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

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Bill 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.

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.

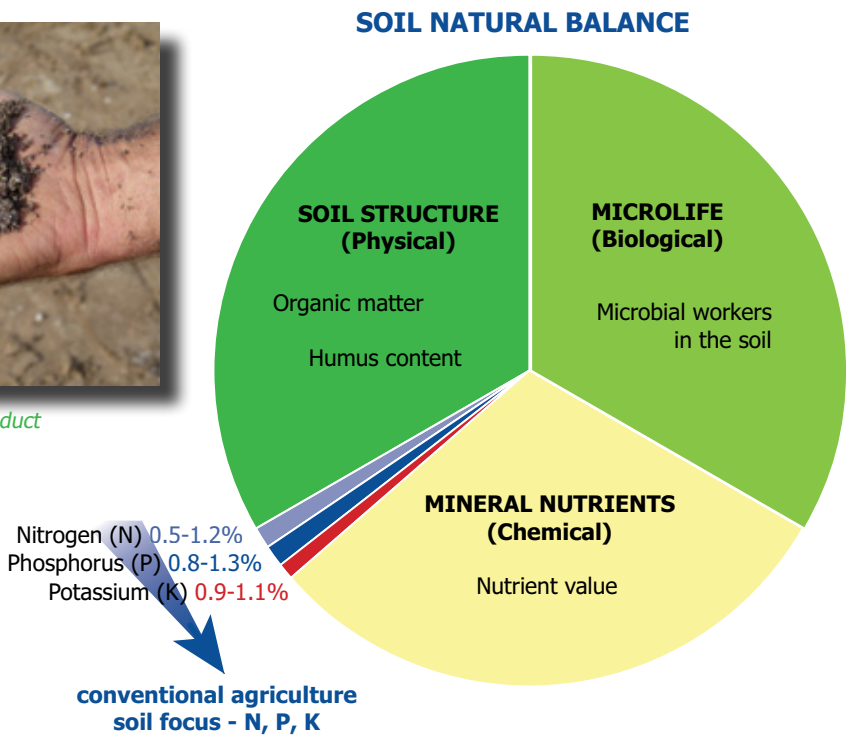
The Dalys follow a specific process in making their compost. Compost materials are combined to ensure a carbon to nitrogen ratio of 25-30:1. This ratio enables the correct temperature and carbon dioxide cycle, ensuring pasteurisation of any e-coli, salmonella and weed seeds. Feedstocks are tested for 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."

Humus Compost - the finished product



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

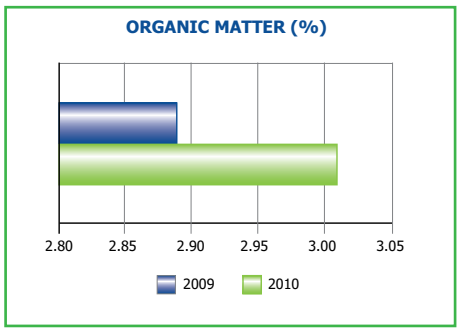
Since 2002 Milgadara has seen a significant improvement in soil structure to a tilthy, well aggregated soil with higher humus levels. Rainfall that is received penetrates further into the soil profile and is retained in the soil for longer. Any excess now flows through the profile without taking nutrients 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.

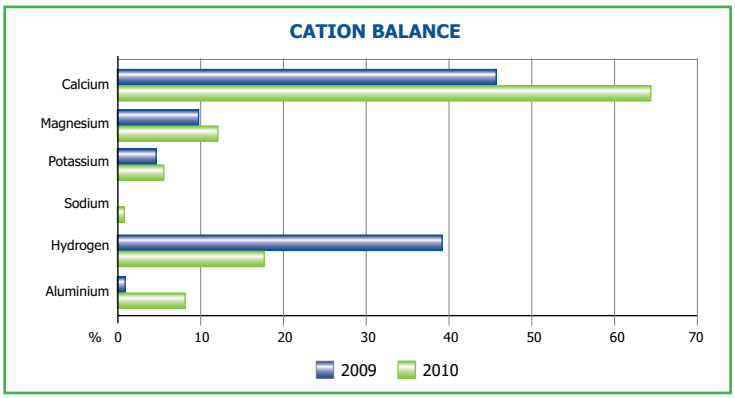
Crop stubble is now retained to be broken down on the soil
Inset: Soil fungi at work

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 vey 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.

Pasture diversity in the sown pastures

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.

"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.

The productivity on Milgadara has increased by nuturing soil biology

"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."

This case study is an excerpt from the Soils for Life report:

Innovations for Regenerative Landscape Management:
Case studies of regenerative land management in practice

REPORT SUMMARY

The Need for Change

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 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.

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.

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)[1,2]. Healthy soils are necessary to provide sufficient amounts of food with quality nutrition and fibre to meet global 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[3]. Unless all limited soil and fresh water resources are understood and wisely managed, we are at risk of 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 realities of an increasingly arid and degraded landscape are already 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 (such as reliance on high energy inputs), increased mining activity and urban expansion.

The national and global challenges being faced are interrelated and can be best met through a comprehensive coordinated approach focused on improved regenerative environmental management practices.

Landscape Regeneration for our Future

The key process drivers for landscape regeneration are **soil**, **water** and **vegetation**. Together in a natural system, supported by a constant flow of solar energy, these provide a regenerative cycle.

By restoring natural systems through improving landscape management practices, we can maximise water use efficiency, improve soil health, nutrient cycling and biodiversity of vegetation. A properly structured soil, with good levels of SOC, allows greater infiltration and retention of rainfall. Every gram of carbon in the soil can retain up to eight grams of water.

Currently, approximately 50% of rainfall on the Australian landscape is lost to evaporation due to poor soil structure and insufficient groundcover. By improving soil structure – particularly carbon – through increasing organic matter in the soil, we will be able to better capture and retain any rain that falls, making it available to plants for longer.

Through revegetation, groundcover is improved, and subsequently so is the quality of the soil, enhancing water infiltration. In turn, improved soil health and efficiency in water use contributes directly to the ability to support a biodiversity of vegetation and species.

If properly supported, this regenerative cycle can continue to sustain and improve the natural resource base and therefore landscape resilience and productivity.

Restoring these natural cycles 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. Business as usual is neither viable nor sustainable. Effective practical policies and actions are needed now.

Landscape Regeneration in Action

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. With relevant policies and incentives these practices could be extended successfully and quickly to involve a significant number of Australia's 135,000 farmers. Whilst there are always opportunities to learn more, enough is already known to take action now.

Soils for Life has documented some of these regenerative practices in 19 case studies across a range of locations and land-use types. Experiences shared by the 17 innovative farmers and two community organisations in the Soils for Life case studies demonstrate successful action being taken to restore the landscape. Due to the interrelated nature of soil, water and vegetation, benefits can be experienced across all process drivers regardless of the particular area of focus.

The Soils for Life case studies describe a range of techniques being used to obtain positive, regenerative outcomes, including:

- 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;
- Controlling weeds through increased competition by desirable species;
- Reducing or ceasing synthetic chemical inputs; and
- Integrating enterprises.

PRINCIPLES FOR REGENERATIVE LANDSCAPE MANAGEMENT

Our case studies show that many different techniques can be applied to regenerate the landscape. Farmers and land managers commonly tailor a variety of methods to their own landscape and personal preferences. There is no single solution to landscape regeneration.

The following principles consistently emerge 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

Notes:

1 United Nations Environment Program, 2012, UNEP Year Book 2012: Emerging issues in our global environment, http://www.unep.org/yearbook/2012

2 Pimentel, D., 2006, 'Soil erosion: A food and environmental threat.' Environment Development and Sustainability, 8, pp119-137

3 Barlow, M., 2007, Blue Covenant: The Global Water Crisis and the Coming Battle for the Right to Water, McClelland & Stewart

CASE STUDY 13 - MILGADARA NSW

Other case studies and the full *Soils for Life* report are available at: www.soilsforlife.org.au.

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CARING FOR OUR COUNTRY

SoilsForLife
AN OUTCOMES AUSTRALIA PROJECT
www.soilsforlife.org.au

Soils for Life is actively working to change landscape management from the top down and the ground up - but we need your help! Be part of the solution - join in, contribute, share learning with others and change your practices!

Engage with us online at www.soilsforlife.org.au. Like us on Follow us on @soilsforlife