By treating their dairy effluent with beneficial bacteria, they are able to use the modified slurry as a fertiliser, returning nutrients to the soil and lowering costs of fertilising the pasture.

Using foliar sprays and bio-fertilisers to address the condition of the soil has also promoted the storage and cycling of organic matter in the soil, making the pastures more productive. The cows are healthier and require fewer interventions to prevent animal health problems.

The Kleins are also using a third less water after establishing a state-of-the-art water reticulation system for irrigating the pastures, linked to laser levelling of the paddocks.

By focusing on keeping nutrients and water on the farm, Ian and Wendy have developed a successful recycling and composting program. In the Klein's experience, changing from conventional farming practices to working with more natural inputs and processes has reduced their input and veterinarian costs and supports a profitable organic dairy.

Contact Ian & Wendy Klein: [iwklein@bigpond.com](mailto:iwklein@bigpond.com)



## Becoming Organic

Ian and Wendy moved to Pine Lodge from Dandenong in 1972. Ian had previously farmed in the Heatherton Road area, which is now part of Melbourne's sprawling suburbs.

After arriving in the district, Ian and Wendy practiced conventional dairy farming on the property for 24 years using skills and knowledge they acquired and learned from local producers and industry experts.

The Kleins recall, "In the early 1970s we were dealing with some personal health issues that were not responding to treatment using conventional medicines. Together we decided to look into natural remedies and soon observed benefits. This realisation soon caused us to question why we were continually working with conventional farm management practices year after year with our cows and pastures".

*"...be open to ideas about investigating and using biological and ecological solutions."*

"In 1996 we attended a public lecture given by Professor Ian Brighthope that inspired us to trial natural farming methods on our dairy. This involved us extending what we were doing in our home

with our own health more broadly to the farm and the dairy cows."

After undertaking research, Ian and Wendy agreed to perform a trial for two years. They decided that if they did not see any benefit, or saw decline, in a number of indicators then they would return to previous management practices. Indicators selected included whether the costs of milk production became higher, or the health of pastures or cows declined.

The Kleins elected to go "cold-turkey", changing to organic practices across the farming enterprise in 1996. "We do not use synthetic fertilisers, synthetic sprays for weeds and pests nor antibiotics to prevent the animals from getting sick", Wendy states.

Productivity increases were observed within 12 months and have been consistently improved, though subject to some seasonal variations.

The Kleins continued to inform themselves throughout the change process, and tried various techniques and options until they found what worked for them. This included investment of some capital into new equipment. Ian and

Wendy believe that their dairy enterprise is only as good as their understanding of the ecological and biological processes that underpin it.

On becoming organic, Ian remarks, "Where you, the producer, have observed seemingly intractable problems with animal health, soil and vegetation condition, water quality and waste effluent, be open to ideas about investigating and using biological and ecological solutions."

"Often this involves joining an association or group of like-minded individuals, reading books and searching the Internet to find suggestions for fixing problems."

As advice for others, the Kleins note, "It's far easier than you think and there are now more opportunities to learn how to farm organically".

"We suggest that you give such solutions 'a go' on small areas at first before applying to larger areas. Be prepared to wait for results, remembering that problems were often slow to manifest themselves, so 'fixes' may also take some time."

Ian and Wendy's business plan was to implement a number of strategies to make the farm more viable, as well as environmentally friendly. This focussed on converting the entire farming enterprise to organic production and recycling as much as possible.



*Around 300 cows produce milk on the Pine Lodge organic dairy*



## Dairy Operations

"We started small; the dairy comprised a relatively small milking operation of around 80 Friesian and Jersey cows in a six bail shed. In those days our operation was based on establishing and managing irrigated improved pastures using synthetic fertilisers, for example, superphosphate and applying chemical sprays to control weeds."

Production was successful and Ian and Wendy considered the farm had potential to become more productive and be a much larger operation. Over the years they progressively increased the scale of the operation to what would be considered medium-sized in Australian terms. The Kleins now run approximately 300 milking cows, some dry cows, bulls and other young stock on the 261 hectare property. The daily milking of the 300 cows takes place in a 60 bail shed. The dairy represents a major piece of infrastructure on the farm.



*The Klein dairy has increased from a six to a 60 bail shed, producing significant amounts of effluent*



A by-product of a large dairy is effluent. The milk shed is equipped with high pressure hoses delivering dam water for washing the floor of the shed and the holding yard. Effluent is mainly a slurry comprising wash down water, manure, urine and other waste.

Large amounts of slurry were accumulating on the Klein farm, collected in a pond next to the dairy. For many years the slurry was regarded as waste because of the high concentrations of ammonia, phosphorus and potassium that would 'burn' the pasture if it were not first allowed to air-dry over some time.

Periodically the slurry was dried in the sun before being spread over the pastures. However, more product was being generated than the Kleins could effectively use.

Ian notes, "Because of our increasing herd size and intensification of production we needed to find improvements in managing and disposing of livestock effluent so that it prevented pollution of surface and ground water. As a result our effluent pond was an increasing concern to us. It was characterised by anaerobic bacteria and the sludge was high in ammonia. While we knew the sludge contained potentially beneficial nutrients, but these were unavailable for immediate use on the pastures".



*Dam water is used to wash down the dairy*

## From Effluent to Fertiliser

Wendy remarks, "In the first 24 years we did not regard the dairy shed slurry as an asset. It was a smelly mess. We reluctantly managed it and because our knowledge of ecological and biological systems was rudimentary we could not see the opportunity before our eyes".

"Our experience and advice meant we just did what everyone else was doing."

With their new approach to natural methods on the dairy, Ian and Wendy aimed to modify the slurry in the pond to achieve higher levels of oxygen by introducing aerobic bacteria. By adding beneficial bacteria to convert the ammonia into amino acid, this made the sludge an economically valuable fertiliser, which could be used as required.

Ian notes, "As a result we no longer had an excess of organic matter and toxic nutrient levels, it also ameliorated the pH to an acceptable level, reduced the offensive odours and removed suspended solids and salts in the slurry".

The once problematic effluent is now contained and managed in a large holding pond and after being treated is used as fertiliser for the pastures. The results are noticeable.

"When we spread the modified slurry onto the pastures we began to observe almost immediate benefits. Where a strip of pasture is missed during spraying, you clearly see that the grass is less vigorous and not as bright green in colour."

The effluent-based fertiliser is complemented by the other natural biological and ecological activities being performed at Pine Lodge in support of recycling nutrients.



*The effluent tanker is used to spray treated effluent onto pastures - with visible results*

## Recycling through Compost

Composting has become a key part of the on-farm recycling program, with all plain cardboard boxes, calf shed bedding, untreated sawdust, domestic wastes and even dead stock composted for farm fertiliser. The Kleins view these activities as reducing the farm's environmental impact, as well as supplying free fertiliser and helping to build humus in the soil. They also see that it gives the opportunity to learn more about composting and the benefits to be gained from it.

Others in the community who want to be a part of what the Kleins are doing are now saving cardboard and other materials to add to the compost heap. By performing their own recycling program through composting, materials destined for land fill are much reduced.

In Wendy's words, "As nothing, other than produce, leaves the farm, the nutrients contained in the soil stay where they are needed – in the soil – hence no nutrients (or chemicals) find their way into waterways to contribute to blue-green algae problems of some of our water storages".



*Milking shed effluent is contained in a large holding pond*





## Irrigated Pastures

The Pine Lodge property is within the Goulburn Valley irrigation region of north-central Victoria. The main water storage for this region is Lake Eildon, which is on the Goulburn River about 100km south-east. Water stored in Lake Eildon is released into the Goulburn River when needed for irrigation. Water for the Shepparton Irrigation Region is diverted from the river at Goulburn Weir, about 50km south of Shepparton.

Pine Lodge is situated in a temperate climate. The long term average rainfall is approximately 500mm, compared with average yearly evaporation of around 1500mm. With hot and dry summers accounting for this rainfall deficit, irrigation is required year-round to maintain plant growth.

Most of the farm's land cover is irrigated dairy pasture. Most paddocks are around three to four hectares with several larger paddocks around 20 hectares. The small paddocks have been laser levelled to provide a gentle slope to enable small bays to be flood irrigated. Farm water for the stock and irrigating the pastures is supplied from a large farm dam and from irrigation water purchased from the regional water authority.

Ian notes, "We have developed a complex system of small and larger paddocks that are irrigated using flood irrigation. Almost all the 261 hectares are irrigated at varying stages in the course of a year. The system of channels is linked to a major storage and reticulation dam on the farm".

Flood irrigation using a border check system is used. The irrigation bays range from 200 to 400 metres long. The Kleins also established a water reticulation system for capturing and reusing irrigation and rain-fed surface flows. Any water runoff goes to the lowest point on the farm, which has a large recycle system – to be used again for irrigation.

Rain water, held in a 255,000 litre tank, is reserved for washing milking equipment and cleaning the milk storage vat. Dam water is used to wash down the dairy.

Increased pasture and milk production meant more profit that enabled the Kleins to improve the standard of water reticulation and flood irrigation. "We laser level the bays that are growing pastures with a light re-grade as required to give us much higher water use efficiency. We have also installed a water reticulation system that captures runoff from irrigation and overland flows from high rainfall events. The benefits of this large water holding capacity are: no

water leaves our farm except in major flood events; we recycle the water more effectively and we only purchase additional water when needed."

Pastures used to be irrigated every six days during the summer months. Thanks to the better soil structure and increased water-holding capacity now achieved, irrigation is only required each 9 or 10 days.



*Top: Irrigation supply channel*



*Below and inset: Pine Lodge irrigation bays*



## Healthy Soils, Healthy Pastures

The soils of the property are classified as loams and clay loams developed from alluvium deposited over many years by the Goulburn River and previous streams. Soil mineral balance has been of greater concern than organic carbon levels.

Ian comments, "In 1996 we ceased using synthetic weed and pest control and applying synthetic fertilisers. Instead we applied numerous conditioners to the soil including gypsum, lime and dolomite as well as molasses and guano. By making this move to more biologically-based approach to farming, we began to observe a number of changes in our farm".

**"Our farming enterprise is like our family's health. We use natural inputs and products to maintain good health and well-being.**

As a result of the application of the soil bio-fertilisers, the Kleins have observed improvements in the health of their soil. More worms are visible, and the soil has better structure and nutrient

balance. The Kleins regularly have soils tests done on each paddock to determine which nutrients are limiting production. Based on the test results, the soil conditions are addressed to achieve the highest levels of productivity. Wendy happily reports, "Finally, the calcium level in our soil is close to where it should be!"

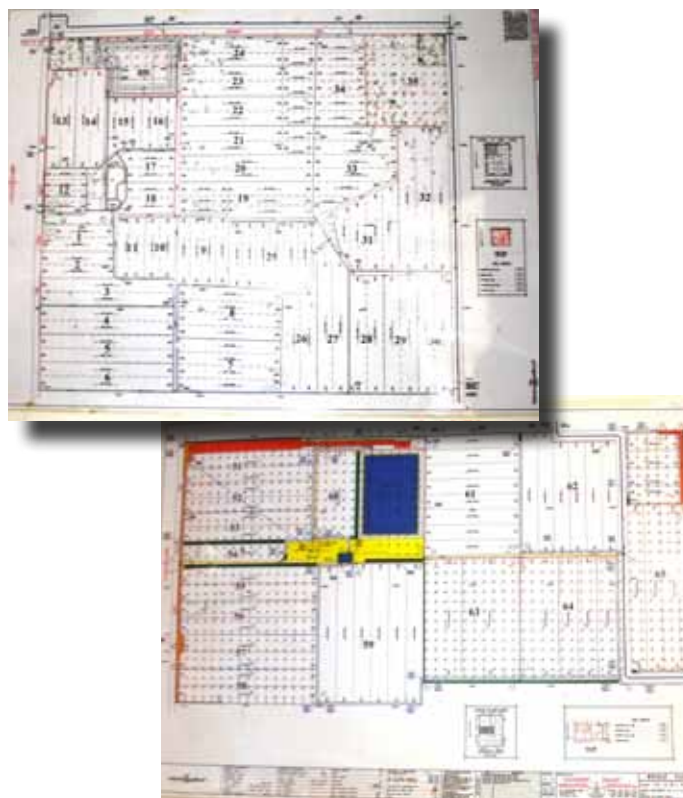
Wendy also notes, "I have farm (independent) soil tests for the past 14 years and it is very rewarding to see the benefits of our farming practices in increased organic matter in the soils. This helps conserve nutrients and water in the soil – much needed for the climate we now farm in".

The change in management to biologically-based practices also saw the Kleins be more careful in stimulating ecological processes. When combined with integrated pasture and pest management systems, this has seen pastures become more productive, growing for longer periods through the year, and significantly fewer interventions required to prevent health problems in the cows.

The enterprise involves intensive management of perennial and annual pastures. A rotational system of summer (perennial) and winter (annual) pastures is followed.

Each three to four hectare paddock is sown to perennial or permanent pasture comprising white clover and rye grass. This is irrigated regularly to maintain high levels of production. These paddocks are grazed every 28 days. Every year each paddock is treated with an effluent/bacteria mix after summer grazing and then irrigated again.

In winter the cows graze on the 20 hectare paddocks, which are annual pastures on subterranean clover. In February-March these pastures are watered to provide growth for the winter months.



*Pine Lodge farm plan*

The system of smaller and larger paddocks and the use of electric fencing has gained efficient pasture utilisation throughout the growing season.

A foliar spray comprising lime, molasses and borax in a rain water base is also applied to each paddock each year.



The farm has few weeds and pests due to the intensive management of the pastures. Keeping internal irrigation channels clear for irrigation purposes is sometimes a problem, as herbicides cannot be sprayed to suppress vegetation growth. Though not as successful as spraying, the Kleins are using other methods and looking at the vegetation in a new light.

"We manage excessive biomass in the channels by using two people with whipper-snippers. Excess vegetation growing in the irrigation channels has benefits in that it cleans the water", Ian notes. Any other weeds are managed by slashing or mulching, ultimately returning nutrients back into the soil.

A small section of the farm has a reasonable cover of remnant grey box (*Eucalyptus microcarpa*) trees which are encouraged to regenerate. As a certified organic farm, 5% of the property must be maintained for biodiversity. Wendy notes, "Grey box were the predominant large trees in this area, and we have tried to plant other species indigenous to this area... with enormous effort we managed to get a large percentage of the trees through the drought, only to see many get swamped in the last two years and die of wet feet". Regenerating trees are protected using tree-guards to prevent the cattle from damaging the young trees.

Wendy observes that there are now more birds, frogs, worms, dung beetles, spiders, bats and beneficial wasps. The dam is near a large remnant vegetation area and is also a haven for bird life.

No chemicals have been used for 16 years, and pests are not seen as a problem at all.

On being organic, Ian notes, "An added benefit has seen us lower our costs for weed control and pest management".



Remnant grey box woodland forms part of the dedicated biodiversity patch on the property

## Production and Personal Highlights

Wendy states, "When evaluating the farm's environmental performance, I would look at where the farm was 15 years ago and where it is now - and the improvement and benefits - both environmentally and financially - are obvious".

Ian points out, "The enterprise is profitable - but as for most agricultural businesses, the drought made life very difficult for a long time". Even with the challenges of drought, both animal and soil health are greatly improved and financial inputs reduced as a result of the changes the Kleins introduced. They aim to achieve a balance between inputs and outputs regarding pasture productivity and milk yield.

Wendy adds, "The farm is viable, partly due to the free fertiliser the farm now generates from the continuous recycling of waste products produced on the farm, no chemicals are purchased and all water is recycled".

"We made a few mistakes and lost a few good cows along the way - but we composted the dead animals and made fertiliser out of them."

On average the Kleins are obtaining greater than a 10% price premium compared to other producers. They are achieving this because of the natural product and through systems of management that can produce regular and reliable milk yield from season to season.

"Even if we were not getting a price premium, we would still farm the way we are because of the benefits to us personally and to the wider society", Wendy says.

By changing from conventional farming practices to working with more natural inputs and processes the Kleins:

- have much richer looking and biologically active soils and more earthworms
- have improved soil friability making it much easier to work, therefore using much less fuel
- have dramatically reduced veterinarian costs



"Our farming enterprise is like our family's health. We use natural inputs and products to maintain good health and well-being. The same is true for our farm. We aim to have active, ecologically healthy, functioning soils that produce high quality pastures; that feed healthy cows producing safe and wholesome milk."

Ian and Wendy have confidence that their management systems are having a minimal impacts off-farm. Their approach is to, where possible, grow all animal feed requirements on farm so that they are satisfied with the quality and health of the products they are producing. This approach offers considerable benefits both private and public.

Wendy comments, "We are not using anything detrimental to us, our animals or our environment – so we all benefit from that, even people who don't know us or how we farm".

"We aim to live with and work close to nature, understanding the seasons and cycles of life. Our systems of management are built on understanding ecological and biological processes. By improving the health of our soils, water and pastures and cows we have peace of mind that our environment is healthier than when we first began. We can also assure those who use our farm produce that it is of a high standard for human health and well-being."



# Empowering farmers to meet the soil carbon challenge



North East CMA, VIC

## NORTH EAST CMA

The North East Victoria Catchment Management Authority (CMA) region is bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west.

The North East CMA region takes in the local government municipalities of Wodonga, Indigo, Wangaratta, Alpine and Towong, plus parts of Moira and East Gippsland Shires. Approximately 95,000 people live in the region. The main industries in the region are agriculture (dairy, beef, lamb, wool, cropping and horticulture), forest products, tourism, value-added processing industries and manufacturing.

Responsibilities of the whole of the North East CMA include:

- River Health
- Floodplain Management
- Water Quality
- Wetlands
- Environmental Water Reserve
- Permits - Works on Waterways
- Waterwatch
- Land Stewardship - including Sustainable Agriculture and Environmental Management Systems
- Monitoring, Evaluation & Reporting
- *Caring for Our Country* projects including: Landscape Scale Conservation - Threatened Grassy Woodlands Project and the Soil Carbon Programme

Within the North East CMA Regional Catchment Strategy, the CMA conducts a wide range of activities addressing these responsibilities.



NORTH EAST  
CATCHMENT  
MANAGEMENT  
AUTHORITY

The North East Victoria Catchment Management Authority (CMA) is running an innovative project to help over 500 farmers improve the soil carbon content of their properties and empowering them with the knowledge to improve production sustainably, whilst meeting catchment environmental goals.

Chris Reid and the Land Stewardship team at the North East CMA recognised a critical gap in the knowledge of many farmers was how to practically manage soil fertility, its structure and the contribution of healthy soil to improved farm production. Assisted by funding from the Federal Government the team developed the *Sustainable Farm Practices - Soil Carbon Programme* to fill this knowledge gap and realise positive environmental outcomes.

In the face of one of the worst droughts on record and falling farm production generally, the team have balanced stakeholder needs with desired environmental outcomes to develop a successful and well-received project. The team is now delivering up to six information activities a month, including field days, forums and workshops. Through these North East CMA is connecting with landholders involved in existing and/or recently completed projects, Landcare groups and networks, industry groups and individuals with an interest in improving their soil organic carbon levels. Participating farmers now have the skills and knowledge to interpret their own soil tests offered by the project and have access to independent agronomy advice on how best to respond – in a sustainable manner.

Managing such a project requires dedication, commitment, and flexibility to address challenges as they arise. The team at the North East CMA demonstrate all these attributes and share how their project came into fruition and is making a difference across the entire catchment

Contact: [necma@necma.vic.gov.au](mailto:necma@necma.vic.gov.au)

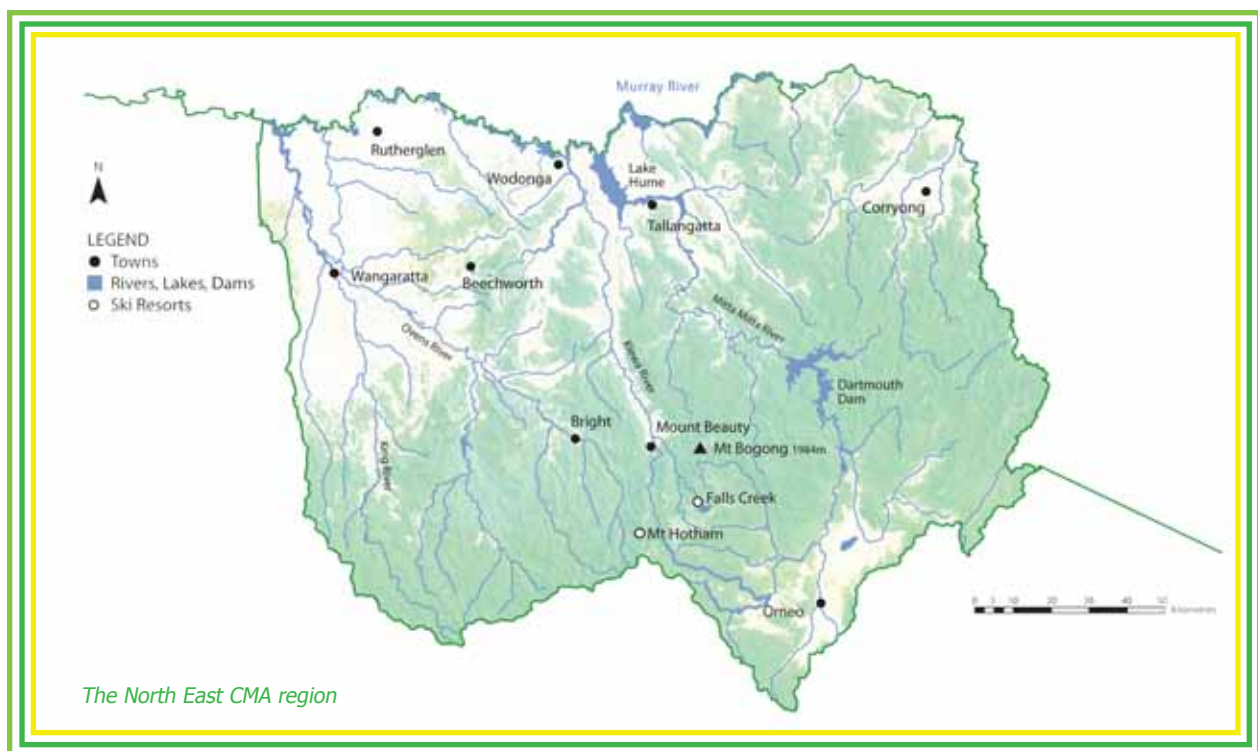
## Taking on the Challenge

The North East CMA Soil Carbon Programme was developed by Chris Reid and his Land Stewardship team in 2009 to take advantage of potential funding available from the *Caring for Our Country* initiative of the Commonwealth Department of Agriculture, Forestry and Fisheries (DAFF). The Land Stewardship team had built up considerable knowledge from numerous previous projects and they knew what contribution healthy soil could make to production as well as the environmental benefits it delivers. They identified a significant opportunity to build on their own previous work and that already undertaken by some Landcare groups in the region to spread this knowledge to the diverse farming community.

The team were not fully convinced by some of the arguments being aired in support of the economic advantages of mooted pasture-based carbon farming under carbon trading schemes. However, they were convinced, by their own surveys and practical engagement with farmers, of the need for land holders to increase organic soil carbon as part of a strategy of farm landscape regeneration, and, ultimately, for improved production. The team had access to data that showed rates of soil carbon in the region in the 1830s as high as 12% and yet the current figures averaged less than 2%. The potential for improvement was clear.



*A critical knowledge gap in understanding soil tests was identified by the NE CMA*





It was apparent to the Land Stewardship team that the majority of farmers did not understand the benefits of soil testing and how to interpret their own results. Farmers were therefore inhibited in making choices for strategies for improving soil fertility and structure.

An issue arising from this lack of understanding was the use of fertilisers, what occurs as a result of continued application and the effects on soil nutrition. This was leading to issues including widespread but localised soil acidity problems, aluminium toxicity and grass tetany. Grass tetany is a reaction in livestock caused by magnesium deficiency often resulting from a mis-match of low-magnesium pastures and fertiliser use. In the view of Chris and his team, better education of farmers on understanding soil structure, soil carbon management grazing management and soil fertility would be inherently valuable.

Promoting the idea of improving soil carbon levels in the face of one of the worst droughts on record and falling farm production generally, was going to be a very difficult task. If stakeholders were to be convinced of the advantages of joining in the *Soil Carbon Programme* in such an environment, the possibility of improving production had to be demonstrable. The other significant part of the equation was that improving carbon levels was potentially a slow process. Results would not be obvious for some time into the future. The potential for increasing farm production therefore had to be clearly linked to the initiatives for improving soil carbon levels.

Chris and his team worked to identify what would help motivate farmers to join the *Soil Carbon Programme* in this challenging environment. Chris says they decided to offer a benefit for participants up front, in the form of, "Soil testing that produced results that farmers could understand and from which they and their agronomists could make sound decisions on soil fertility and management".

Given this starting point, the team then developed the concept further to include independent agronomy workshops to explain to farmers how to read soil analysis and to provide guidance for further decision making. They would offer access for farmers to an agronomist of their own choosing from a panel of eight to provide follow-on support in the workshop program. The team would also seek out speakers from across Australia - and even international experts - who had practical experience in building soil health, with a focus on carbon, to pass on their experiences to land managers across the catchment.



*Field days provide a valuable opportunity for information sharing and maintaining engagement*

## Project Objectives and Activities

Chris defines the key objective of the program as, "To achieve long term and continuing change to farm management practices that will raise the capacity of farmers to improve the soil carbon content of their properties in the long term".

Overall, the project activities developed were quite straightforward. The CMA team determined that it would pay for soil testing for the participating landholders; provide free agronomic advice to these landholders on the soil test outcomes; run field days, workshops and forums on soil organic carbon and related subjects; and deliver free eFarmer training through adult education approaches. A final soil test would be provided at the end of the program to measure improvements in soil health.

In turn, the project would require specific actions from participating landholders:

- ♦ Committing to changing their management practices for the term of the project on a nominated area of their property.

- ◆ Agreeing to participate in farm planning and soil management training and information sessions, in which they would have access to free soil testing and agronomic advice.
- ◆ Selecting an agronomist from a panel nominated by North East CMA who would provide up to four free on-site advice sessions.
- ◆ Attending free eFarmer workshops conducted by North East CMA, for which the project team would set up an eFarmer help desk in support.

eFarmer is a web-based application which supports the capture, viewing and sharing Natural Resource Management information across farms, landscapes and catchments. The web application, together with a simple matrix, informs private land managers of the natural resource management priorities of the CMA within which they reside and allows them to identify proposed and voluntarily implemented activities on their properties that may contribute to the achievement of CMA catchment wide targets.

### SOIL CARBON PROGRAMME TARGETS

**2800** land managers would improve their natural resource management knowledge.

**1500** landholders would begin using improved soil management practices.

**1300** land managers would attend soil management forums.

**500** land managers would commit to the whole project and attend farm planning and soil management training and conduct prescribed management practices on a nominate area of their land. These would be the key stakeholders of the project and its champions.

## Planning Process

The majority of the planning for the project was conducted as part of compiling the submission for DAFF funding. Suzanne Johnstone from the team explains that the North East CMA team found developing the Program Logic document, required for an application for DAFF funding, was a useful methodology for scoping the project. The Program Logic has since provided the basic guidance for all further project documentation.

Another key document that was developed during the planning phase was the Community Engagement Plan. This Plan identified stakeholders and set out strategies for dealing with the issues that their research had shown were the keys to the success of the project. Identified communication activities included actions such as attending meetings and discussing the project with community groups, mainly local Landcare groups, and a whole-of-catchment mail out using tailored postcards supplying project information and contacts.

The team identified its stakeholders for the *Soil Carbon Programme* to include:

- ◆ Landholders of the CMA region
- ◆ Landcare groups of the CMA region
- ◆ Local industry supporting farming activities
- ◆ Conservation management networks
- ◆ CMA staff

The landholders of the region were the communication priority. Key messages for the communications were the 'no strings' soil testing, the independent agronomy advice, the use of the eFarmer planning tool and the field services provided for training and education. The communication activities would also be subject to the continuous improvement based on documented stakeholder feedback.

Credibility at all stages of the project was identified as essential. All of the stakeholders needed to have trust in the CMA team and in what the project could deliver. The farmers, in particular, needed to have trust in the information they received from the CMA team, the soil testing reports and in their chosen agronomist.

The team was certain that, only when this mutual trust and credibility was established, could they expect a commitment from farmers to the project and its outcomes.



## Obtaining Funding

In developing their grant funding proposal, the project team identified three streams that required funding for the *Soil Carbon Programme*:

- ◆ soil testing
- ◆ agronomists and associated training and information delivery
- ◆ staffing of the project

The CMA Board reviewed and supported the soil carbon initiative proposal and recommended it to DAFF as one of a number of North East CMA proposals recommended for funding. DAFF agreed to fund the *Soil Carbon Programme* to \$2.2 million over four years, running from July 2009 to June 2013. The allocated funding supported all the proposed soil carbon activities as well as salaries for 3.5 full-time equivalent (FTE) staff positions.

## Risks and Challenges

Early in the planning phase, the project team expected that continuous risk and impediment management would form a large part of project management. The team identified risks to the project and developed strategies to manage them.

One of the major risks identified was the potential for staff turnover, and thus a loss of competencies from the project, as project funding was expended and staff sought other secure employment. To address this, the management team set to identifying opportunities for future projects and associated funding to ensure ongoing tenure and retain and use existing competencies.

Another significant risk identified was the difficulty of engaging 500 landowners in the program and keeping them committed for the four year duration. The team determined that maintaining ongoing communication and ensuring continued engagement through active participation in regular events would be the best way to manage this risk.

The planning phase also identified a number of likely impediments to the success of the project.

Being conducted at the height of a major and long term drought, many of the landholders would be focussed on surviving the drought and would not necessarily be interested in improving soil structure, carbon content and fertility. Additionally, many landholders were accustomed to dealing with a number of organisations, entities and



*Learning to interpret soil tests helped farmers develop sustainable solutions for improving their soil carbon*

individuals who were committed to traditional farming practices. Farmers had long followed their advice and support and may, therefore, be reluctant to abandon comfort zones and begin something new.

As part of their impediment management program, Chris and his team decided that their impediment management approach would include:

- ◆ Soil testing for the 500 participants undertaken by a trusted scientific entity that was used in a previous large scale Landcare soil testing project.
- ◆ Free explanations from experts on how to interpret soil testing results.
- ◆ Providing free advice to farmers from a CMA-identified panel of independent agronomists.
- ◆ Conducting field days and seminars with guest presenters suggested by farmers who were not committed to any particular method of farming or landscape regeneration to the exclusion of other ideas.
- ◆ Ensuring that all advice came from independent sources and was not delivered by local, state or commonwealth agencies.
- ◆ Ensuring that the project team members and the agronomists listened to the landholders and reported back their comments, ideas and suggestions.



## Managing the Project

Although the communications activities were relatively unsophisticated, Suzanne explains, “We were swamped with Expressions of Interest, to the extent that we had a backlog that we were having trouble dealing with”. Overall, 505 landholders have been selected to participate in the initial soils testing component of the project, from a range of farming enterprises including grazing, cropping, horticulture, viticulture, dairy and mixed enterprises.

As the project got underway, North East CMA organised and funded the initial soil sampling, comprising 22 soil cores extracted from 2 x 100m transects from each property. Soil was subdivided into four depth categories between 0-30cm and pooled prior to laboratory analysis for soil carbon as well as other chemical and physical soil characteristics. Group on-farm soil advice from their nominated panel of agronomists through field days and forums was also funded and organised. Landcare groups and networks, industry programs with similar focus, and individuals with an interest in improving their soil carbon management were identified and engaged. Regular newsletters and soil improvement information sheets were distributed to maintain interest within in the project.

The project was fortunate in that the staff carried over from a previous project had a broad range of natural resource management and agricultural skills and also had the advantage of tapping into existing Landcare coordinators and project managers that had great field and community experience. The team built on the previous experience and took on new skills. Chris notes, “Training in other areas was conducted, such as use of the soil sampling machine and preparing a formal process and following it for consistency of data and for reducing sampling error”.

Chris and his team manage from the project baseline plan and the original brief. The project is managed across three streams into which individual components have been grouped.

1. **Soil Testing** – soil testing and seminars for interpreting results.
2. **Training and Education** – agronomy sessions, field days, seminars and the eFarmer training.
3. **Quality Management** – post-activity surveys, eFarmer help desk feedback and ongoing communications including CMA Internet site updates.

## Continuous Improvement

The Quality Management stream of the project aims to ensure continuous improvement of activities and information resources. Anonymous post-activity surveys administered to review training outcomes and take-up provide an opportunity for respondents to comment on content, speakers, activities and to suggest changes and improvements. This information is analysed by the CMA team and changes made to programs and activities according to need and available budget.

The CMA team depends on these anonymous surveys to check achievement of objectives and targets and to provide input to improvement of future activities.

The information from surveys is also vetted and commented upon by the agronomists participating in the program and compared with anecdotal information from North East CMA staff.

**Feedback from field days held in February 2012** showed that all attendees answered ‘yes’ to the question “*Has your knowledge of Soil Health improved from this session?*”, each marking five out of five that they had “learned a lot”.

In response to the question “*Having participated in the Soil Carbon Programme, do you consider that your approach to farm management practices may change to incorporate some more sustainable practices?*” those that answered ‘yes’ also provided comments of the changes they may make including:

- “Less emphasis on spray and more emphasis on management”
- “Use less chemical, rely on biodiversity”
- “Improve grazing management”
- “Look at a longer management cycle to grazing”
- “Understanding your landscape”
- “What weeds are telling me about my management”
- “Ground cover management is now my top priority”
- “I will manage to increase local biodiversity”
- “Floodplain management”
- “Maintaining water in the soil profile and using carbon to do this”



Suzanne Johnstone, as the lead in the eFarmer training, provides information based on her help desk role and hits on the eFarmer Internet site.

All the information gathered contributes to the continuous improvement of project activities and content and targeting of supporting publications. The project team regularly reviews activities and outcomes for opportunities to implement changes to the project and activities.

## Lessons Learned

The well developed continuous improvement program ensures that any shortfall in expectations, of which there have been very few, becomes the basis for improvement. For example, when the manual collection and storing of information became onerous, a database was established. The database continues to be developed and its numerous functions are major contributors to efficiency in the project and have reduced resource overheads by the equivalent of half the workload of one full time staff member.

The hand auger sampling was an idea that did not stand up to early optimistic expectations and was soon abandoned with the arrival of a suitable mechanical option.



*NE CMA staff were trained to use the soil sampling machinery*

"In the first instance, we had a three months wait for suitable soil sampling machinery and undertook a program of manual sampling in rock hard, drought affected soils. We found that we did not have the resources to continue with the manual taking of soil in accordance with our planned timetable and, in any event, from an OH&S viewpoint, manual sampling was not a good idea. However, suitable machinery was eventually sourced and staff trained to use the machinery and to follow a constructed soil sampling process."

Initial team grouping of participants did not always work out in all instances. There was a need to move some participants to other groups as their interests were not well aligned with the majority of the participants in their area.

Similarly, choice of agronomists by some participants did not align well with requirements. "Two to three of the agronomists were exchanged by some participants for others – we always planned to offer choices to participants – even offering them to other groups such as similar enterprises, independent of their geographically location. This worked well."

Other key lessons from the project include the importance of:

- ◆ Establishing credibility through empowerment of stakeholders.
- ◆ Maintaining continuing contact with stakeholders and responding positively to suggestions and feedback.
- ◆ Continuous improvement of project activities and outcomes based on stakeholder feedback, such as:
  - ◆ using independent consultants;
  - ◆ adaptive management; and
  - ◆ initially offering an obvious benefit to project participants (in this case, soil tests and agronomic sessions).

In addition, to align with the expectations of landholders, it was essential for success that the program focussed broadly on soil health, not carbon sequestration alone, but to ensure that the program did not exclude information on carbon sequestration.

## Significant Outcomes to Date

Some interesting insights were provided by one of the projects participants, John Paterson, a beef producer in the Mitta Mitta Valley. John and his wife 'retired' to the area after many decades of dairy farming in the Cobram Area. Their approach to farming over that time might be considered conventional and John recognised their reliance on superphosphate and chemical inputs to keep the pastures growing.

Over recent years, with the costs of these inputs continuing to increase, John began to ponder alternatives. The *Soil Carbon Programme* seemed to offer an insight on other management options and the free soil testing and access to alternative agronomists were appealing. He 'put his hand up' and has enjoyed the experience immensely, particularly in joining others from the district and hearing their experiences.

John has learned much about soil health including getting mineral balances right, the beneficial work of dung beetles, the ability for native and clover pasture species to re-emerge and the positive effects that improved grazing methods can have on the enterprise. He has experimented with rock phosphates which support the soil biology and the pasture results are readily apparent when compared to adjacent untreated paddocks. The program has exposed John to new possibilities in grazing and he says he will, "Keep giving it all a go and see what happens".

So far, more than the target number of landholders have become involved in the farm planning/soil management training, have accessed free soil testing and agronomic advice and agreed to change their management practices on a nominated area of their property.

Suzanne reports, "The offer of free soil tests with an obligation to attend four free soil agronomy sessions with a soil specialist of their choosing attracted 505 land holders - covering a significant area of the north east region. The attendance at each of the sessions has indicated the strong interest in soils in general and soil organic carbon in particular".

The combined area of all the properties involved in the *Soil Carbon Programme* is over 116,000 hectares, noting that not all of this area is subject to changed soil management practices at this stage.

"The overall objectives of the project have been largely met due to the need and interest of the region's landholders to improve their productive resource (soil) due to the years



*Improved pasture on the property of Soil Carbon Programme participant, John Paterson*

of degradation through general inattention and drought; and genuine interest in improving their soil health for long term sustainability."

The training and education activities have been very successful and high demand has meant that, in some cases, there have been up to six seminars/field days in a single month to different locations in the North East CMA region.

Highlighting some of the significant outcomes of the program so far, Suzanne observes, "New people keep coming to our events. Involving local people in local events empowers them. Empowered people are easier to convince... and the cost is minimal. We now have over 2000 landholders on our database from attendance at our events!"

The team also points out that credibility is the key, "Farmers can see that we respond to their suggestions and that there are no strings attached".

The anonymous exit surveys conducted by the team have shown that the field days on farms have developed promoters and champions of change, who, in themselves are not usually promoters of new ideas.

While noting that it is too early to point to dramatic changes in soil carbon levels where changed farming practices are in place, the team are confident that participants can show improvements in soil structure, pasture cover and stocking rates. Analysis from the results of the initial round of soil tests can be found on the North East CMA Internet site: <http://www.necma.vic.gov.au/OurPrograms/LandStewardship/SoilCarbonProgramme.asp>.





As an indicator of the success of the program, the team point out that no participants have really separated from the *Soil Carbon Programme* and, indeed, some from the wider population have sought to join.

"From a provider of integrated catchment management programs, the delivery and uptake of information from this project has been very successful. We will be going back to all 505 landholders in the last year of the project to undertake soil carbon testing and interview each landholder to understand what changes they have adopted as a result of attending the information sessions and the general heightened level of information that has been made available through this program. The data base of information collected as part of this project through interviews and soil tests will be assessed to understand the health of the regions' farming soils and opportunities to improve the environmental service the soil provides."

Interim reports are demonstrating that, as a result of being involved in the *Soil Carbon Programme*, many participants are adopting agricultural and management practice changes across their whole property, not just on the sites committed to the soil testing activities. Changes already adopted include:

- ◆ Increasing paddock numbers and transition to rotational grazing management
- ◆ Improved ground cover maintenance
- ◆ Promotion or sowing of perennial species
- ◆ Maximising species diversity in pasture
- ◆ Increased stubble retention
- ◆ Changes to fertilisers used, such as seaweed and trace element application rather than only annual NPK application
- ◆ Application of more precise Calcium products, such as sulphur/calcium/magnesium mixes

Once the final interviews and soil testing are complete a thorough assessment of the *Soil Carbon Programme* will be undertaken.

Chris and the team see a clear need to communicate their successes beyond the farming community. The region includes some major urban population centres, in



*Interest in the North East CMA Soil Carbon Programme has been ongoing*

particular Wodonga (and nearby Albury) and Wangaratta, that are home to schools, community groups and business and agricultural production organisations and also industrial entities that support agriculture. In addition, the team has identified a number of complementary programs being run by Landcare that could provide opportunities for mutual benefit in widening awareness of the economic and environmental benefits of farm landscape regeneration. These areas will be addressed through the regional media as an enhancement to the existing stakeholder engagement activities.

As another aspect of soil carbon improvement, the project team are involved in, is an in house experimental program which is using willows extracted from stream regeneration projects to produce bio-char in a portable charcoal furnace. Further bio-char funding has been received by the *Soil Carbon Programme*, to implement field trials in bio-char and test its value for local agricultural enterprises.

Chris and the team believe that the momentum created by the *Soil Carbon Programme* could well be the starting point of a further projects that deal with the integration of soil hydrology, soil fertility and vegetation in triple bottom line outcome for CMA landholders. Project of this nature could logically build on the considerable amount of data collected a part of the *Soil Carbon Programme*.

Perhaps the success of the project to date can be best summed up by Suzanne Johnstone, who comments, "This has been the most rewarding project in the 15 years I have been involved in NRM activities... there have been more 'light-bulb' moments associated with our work with farmers than I can ever remember".

“New people keep coming to our events. Involving local people in local events empowers them. Empowered people are easier to convince... and the cost is minimal.”

## SHARING THE SUCCESS

This project is achieving catchment-wide change in knowledge of how to build healthy soils, using a range of methods that best suit the individual farmers. This closing of a critical knowledge gap, supported by practical advice and action on the ground, provides a positive example that others could follow. With funding of \$2.2 million over four years, over 500 farmers are actively involved and up to 1500 are beginning to use improved soil management practices. This equates to around \$1500 investment in each farmer over a four-year period.

The project demonstrates a very cost efficient way of encouraging change in farming practice. If extended across Australia's 53 other CMA/NRM organisations it would realise 25,000 farmers actively changing their soil health for the better, together with another 50,000 looking to make a change.

Through an expanded communications program, the results can be explained to not only land managers but also to local government, businesses and schools to provide wider community awareness of the importance of soil health and the methods of achieving improved fertility.

The knowledge gained and then successfully applied through such a program could also be recognised through the awarding of a formal qualification through local training providers.



# Working with the willing



## NRM SOUTH

### Southern Tasmania

#### Enterprises:

Grazing, cropping, perennial horticulture and other sectors

**Average Annual Rainfall:** 400-2400 mm

**Elevation:** Sea level to 1450 m

**Soils:** Varied, on dolerite, mudstone and sandstone, ranging from podzol, podzolic to brown, black and alluvial

**Native Vegetation Cover:** 60-70% on average, less than 50% in the Jordan catchment (mostly within the Southern Midlands municipality)

#### Innovation

- Engaging farmers through supported activities to encourage trial and adoption of regenerative landscape management
- Tailoring support to land manager requirements
- Activities commenced: 2010

#### Key Results

- Farmers adopting trials of planned grazing
- Gaining a sound understanding of farmers' interests in improving their landscape
- Developing the ability to set-up and monitor farm trials
- Exceeding engagement targets



The team at Tasmania's NRM South are tailoring solutions to meet the needs of landholders in their catchment and are offering low risk trials for farmers willing to try new land management practices.

Southern Tasmania's natural resource management organisation, NRM South, has determined that the best way to encourage regenerative land management practices in their region is to give farmers what they want. Surveys of landholders participating in the Woolworths drought landcare project showed that soil health, pasture management and irrigation were the areas of most interest to farmers in NRM South's region. Understanding that everyone is at a different stage of learning, with different priorities for the management of their land, the team at NRM South has developed a range of activities and learning strategies most suited to individual landowners to improve knowledge and practice in these areas. Their methods provide a model of coordination and cooperation for organisations helping landholders to embrace change in land management.

The NRM South Sustainable Farm Practices program has two components: *Living Soils* delivers education, engagement and support, and *Building Evidence for Regenerative Agriculture* incorporates a range of projects to develop a body of evidence for the application of low input, biological farming practices in southern Tasmania. Central to this, NRM South is working with farmers to perform monitored trials, particularly in holistic planned grazing. With comprehensive support and guidance, willing participants are learning new methods and obtaining evidence to help them decide whether to adopt new practices on their land.

With a focus on landscape health, NRM South is providing tools to help identify and support farming goals through an approach that targets outcomes across the triple bottom line – social, environmental and financial.

Contact: [admin@nrmsouth.org.au](mailto:admin@nrmsouth.org.au)

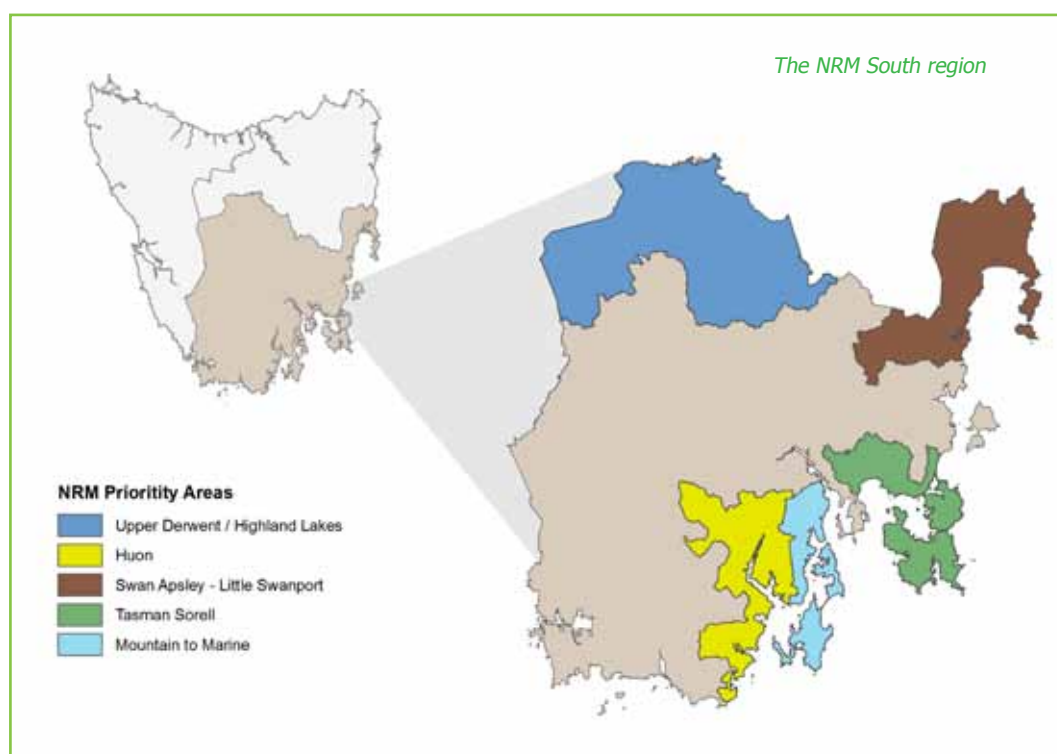


## About NRM South

NRM South is the natural resource management body for southern Tasmania and engages with government, business, scientists and the community to protect and manage the natural assets of the region.

The Southern Tasmanian NRM Region covers 2.5 million hectares, including Hobart, its urban fringes and numerous towns and hamlets, and supports almost half of Tasmania's population of 500,000. It spans the twelve urban and rural municipalities of Brighton, Central Highlands, Clarence, Derwent Valley, Glamorgan Spring Bay, Glenorchy, Hobart, Huon Valley, Kingborough, Sorell, Southern Midlands and Tasman and the state and federal electoral divisions of Franklin, Denison and roughly one third of Lyons. NRM South has five priority areas for investment in its region, established on the bases of threats to natural assets and community readiness.

Approximately 1200 landholders reside in the NRM South region, however, due to the nature of the region, only 12% of these consider themselves full-time farmers. Around 240 landholders have some form of active engagement with NRM South.



Eighteen staff work at NRM South implementing a range of programs, projects and initiatives. These activities seek to address the corporate priorities, namely:

1. Develop and share knowledge of the region's natural resource condition, values and threats
2. Build partnerships and engage the community in positive action
3. Deliver on-ground and sustainable practice programs in priority areas
4. Optimise the use of available resources for NRM and secure additional resources
5. Govern and manage the NRM South business effectively

## Tailoring Support

NRM South engagement activities aim to develop “a productive and ongoing relationship based on mutual respect, trust and benefit”. Central to this is jointly meeting landholder and NRM requirements.

NRM South understands that the landholders in their region have varying motivations and needs. Dr Magali Wright, the NRM South Biodiversity Coordinator, points out, “People are at different places [with their land management practices and knowledge] and need different things”. This understanding has led NRM South to tailor their information and support as much as possible within their available resources to meet landholder needs.

Using their base funding from the Australian Government’s *Caring for Our Country* program and funding from the Federal Department of Agriculture, Fisheries and Forestry, the team at NRM South have developed a range of activities to meet these goals.

Drawing on survey information that showed that soil health, pasture management and irrigation were the areas of most interest to landholders in the region, information and activities are targeted to address these areas, but always within the context of overall environmental, economic and social health. The team at NRM South attempt to provide broader land health solutions to address specific problems being experienced by landholders (for example, weed invasion), to better support triple bottom line outcomes.

The ability of the local facilitators, who work in each of NRM South’s priority areas, to build relationships in local communities is essential to the success of the program. They initiate engagement with landholders through advertised workshops or field days and one-on-one farm visits. Interest in regenerative farm practices is also spread more broadly through word of mouth between the range of long-term landowners, sea-changers and tree-changers which comprise the region’s populations.

## Living Soils

*Living Soils* activities provide a range of methods of education, engagement and support. The team attempts to manage activities that best engage landholders and facilitate communication. Workshops and field days are fundamental to the program. Barry Hardwick, the Regional Landcare Facilitator notes, “Group processes are powerful learning experiences. As are visiting other landholders to share experiences”.

The Living Soils workshop series addresses a range of methods and techniques including but not limited to Keyline ploughing, compost, compost teas, holistic planned grazing and pasture cropping. Local facilitators also deliver workshops addressing issues such as weed management, salinity, tree decline, erosion, pasture decline, soil health and native grass management. On farm visits are also performed, providing advice and action planning with expert consultants or advice and support from local facilitators.

NRM South also supports existing farmer groups in the region and facilitates the formation of new groups to further spread their engagement and enable information sharing.

On-Farm Action grants are available as an alternative method of supporting engagement and practice change. These have received strong interest from the community and further extends NRM South’s reach. These incentives provide financial and in-kind support for various areas of landscape regeneration, such as weed management, biodiversity and riparian protection. The On-Farm Action grants encourage co-investment from landholders and align with available service provision and ongoing support advice or activities from local facilitators.

“Group processes are powerful learning experiences.”



Landholder visits provide the opportunity to share experiences

*Living Soils* is a key project delivered through the Regional Landcare Facilitator role. As at December 2011, halfway through the three-year project, it has:

- ◆ assisted 43 landholders to prepare action plans to improve the environment both on-farm and off-farm, from a target of 60
- ◆ provided advanced training activities on sustainable farm and land management practices that deliver improved ecosystem services to 116 landholders, from a target of 360
- ◆ engaged 452 landholders through workshops and field days, already exceeding the three year target of 400.

The team want their projects to empower and build capacity in their landholders, rather than relying on external supports. In Barry's words, NRM South wants to help landholders "To find their own solution for their business, for their property, for their family, for their community".

### LIVING SOILS contributes to SUSTAINABLE MANAGEMENT OBJECTIVES & MEASURES

- ◆ Promote and support the uptake of sustainable management practices, attain **20%** uptake
- ◆ Promote innovation in agriculture
- ◆ Build evidence in the application of sustainable practices in a Tasmanian context as an engagement mechanism
- ◆ Engage **400** landholders with the program
- ◆ Support practice change in **60** landholders
- ◆ Measure area (hectares) under improved management
- ◆ Measure the amount and type of resource condition and change monitoring conducted

NRM South is continuously learning from their activities to improve their services and the outcomes in their region. Cathy Limb, the Communications and Engagement Manager, knows that many activities, "Develop and support passion in the land managers", but that, "follow up is critical – to maintain the momentum."

To support this, NRM South are moving from the previously typical short-term individual projects, to longer term activity planning to gain continuity of outcomes, including ongoing engagement, support and empowerment.

## Building Evidence for Regenerative Agriculture

To encourage landowners to adopt new regenerative practices and holding a long-term view to landscape regeneration, NRM South has developed the *Building Evidence for Regenerative Agriculture* projects.

The primary objective of the *Building Evidence* trial sites is to demonstrate the application of regenerative agricultural practices on farms in the southern Tasmanian region. The evidence collected through the trials will be used to support farmers interested in these techniques and improve the sustainable management of natural resources on their properties. These are successful in bringing farmers on board, because, as Cathy points out, "Trials are a low-risk approach".

The experience of team members at NRM South has shown that changing thinking is a very challenging process for some landholders, whereas others find it easier. Only having to commit to a trial helps to ease some farmers into new practices and allows them to test these out for themselves.

The *Building Evidence* trials ultimately aim to bring landscape change across southern Tasmania grazing land and improve landscape function, in particular retention of resources in the landscape and improved water and nutrient cycling. Holistic planned grazing was selected as the trial method, as improved grazing regimes have the potential to lead to large scale change - a large proportion of private land in the NRM South region is grazed. Many threats to the region's natural assets have also been linked to inappropriate grazing practices.

The trials follow principles that build on the concept of 'holistic decision making' which provides tools to help identify and support farming goals across the triple bottom line - considering economic, social and environmental aspects. The trials incorporate holistic planned grazing





“Trials are a low-risk approach.”

treatments with a focus on dealing with causes of land management issues, not the effects or symptoms. They aim to develop skills to improve soil health and landscape function.

The short to medium term outcomes of the *Building Evidence* trials are communication, engagement and capturing qualitative and quantitative data based on changes in pasture and soil resources. In the longer term, in addition to ongoing communication and engagement, the project aims to provide a research base, and the potential for scientifically rigorous comparisons to reference sites.

Over 25 trial sites have been established across the region, with a number of other less formal trials taking place on other farms. Fifteen of the trials are undergoing formal monitoring processes, and five have been set up as demonstration sites. Ongoing monitoring and evaluation is helping to identify issues and is an integral part of the project.

NRM South staff are now building sufficient skills to set up trials on farms, reducing previous reliance on consultant support. This both assists with minimising expenses and helps achieve credibility and trust from landholders.

Approximately six staff work on the *Living Soils* and *Building Evidence* projects, however, most of these also have other responsibilities, so all are on a part-time basis, ranging from around one to three days a week on the project. Budget allocated to the projects vary each year, depending on the activity and focus. In Financial Year 2011-12, \$76,000 has been allocated to *Living Soils* and \$70,000 to the *Building Evidence for Regenerative Agriculture* project. These figures do not include salary components.

## The Participants

*Building Evidence for Regenerative Agriculture* trial participants are private landholders with different enterprises, values, land management issues and production. The majority are conventional agricultural enterprises, however there are also two organic farms with conventional grazing regimes. Each landholder is trialling the use of holistic planned grazing on a small half to one hectare paddock. However, Barry reports, “A number have gone to whole of farm first up”, with two landholders making a full transition to holistic planned grazing across their entire properties.

### BUILDING EVIDENCE FOR REGENERATIVE AGRICULTURE OBJECTIVES & MEASURES

- Encourage improved grazing management in southern Tasmania
- Trial the effectiveness of planned grazing to address a range of land management issues and landscape goals with landholders willing to host long term demonstration sites
- Establish **5** sites in 2010-11 and **10** new sites in 2011-12
- Monitor results of resource condition improvement
- Record how many landholders extend the practice beyond trial scale

All of the 15 trial sites with formal monitoring have poor landscape function and most have been selected to focus on the poorest soils and pastures on the properties. The trial sites have been set up to address a range of land management issues including herbaceous and woody weeds, salinity, soil erosion, poor ground cover and water-logging. Water cycling is an issue on all sites.

The trial locations range from coastal scrub to wet forest, however the majority would originally have been grassy woodland. All sites comprised degraded native or introduced pastures and would have previously functioned more effectively. Some sites contain or are linked to native vegetation, and the majority of the 15 trial sites had low cover of perennial grasses prior to changing grazing management.

Most common weeds being addressed on the trial sites include ragwort (*Senecio jacobaea*), horehound (*Marrubium vulgare*) and gorse (*Ulex europeaus*).

The prime motivation of landholders to participate in the trial appeared to be an interest in improving soil health through encouraging biological activity. The goal of many of the landholders in participating in the trials was to increase the cover and diversity of palatable perennial grasses on their land.

Additional information is also being captured through the trial on landholder motivations, drivers and barriers to adopting new practices. Interviews have been conducted with the 15 landholders hosting trials and these will be revisited in 3-5 years to help understand what influences the uptake of regenerative farm practices.

## The Trials

Participants have set up two small half or one hectare paddocks for the trial and selected an area of conventional practice to be their 'control' or reference site. Some increased fencing has been required on the majority of properties in order to establish the trials.

The trials comprise a short grazing event with intense stock density followed by a long recovery period (greater than 150-180 days). These recovery periods are determined by monitoring the recovery of perennial grasses. For the landholders that have extended holistic planned grazing across their entire property they have either increased the fencing or started to run their stock in larger mobs.

With the assistance of expert consultants, NRM South has produced a comprehensive, yet simple to understand *Guide to Planned Grazing* to support this project. The first part of the guide shows how landholders can conduct a trial of planned grazing on their land to see how the method works. The second part of the guide provides planning and monitoring tools to help those who have already trialled the method to refine it for their property.

Five field days have been held at grazing trials sites with practical demonstration on how to monitor for changes in pasture following the methods in the *Guide to Planned Grazing*. Demonstration sites have provided a great opportunity for people to get together and talk. Common points of discussion at these activities include:

- ◆ How small scale trials relate to whole properties
- ◆ Perennial grass recovery
- ◆ Animal performance
- ◆ Applying planned grazing using existing farm infrastructure

The following is an abbreviated excerpt from the guide on how a trial is set up. The full guide is available on the NRM South Internet site: [http://www.nrmsouth.org.au/uploads/d/287/15131299\\_51nrmsouthplannedgrazingg.pdf](http://www.nrmsouth.org.au/uploads/d/287/15131299_51nrmsouthplannedgrazingg.pdf)

### Setting Up a Planned Grazing Trial



**Step 1:** Fence off a small area. Choose your smallest paddock or fence off a corner so that with your mob size the animals are at stockyard densities. For example, if you have sheep in mobs of 500 put them into an area of less than 0.5 ha (1 acre). The closer you can get to stockyard density the less time the stock will need to be in the trial area.

**Step 2:** Make a record of the current health of the pasture.

It can be helpful to take photos before, during and after this treatment so you can easily monitor any improvement. Take the photo looking straight down from around chest height so that you can see the soil surface.

**Step 3:** Add stock. You might need to leave the animals there for as little as four hours, so keep a close eye on your trial area.

**Step 4:** Remove stock. It's important to take stock out at the right time... when the animals have trampled most of the area but the soil surface is still 100% covered either by plants or litter.

**Step 5:** Record the date, for how long and how many stock were in the trial area.

**Step 6:** Leave the area to recover. It typically takes between 6 and 12 months in temperate regions such as southern Tasmania for the best perennial grasses to recover. Grasses are considered to be recovered when they contain fresh litter (dead leaves still attached to plants) and there is no evidence of previous grazing such as chewed tips.

**Step 7:** Repeat the process. By doing this you should continuously improve biodiversity of your pasture and the land function. Recovery time varies with season and from year to year, so you need to keep monitoring and make sure you do not put animals into an area to graze before it is ready, or leave them so long that they create bare ground, otherwise you won't produce the healthy, diverse landscape you need for your farm. Remember to keep records of stock movements and take photos to see how the length of the recovery time affects your pasture.



## Measurement and Monitoring

NRM South is conducting site specific biophysical monitoring at each trial site with measures of the soil and pasture in the holistic planned grazing trial plots and reference sites (in good condition with similar soil, topographic and vegetation characteristics). This monitoring includes the following methods and is tailored to the test the site-specific landscape changes desired by the landholders:

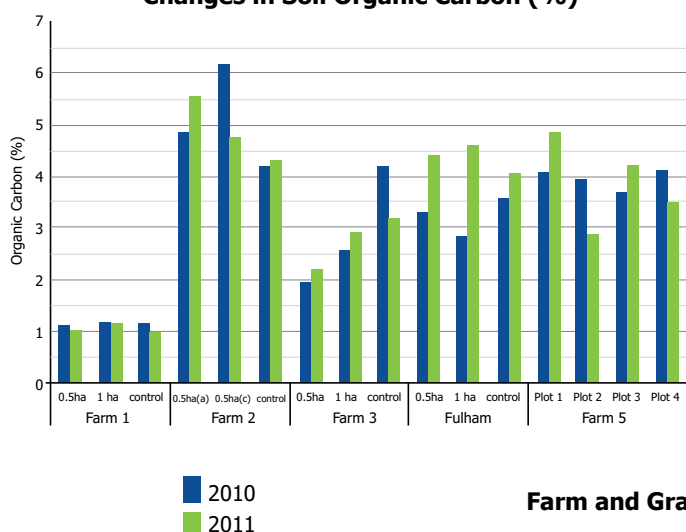
- ◆ Landscape Functionality Assessment (LFA) of treatment and reference/control areas
- ◆ Basic soil nutrient analysis (N, P, K, organic C, etc.)
- ◆ ScarP soil carbon tests
- ◆ Bulk density samples
- ◆ Soil compaction
- ◆ Soil invertebrate samples
- ◆ Tasmanian vegetation condition assessment benchmarks (VCA)

- ◆ Permanent transect-guided quadrant-based studies of pastures measuring the relative composition of native perennial pasture species
- ◆ Permanent transect-guided quadrant-based studies of pastures measuring presence of exotic annual and perennial pasture species and understorey vegetation
- ◆ Density measures of species of interest such as weeds
- ◆ Landscape context for farming enterprise (e.g. patch connectivity)

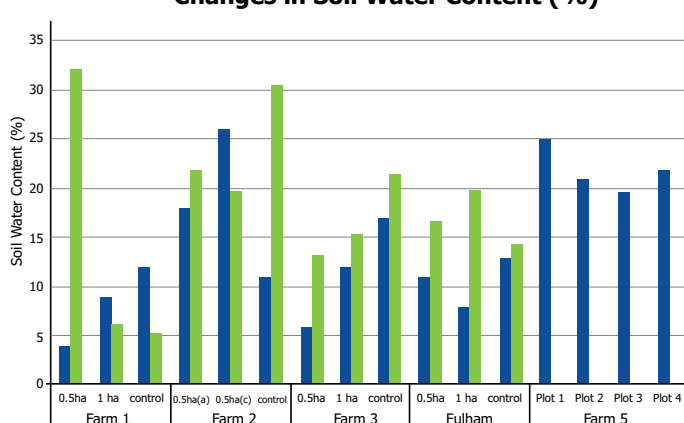
Baseline and 12 month follow up reports have been performed for five properties in collaboration with researchers from the Tasmanian institute of Agriculture. Fifteen of the properties will undergo follow up monitoring in three to five years. First year data for changes in percentage of organic soil carbon and soil water content for the five demonstration trial sites is presented in the graphs below. After the first year, measurement shows that there have been increases in soil organic carbon and soil water content in both planned grazing treatments (0.5 and 1 ha) at Farm 3 and Fulham.

### NRM SOUTH TRIAL DATA

**Changes in Soil Organic Carbon (%)**



**Changes in Soil Water Content (%)**



**Farm and Grazing Treatment**



## NRM SOUTH TRIAL SITE – ‘FULHAM’

Sandy Gray leases his 1000 hectare farm, Fulham, for sheep grazing, but has dedicated a couple of hectares to the NRM South grazing trial. His property falls in the Tasman catchment and is part of NRM South's priority Tasman Sorell area.

When asked why he decided to adopt the trial Sandy responds, jokingly, "Because they spun me too good a yarn to refuse".



Jokes aside, ultimately it was the suggestion that sustainable regeneration of the landscape to support production could be achieved without dollar input that piqued Sandy's curiosity. He had previously attended a course on a similar grazing technique, cell grazing, so was aware of some of the concepts, however his own current management preference is a slow rotation over a small number of large paddocks.

Sandy shows an open interest in the results of the trial, with a half and a full hectare paddock dedicated to the trial. He has also fenced off an additional hectare where he is experimenting with a slightly different rest period to the trial paddocks and monitoring the outcomes for his own interest. He agrees that the trial paddocks are already clearly healthier than those still under conventional methods.



*Fulham 1 hectare trial paddock, February 2011 (left) and May 2012 (right) six weeks after 24 hours of 700 sheep grazing. Note improved groundcover and concentration of manure.*

Observable differences are apparent at Fulham after only 12 months and two grazing periods. The soil in the trial paddocks is softer underfoot and more fibrous, have more litter, healthy regrowth and an even spread of sheep 'fertiliser'. Thistles are also less than in the 'control' paddock, which is subject to slow rotation grazing, where they have seeded in bare soil exposed by over grazing.



Based on the formal monitoring as part of the project, the NRM South 12 month report for Fulham notes, "There is evidence of improvements in both the soils and pastures in the Fulham holistic planned grazing trial site with increases in sown perennials, organic soil carbon, soil water content and decreased bulk density as early as 12 months into the trial. Increases in cover of perennial grasses mean that more of the soil surface will be covered throughout the year where increases in organic carbon improve the ability of the soil to hold water and supply more fuel for soil biological activity".

Sandy is happy to continue with the trial and is positive about results so far. The lessee is also becoming engaged and is watching the results from the trial activity. Sandy appreciates the support and engagement offered by NRM South and the opportunity to share experiences with other landholders.

Continued monitoring and activities on demonstration sites helps to maintain engagement with participants and other interested landholders. This helps to maintain enthusiasm and also provides the opportunity to share and discuss results or experiences, contributing to NRM South's goal of ongoing support and empowerment to landholders in their region.

## Early Indicators – Towards Sustainable Outcomes

NRM South has encountered some challenges throughout their projects, noting that, "the existing (conventional) agricultural paradigm in Australia does not encourage farmers to trial regenerative farming methods". They have experienced some resistance from some agronomists, farmers, ecologists and public land managers.

**"We are... able to provide support for farmers willing to trial new techniques; those willing to change."**

On the whole, however, landholder engagement has been very strong. An independently conducted survey in mid-2011 found that 79% of landholders that NRM South has engaged have gone on to invest additional resources and/or introduce new practices to improve

profitability and pasture production and soil health. As Barry notes, "[It is a] challenge to move from linear to holistic thinking, however if it's worthwhile to the farmers, if they can see money in it, they'll do it".

*Living Soils* activities are attracting increasing interest from landholders, with less advertising and promotion. This program also continues to share the information gained in *Building Evidence* trials.

In the first 12 months of the *Building Evidence* trials, changes are already being observed in soil carbon, soil water content and increase biomass and cover of perennial grasses. Due to a good season however, improvements are being seen both on control and planned grazing plots. Across the trial demonstration sites, there are also some site specific changes, and changes vary depending on original practices.

In addition to participating in the trials, some landholders have chosen to trial different practices or methods, seeking their own solutions and evidence – or even trying to disprove the advice NRM South is providing. The team find this positive as it increases farmers' ownership of results.

The tailored approach taken by NRM South directly addresses other challenges that have been experienced. Magali notes, "There are a lot of learnings from the project, especially that everyone does it differently, with different enterprises and social circumstances which can result in different motivations and impediments".

"Initially we were collecting purely biophysical evidence, however it is clear that social and economic information is need to have a clear evidence base for farmers interested in regenerative farm practices in southern Tasmania."

NRM South believes that they are achieving positive outcomes for healthy rural profits, communities and environment with the range of activities they are delivering. Encouraging results include:

- A high interest of landholder engagement for future planned grazing trials and events;
- High participant satisfaction with demonstration field days;
- Three landholders hosting trials have applied techniques beyond the original trial sites;
- Engagement with industry and community groups through field days; and
- Broader communications and recognition outside of Tasmania, such as an invitation to speak at STIPA conference in Holbrook Nov 2011.



*The team at NRM South are achieving positive results from their active and tailored engagement in the region*

In the future NRM South hopes to build redundancy into the delivery of their programs, with the development of communities of practice, or farmer support networks. The increasing demand, evidenced through the numbers attending courses, suggests that this has the potential to become a commercial venture. Some farmer bodies of practice that have been set up elsewhere are self sustaining due to farmers driving and providing educational activities and NRM South would like to explore these options.

As summarised by Barry, "We work with the willing. If landowners are already happy with their production system, we'll support them in mutually beneficial activities, but, we are better able to provide support for farmers willing to trial new techniques; those willing to change."

## SHARING THE SUCCESS

The projects run by NRM South are encouraging landholders to adopt sustainable land management practices in a low risk way that suits the situation of individual farmers. By using a method based on coordination and cooperation, a range of options are available to assist farmers to change their practices. These provide sufficient ongoing engagement to support changes beyond the initial enthusiasm experienced at field days or workshops.

Landholders are being empowered to understand new techniques at their own pace through the assisted trials. Trial demonstration sites allow for sharing of results and broader discussion and generate interest across the catchment. The landholders are a part of the change, with minimal disruption to their production, and they can choose whether or not to adopt practices based on their own evidence.

The wider adoption of regenerative landscape management is a strategic imperative for Australia's future well being. Support mechanisms are clearly required to assist land managers who have attended training activities or demonstration days as a means to gain confidence in changing practices. The NRM South case study provides an example of effective techniques to which could be used to provide the required encouragement and support to farmers and land managers to adopt regenerative landscape management practices.





## ENDNOTES

### Chapter One Notes

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## GLOSSARY AND ACRONYMS

<b>bio-amendment</b>	A soil additive that focuses on addressing soil biology.
<b>bio-cide</b>	A chemical that is used to kill selected living organisms; for example pesticides, herbicides, fungicides.
<b>Bos Indicus</b>	A type of domestic cattle originating in South Asia, sometimes known as humped cattle, Zebu or Brahmin cattle, particularly the Indian subcontinent. They are characterised by a fatty hump on their shoulders, drooping ears and a large dewlap.
<b>Bos Taurus</b>	The European or “taurine” domestic cattle (including similar types from Africa and Asia).
<b>bund</b>	An earth embankment or dike for the containment or re-direction of water flow. Also known as a ‘berm’.
<b>cation exchange capacity (CEC)</b>	The measure of the capacity of the soil to hold the major cations (positively charged ions), such calcium, magnesium, potassium and sodium in a form that is available to plants. An imbalance in the ratio of cations can result in soil structural problems and high levels of some cations (e.g., aluminium and manganese) can be toxic to plants. CEC is used as a measure of fertility, nutrient retention capacity, and the capacity to protect groundwater from cation contamination.
<b>cell grazing</b>	A type of grazing management.  In this report this term is largely interchangeable with <i>time-controlled planned grazing</i> .
<b>DSE</b>	DSE is a stock measurement, ‘dry sheep equivalent’ based on the feed requirements of a 45kg wether. This can be multiplied for various types of stock, for example a ewe with one lamb is measured as 1.5 DSE, and a dry cow is equivalent to 6-8 DSE, depending on weight.
<b>food integrity</b>	Applies to all aspects of the supply chain that support the acceptance of food by the consumer. Ensuring food integrity therefore encompasses the biological, chemical and physical aspects of food safety; the food production systems including animal welfare and potential environmental matters and aspects of foods including nutrition value, functionality claims and food characteristics (as defined by the Rural Industries Research and Development Corporation, 2004, <a href="http://www.safoodcentre.com.au/site-">http://www.safoodcentre.com.au/site-</a> ).
<b>food security</b>	The state or degree of availability of food when populations have ongoing access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life.
<b>fulvic acid</b>	A yellow to yellow-brown humic substance that is soluble in water under all pH conditions.
<b>Holistic Management</b>	Holistic Management is based on a decision making framework which results in ecologically regenerative, economically viable and socially sound management of grasslands. It was first developed by Allan Savory, a Zimbabwean biologist, game ranger, politician and farmer who was searching for ways to save the savannah and its wildlife in southern Africa.
<b>humic substance</b>	An organic residue of decaying organic matter.
<b>labile organic matter</b>	Readily decomposable soil organic matter.



<b>mycorrhizal fungi</b>	Fungi that form symbiotic relationships in and on the roots of host plants. The association usually enhances the nutrition of both the host plant and the fungal symbiont. The establishment and growth of certain plants (e.g., citrus plants, orchids, pines) depends on mycorrhizae; other plants survive but do not flourish without their fungal symbionts.
<b>Natural Sequence Farming</b>	Natural Sequence Farming was developed by Peter Andrews as a system to reinstate landscape function in Australia, using remnant features of the original hydrological pattern to manage water, fertility, salt and erosion. The structures installed are made of natural materials and rely on vegetation for stability. They are comparatively cheap to establish and are resilient to flood and drought.
<b>pasture cropping</b>	Pasture cropping is a zero tilling technique of sowing annual cereal crops into living perennial pastures and having these crops grow symbiotically with the existing pastures. This results in benefits for the pasture, crops and the soil.
<b>pedogenesis</b>	The process of soil formation over time.
<b>podsol</b>	For soil types see <a href="http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf">http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf</a>
<b>rakes</b>	A structure of spaced posts or stakes inserted diagonally across a stream bed to trap debris, forming an intervention to slow water flow and cause sediment buildup.
<b>rotational grazing</b>	A type of grazing management.  In this report, this term is largely interchangeable with <i>time-controlled planned grazing</i> , however in conventional practice, rotational grazing may not follow similar principles and may not deliver the benefits described in this report.
<b>SOC</b>	Soil organic carbon.
<b>soil types</b>	For soil types see <a href="http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf">http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf</a>
<b>SOM</b>	Soil organic matter.
<b>stable soil organic matter</b>	Organic matter, substantially poorly biodegradable humates and glomalin, which is persistent for decades to hundreds of years. Also referred to as non-labile.
<b>stocking rate</b>	Stocking rate refers to the number of livestock on a paddock or a whole farm and is expressed as an indication of number of a particular type of animal per unit area. The usual measures include dry sheep equivalents (DSE) or large stock unit (LSU) per hectare, however this may also be expressed in terms of cattle per unit area, such as breeders (cattle) per hectare or square kilometre.
<b>swale</b>	A soil embankment created along an elevation contour line to slow and capture water runoff on the land by spreading it horizontally across the landscape, facilitating infiltration of runoff water into the soil.
<b>time-controlled planned grazing</b>	A type of grazing management based on principles including: <ul style="list-style-type: none"> <li>reducing paddock size and rotating stock through the paddocks;</li> <li>matching stocking rate to the carrying capacity of the land;</li> <li>determining the pasture rest and recovery period by plant growth rate;</li> <li>controlling graze period; and</li> <li>adjusting stock density, usually through paddock size and number.</li> </ul>
<b>vertisol</b>	For soil types see <a href="http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf">http://www.clw.csiro.au/aclep/asc/Soil_Poster.pdf</a>
<b>wagon wheel paddock design</b>	A paddock fencing configuration where the watering point and/or a stock handling facility is at the centre (the 'hub') and the fences radiate from the centre forming paddocks (the 'spokes' and 'rims'). This design facilitates stock handling and provides an economical method of watering stock.

