



Tips for sustainable soil management that save costs & emissions

“Reducing carbon emissions is good business. Reducing soil degradation, fertiliser and fuel [use], is not only good for soils but also good for the bottom line”,

Coal Valley, Tasmania



At a glance

Owner & location	Chris & Ronald Gunn Glen Quoin, Richmond
Property size	1000ha
Enterprises	Irrigated cropping, wool, lambs and beef
Average annual rainfall	500ml
Soil types	Black soils on basalt, black soils on dolerite brown soils on dolerite, podzols on sandstone & alluvial soils.

Chris & Ronald Gunn

Richmond farmers Chris and Ronald Gunn are advocates for protecting their soils to maintain soil carbon for the benefit of their farm productivity, bottom line and to combat greenhouse gas (GHG) emissions.

“Reducing carbon emissions is good business. Reducing soil degradation, fertiliser and fuel [use], is not only good for soils but also good for the bottom line”, Ronald Gunn

Chris and Ronald have been participating in the Tas Farming Futures (TFF) project and have worked with project extension staff to calculate the greenhouse gas emissions (GHG) derived from cropping and livestock production on their Glen Quoin property.

It was important to them that the TFF project delivered information for the benefit of the broader farming community and they have been happy to share their information so that it might be useful for others who might be new to growing crops or new to irrigation. Their approach to sustainable soil management is the focus for this case study.



Did you know?

Changing tillage practices can reduce farm GHG emissions. Based on estimated emissions from diesel usage in the Gunn’s farming operations, compared to conventional tillage practices, emissions from diesel fuel were reduced by 47% when using reduced tillage and 54% when using no-till.



Farm emissions snapshot

Farm GHG emissions from livestock, fertilizer and energy on the Gunn's farming operations are 538 t CO₂e/year or 0.538 tonnes CO₂e/year/hectare ¹. As with most mixed farms that produce livestock (ruminants e.g. sheep, cattle) the majority of the Gunn's GHG emissions are derived from enteric methane (74%) or belching from livestock (sheep and cattle). Only 5% of emissions stem from energy consumption and diesel use. Both affect variable farm costs and therefore farmers are keen to reduce the use of diesel and power.

GHG calculations did not

include potential emissions from soil carbon due to data availability; still Ronald and Chris are focusing on continuously improving soil management to preserve carbon, the main component of soil organic matter (SOM).

There are many reasons to look after SOM in soils as listed in the box below.

¹ CO₂e (Carbon dioxide equivalence) - Greenhouse gases can be measured in carbon dioxide equivalents. Carbon dioxide equivalence, or CO₂-e, is estimated by multiplying the amount of gas by the global warming potential of the gas.

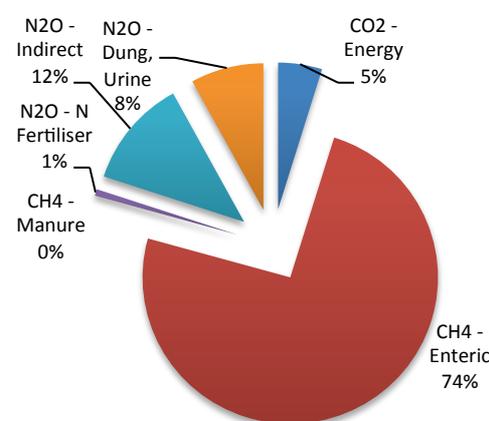


Figure 1: Estimated GHG emissions from the Gunn's farming operations are 538 t CO₂e/year, of which 74% is enteric methane (CH₄)

Soil Organic Matter (SOM) explained:

SOM is the major sink and source of soil carbon. SOM is typically estimated to contain 58% C, and the terms 'soil organic carbon' and SOM are often used interchangeably, with measured SOC content often serving as a proxy for SOM. Soil represents one of the largest carbon sinks on the planet and plays a major role in the global carbon cycle.

SOM consists of plant and animal residues at various stages of decomposition, soil organisms, and substances synthesized by soil organisms. Humus is highly stable (well-decomposed) organic material. Surface litter is generally not included as part of soil organic matter.

SOM has positive effects on soil structure, aggregation, water retention, soil biodiversity, absorption of pollutants, buffering capacity, and the cycling and storage of plant nutrients. SOM increases soil fertility by providing cation exchange sites and acting as a reserve of plant nutrients, especially nitrogen (N), phosphorus (P), and sulfur (S), along with micronutrients, which are slowly released via SOM mineralization.

Tips for sustainable soil management

Ronald and Chris Gunn have six rules of thumb when it comes to managing their soils.

Tip 1 - Don't cultivate too much - Use no-till or reduced till practices.

Chris Gunn explains that it is about asking yourself the question "how much is the cultivation costing me?" This involves weighing up the potential losses of soil carbon and all its benefits every time the soil is cultivated as well as structural damage that can occur if soil is worked in the wrong conditions (e.g. too wet or too dry).

The Gunn's standard ground preparation is based on a reduced or minimal-till system and includes;

Bale & remove straw: After harvest, straw in the windrow is baled and removed from the paddock.

Harrow and then graze stubble: A set of Coolamon harrows is used to knock down the standing stubble prior to grazing. It consists of a cement mesh grid (like heavy rio).

"It smashes the stubble up enough to allow the straw to break up and it is better for stock to graze. Sheep don't like to graze standing stubble."
Ronald Gunn

"We only graze [the stubble] when it is dry. If it rains we get them off and don't allow the sheep to pug the ground." Chris Gunn

Apply Biosolids: in the summer and autumn.

"It will dry in 2-3 days and then we go over with harrows / mesh to break it up." To avoid nutrient losses, biosolids are applied as close to the time of sowing as possible.

Chisel plough or multi disk following rain.

Direct drill next crop into the paddock.

"We have tried heaps of different types of tillage points over the years. In the past we used a tyne drill with keech points, now have a new 'single disc' drill, so we'll go straight in with that."
Ronald Gunn

The Gunn's are now moving to a no-till system. They have recently bought a single disk drill which will enable them to sow their crop directly without any pre-cultivation. They are hoping to use the no-till system with most of their crops.

"We have only had it a few months, so now we are on a bit of a learning curve." Chris Gunn

"With poppies we might need to pre-cultivate depending on the soil condition. This is because it is a very fine seed, although there is no reason why not [direct drill] with the right drill and in the right [soil/paddock] conditions." Ronald Gunn

The Gunns have the advantage of having access to biosolids which are a source of carbon and nutrients (Fig.2). On other farms this could be replaced by other organic amendments such as composts, manures, pyrethrum or poppy waste. Retaining crop residues is another way of adding organic carbon and nutrients.

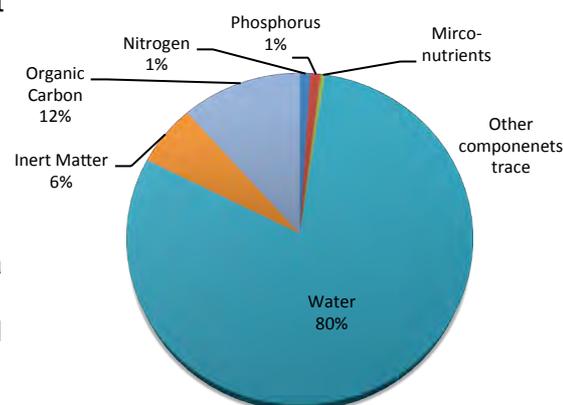


Figure 2: Typical biosolids breakdown (Source: Department of Sustainability, Environment, Water, Population and Communities 2012: Biosolids Snapshot)

Monitor to manage

“We soil test every paddock every three years so we have a good handle on what’s happening.”

Tip 2 - Cultivate at optimum conditions

Do not cultivate paddocks that are too wet or too dry. This will damage soil structure and lead to problems such as compaction, especially hard pans and therefore water logging when it is wet and poor water retention for dry periods.

Chris Gunn explains that they will use irrigation in order to have soil at the right condition prior to working it, if there has not been sufficient rain. *“We throw the calendar out the window and won’t cultivate based on dates. We will pre-irrigate [for pea crops] in order to work country and to get the soil into the right condition to work it.”* Chris Gunn

Pre-irrigation also helps with weed control by encouraging a germination of seeds. *“There is no point in planting crops before you have effective weed control”*, Ronald Gunn

Pre-irrigation is especially important with peas as they

have a set plant by date (set by the processing company) for the region.

“Having big gear helps so that you can get over the ground quickly to maximise small amounts of retained soil moisture.”

“It can be difficult if you are relying on a contractor to do the ground prep for you. For example if we have 20 mm of rain and you want to work the paddock you have little control over when the contractor can get there”

“There is a caveat to pre-irrigation in that if you pre-irrigate and then get a rain you can get into trouble”. Chris and Ronald base decisions on weather forecasting and seasonal conditions and believe that weather forecasting technology has improved to a great extent in the last five years so that you can be fairly confident in the predictions.



Tip 3 - Use soil testing and sap analysis to guide fertiliser decisions

“We soil test every paddock every three years so we have a good handle on what’s happening. We also use sap tests for poppies, peas and canola a couple of times throughout the season. We use sap testing for nitrogen, to guide nitrogen decisions and are also guided by our agronomist”

Soil and plant testing enables you to match fertiliser applications to crop demand and reduces the risk of imbalances, over or under fertilising and losses from run off or leaching.

Soil compaction explained:

Compaction is a collapse of soil structure; it reduces the soil’s pore space that is important for drainage (large pores), water holding (medium pores) and air supply to roots and soil life. Roots cannot penetrate hard pans; this means roots cannot explore compacted soil for nutrients and water like they do in a friable, well aggregated soil.



Tas Farming Futures

Providing on-farm services
to support producers in
improving farm efficiency
& reducing GHG
emissions

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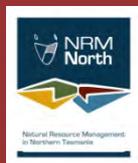
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Working with industry and
NRMs statewide

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Managing stock, grazing & ground cover

Tip 4 - Remove stock from cropping paddocks when wet

"If we get a big rain then we get them [the sheep] off our cropping paddocks. That's one of the reasons we don't have high stocking rate, so that we can be flexible. If we don't have access to a paddock because it's too wet, we won't go there." Chris Gunn

Grazing stock when on waterlogged soils is problematic as it causes pugging and compaction issues. This is also bad for farm GHG emissions as waterlogged soils lead to denitrification which releases large amounts of nitrous oxide from the soil into the atmosphere (i.e. loss of nitrogen from the soil). If the soil becomes more compacted (e.g. as a result of grazing when wet), it becomes anaerobic more quickly; this leads to higher losses of nitrogen as nitrous oxide (N₂O) gas.

Tip 5 - Maintain ground cover

"We maintain ground cover on our paddocks. Eighty percent of our land is (used for) grazing." Chris Gunn

Maintaining ground cover reduces the risk of soil erosion and also reduces the risk of soil carbon losses. Avoiding bare fallows and having continuous plant cover where possible e.g. green manure crops between seasons and crops is an important management tool. Green manure crops can also use available nitrogen and avoid losses by leaching.

Tip 6 - Don't over graze

Over grazing can result in poor persistence in perennial pastures, bare patches and encourage weed growth, carbon losses and erosion. Maintaining pasture cover is important for protecting and building soil carbon levels and preventing soil loss from wind or water especially on hill slopes. Rotational grazing principles that allow sufficient 'rest' time between grazing phases as well as leaving a good residual ground cover after grazing, will avoid over grazing.

"Our carrying capacity per hectare (DSE/ha) is less than others but our rating of animals per DSE is higher as well – we get a better lambing percentage and wool cut. In doing so our price per head when selling is increased." Chris Gunn.

The Gunn's stocking rates are reflective of the fact that they are in a dry region and can't rely on guaranteed rainfall. *"We have less in carrying capacity to have more flexibility as you don't know what the season is going to do"*, Chris Gunn.

The production of mutton and red meat has increased on the property. Having this as an option means that they always have flexibility if there are changes to crops available or seasonal conditions. Buying cattle in to fatten is also used when seasonal conditions are favorable.

