DairyTas Climate Change Mitigation for Tasmanian Dairy Farmers

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Agricultural Resource Management

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Contents

Project Summary

The project commenced in September 2009 and concluded in June 2010. In that timeframe, the huge uncertainties regarding climate change policy, particularly the inclusion of agriculture, were reinforced. This time period has been one of the most challenging faced by the Tasmanian dairy industry in recent years. The low milk price, coupled with an extremely wet Spring in 2009 and power outages for many NW dairies (storm damage to electricity lines) saw many dairy farms operating in 'survival' mode.

A range of technical resources suitable for use in climate change extension activities with dairy farmers have been developed. These have been made publicity available via the government website Farmpoint.

Based on the outcomes of the technical work done with our 3 focus farms, we worked with the farmers to identify cost-effective mitigation activities. We funded mitigation activities that the farmers thought would contribute to their overall profitability and which would reduce greenhouse gas emissions on their farms.

Background

This dairy project leveraged off funding to develop technical resources for delivery of a climate change property management planning (PMP) module. The dairy funding allowed for greater focus on issues specific to dairy, particularly energy efficiency. Farm energy audits for dairy farms are generally more complex as energy use in the dairy shed is a significant component of the overall farm energy bill and dairy shed audits can be complex. The dairy funding enabled us to work closely with three dairy farm operations in refining technical resources and to fund mitigation activities. The dairy farm businesses we worked with were: Janefield, Rosemount and Ravenscroft.

Farmers from Rosemount and Ravenscroft were also concurrently involved in a series of meetings to plan development of the PMP module. As part of these meetings, a range of climate change related issues were discussed. Appendix 1 provides a summary of the main climate change issues and risks identified by all farmers in the group. We felt there was no need to cover this material again in the context of this dairy project.

All of the focus farms had undertaken DairySAT discussions in the past and had considered climate change issues as part of that process.

Carbon Stories for Tasmanian Dairy Farms

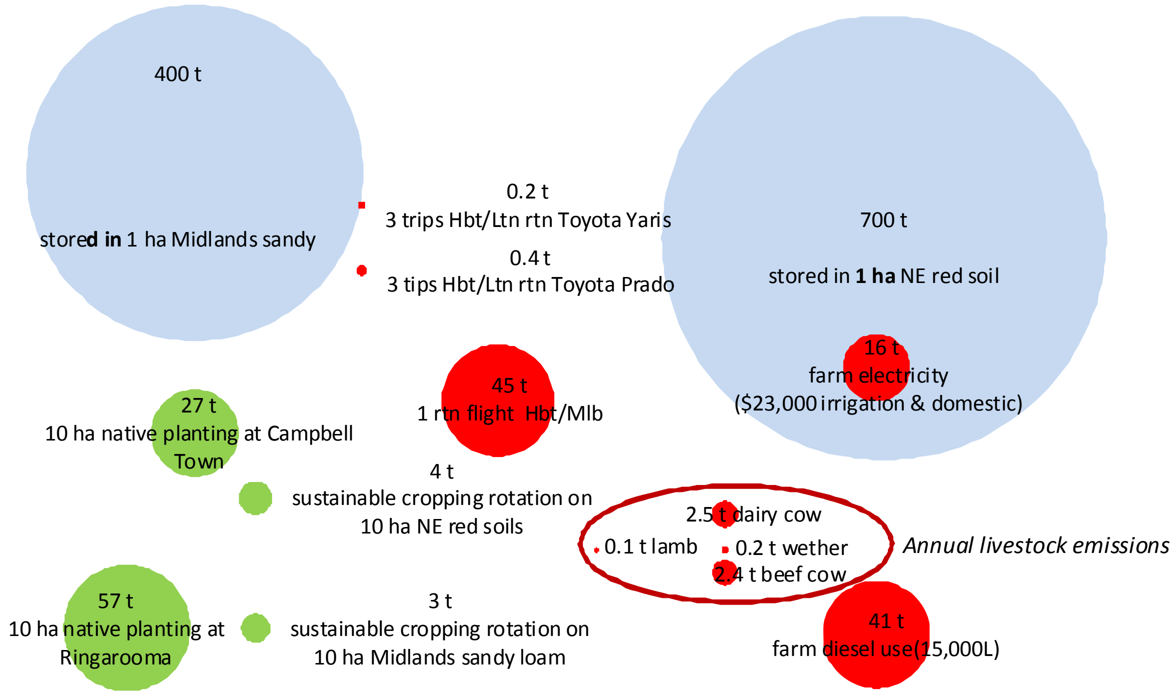
We undertook detailed carbon accounts using the Carbon Story Tool (see Technical Resources Developed) for three Tasmanian dairy farms. Whole-of-farm carbon accounts (balancing emissions and sequestrations) showed all farms had significant carbon stored in soils and native vegetation and net annual emissions of 1,500 to 2,500 t CO_2 equivalent. We used vehicle and airplane emissions calculators to generate numbers to give a frame of reference for comparison of dairy emissions.

A simple reference to put dairy emissions in context is that the net annual emissions for a typical Tasmanian dairy farm are less than a plane flying to Europe return.

Tasmanian Agriculture Carbon Comparisons - What Happens in 1 Year?

● Sequestrations ● Stored ● Emissions

Tasmanian farmers are custodians one of the state's largest carbon 'banks', soil carbon. The huge amounts of stored carbon in soils are retained with good management practices and susceptible to degradation and conversion into CO_2 if management is not sustainable.



Note: Soil and tree carbon sequestrations estimates are based on averaging over a 100 year period. Agricultural estimates are derived from calculators linked to the *Farm Carbon Story Tool*. Vehicle emissions calculated from *www.greenvehicleguide.gov.au* and air travel emissions from *www.atmosfair.de*.

Farm Energy and Irrigation Energy Efficiency Audits for Tasmanian Dairy Farms

Farm energy and irrigation energy efficiency audits were undertaken as part of the larger PMP module project, with the dairy funding allowing inclusion of an additional dairy (Janefield). These were the first series of independent farm energy audits in the State and generated information that has not been available up until now. The farm energy audits were undertaken by Soheil Haee *(B.E. (Hon.s), Grad. Dip. (Sustainable Development)* from Hydro Tasmania Consulting.

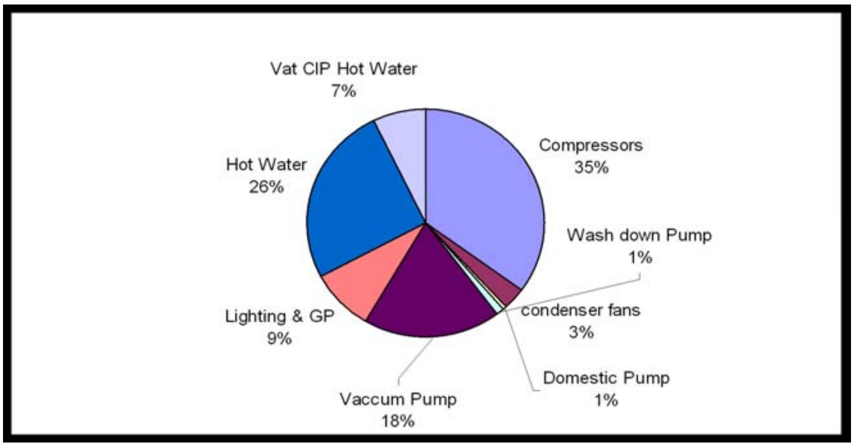
Information from the specific audits is not for public distribution, but general outcomes from the energy audits are summarised below:

- Total energy bills (electricity + fuel) varied from $35,000 to $156,000 per year, with average being just over $80,000 per year. Electricity bills accounted for an average 64% of the total energy bill or nearly $52,000 per year.
- Irrigation accounted for 70-80% of farm energy costs.
- The average energy index for irrigated areas was 1,268 kWh/ha ($216/ha at 2008/09 costs)

- For those irrigation systems with flow meters installed, energy indices were calculated at between 200 kWh/ML to 500 kWh/ML, or around $35/ML to $85/ML . Variations depended on pump/irrigation sets efficiencies and the Total Dynamic Heads for those pumps.
- Dairy sheds comprised 20%-30% of total energy consumption on dairy farms
- For dairy sheds on the three dairy farms audited, an average energy index of 168 kWh/cow was estimated (at 2008/09 cost of $29/cow).
- Dairy shed energy consumption as a portion of the milk price was typically 0.5 to 0.7 cents per litre of milk
- Total energy consumption (including irrigation) as a portion of the milk price was approximately 2.5 c per litre milk

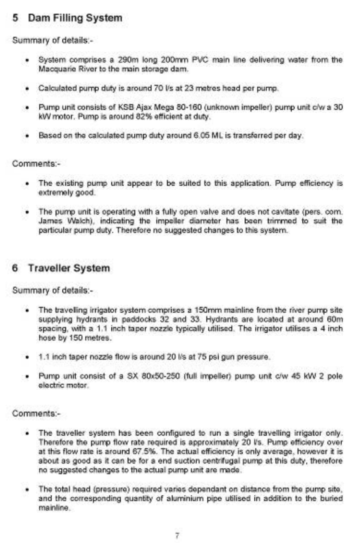
Power prices have increased since the audits were undertaken, and are predicted to increase again by the end of the year. By the end of the year, it is possible that energy will comprise close to 10% of the farm gate milk price.

There is widespread consensus among all involved in the energy market in Tasmania that electricity prices will continue to rise markedly over the next few years. Dairy farmers are particularly vulnerable to this cost impost on their business because they are so reliant on electricity.



Breakdown of typical energy consumption in the dairy sheds audited

Irrigation accounts for 70-80% of most Tasmanian farmers' electricity bills. A focus on irrigation energy efficiency, particularly irrigation pumping, is essential for improving overall farm energy efficiency. James Curran *(Dip. Irrig. CID ASP3845),* ARM undertook a detailed review of the irrigation and pumping systems of the eight audited farms. These reports provide a template for others to conduct farm irrigation energy efficiency audits.



5 Dam Filling System

Summary of details:-

- System comprises a 290m long 200mm PVC main line delivering water from the Macquarie River to the main storage dam.
- Calculated pump duty is around 70 l/s at 23 metres head per pump.
- Pump unit consists of KSB Ajax Mega 80-160 (unknown impeller) pump unit c/w a 30 kW motor. Pump is around 82% efficient at duty.
- Based on the calculated pump duty around 6.05 ML is transferred per day.

Comments:-

- The existing pump unit appear to be suited to this application. Pump efficiency is extremely good.
- The pump unit is operating with a fully open valve and does not cavitate (pers. com. James Walch), indicating the impeller diameter has been trimmed to suit the particular pump duty. Therefore no suggested changes to this system.

6 Traveller System

Summary of details:-

- The travelling irrigator system comprises a 150mm mainline from the river pump site supplying hydrants in paddocks 32 and 33. Hydrants are located at around 60m spacing, with a 1.1 inch taper nozzle typically utilised. The irrigator utilises a 4 inch hose by 150 metres.
- 1.1 inch taper nozzle flow is around 20 l/s at 75 psi gun pressure.
- Pump unit consist of a SX 80x50-250 (full impeller) pump unit c/w 45 kW 2 pole electric motor.

Comments:-

- The traveller system has been configured to run a single travelling irrigator only. Therefore the pump flow rate required is approximately 20 l/s. Pump efficiency over at this flow rate is around 67.5%. The actual efficiency is only average, however it is about as good as it can be for a end suction centrifugal pump at this duty, therefore no suggested changes to the actual pump unit are made.
- The total head (pressure) required varies dependant on distance from the pump site, and the corresponding quantity of aluminium pipe utilised in addition to the buried mainline.

7

Recommendations from farm energy and irrigation energy efficiency audits were specific to the farms, but generally they included options such as:

- Irrigation efficiency (right tariff, maximum use of off peak, pump efficiency, low press. systems, variable speed drives etc.)
- Heat pumps for hot water heating
- Improving Pre-coolers efficiency
- Insulation and heat recovery
- Variable Speed Drives for vac pumps and milk pumps

Mitigation Activities Funded

In order of magnitude, all farms showed a similar pattern with annual greenhouse gas emissions:

1. Dairy cows (methane)
2. Nitrogen fertiliser use (nitrous oxide)
3. Electricity use (carbon dioxide. Depending on the season, Tasmania imports varying amounts of coal-fired power. Project calculations based on 30% brown coal, 70% hydro)
4. Fuel use (carbon dioxide)

All three farms operate efficient pasture management and current scope for reducing cow emissions was considered minimal. All farmers identified that they wanted to look at fertiliser or energy mitigation activities. This project was delivered in one of the worst dairying seasons experienced in recent times and our farmers had significant financial constraints. Their priority was to undertake activities that were essentially reducing the greenhouse impact of current practices, rather than invest in significant upgrades. We did get a quote for a solar hot water heating system for "Janefield" dairy shed, but the quote was $31,000 and well beyond what the project or the farmer could afford to invest.

"Rosemount" Cressy

Mitigation activity – improve farm energy efficiency. Reduce pumping costs and labour savings.

Grant Archer and Rob Bradley share farm on a property sourcing its irrigation water from the Cressy Longford Irrigation Channel. A lot of debris comes down this channel and there are year-round problems with the pump getting clogged. The Clearwater Self-Cleaning Suction Screen which will ensure clear water around the pump intake so that the pump continues to operate efficiently and staff are not having to make special trips to clean out the pump.

"Ravenscroft" Ringarooma

Mitigation activity – reduce nitrous oxide emissions by reducing amount of urea used on farm.

Theo van Brecht and Cheryl McCartie are trialling a fish waste based fertiliser called Ecofish (manufactured by Multicrop www.multicrop.com.au) as an option for reducing the amount of urea they apply. They are undertaking ongoing monitoring of the trial area in consultation with TIAR.



"Janefield", Meander

Mitigation activity – improve farm energy efficiency. Reduce pumping costs and labour savings.

Brian and Michele Lawrence are aiming to reduce their electricity bill. Their farm energy audit showed use of on-peak tariff for bore-pumping was a significant component of their bill. They commissioned a local electrician to install a timing system to ensure that bore pumping is undertaken on off-peak tariff. The timing system will also save time and labour as the pumps can be controlled remotely.

Technical Resources Developed

Fact Sheets

A series of 3 fact sheets is being produced on a range of topics specifically relevant to dairy farmers. We hope the fact sheets can be made available electronically via DairyTas or other relevant website.

A series of 6 fact sheets about general climate change issues for Tasmanian farmers are currently loaded on Farmpoint www.farmpoint.tas.gov.au

Carbon Story Tool

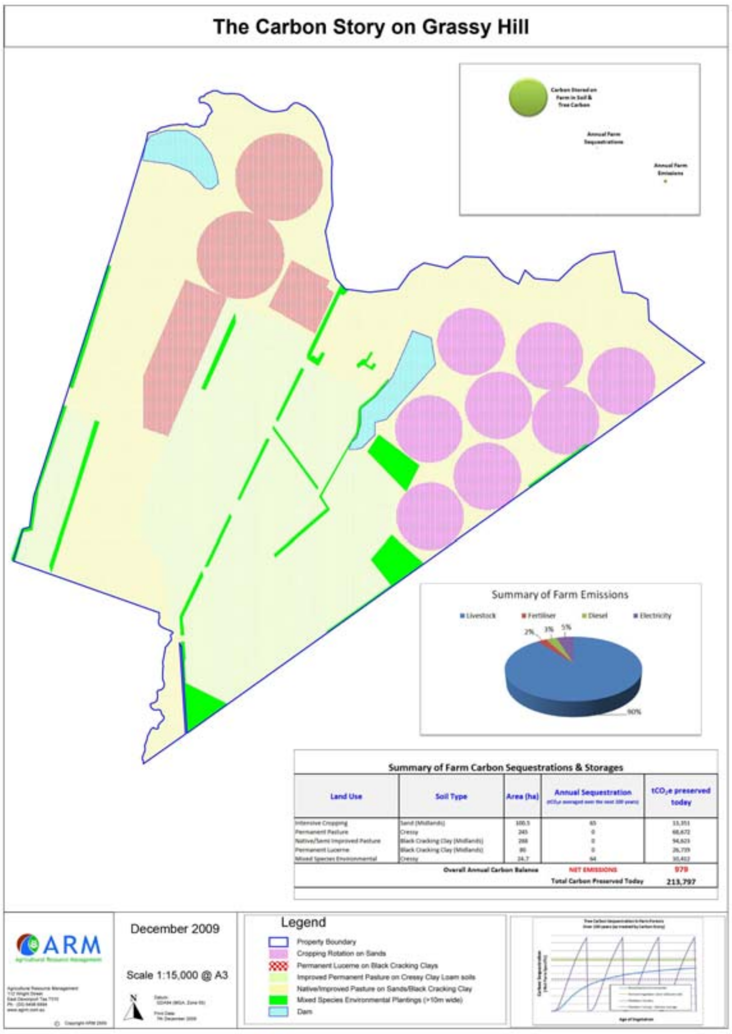
The debate about greenhouse gas emissions from agriculture is complex. Farmers feel that agricultural emissions are often misrepresented and oversimplified in the media, and this is a concern as urban populations understand less about where their food and fibre needs come from. Ideally we should consider each farm on the basis of its own land use and management practices.

We developed the Carbon Story approach to better understand the 'whole of farm carbon balance', based on actual soil types, land uses, cropping rotations, planted and remnant native vegetation, livestock numbers and fuel, fertiliser and energy use. The Carbon Story is an Excel based spreadsheet linked to SheepGas, BeefGas, FullCAM, dGas (dairy calculator) and Black Magic (Tasmanian soil carbon calculator based on RothC modelling). The Carbon Story tool allows for a simple, single sheet of data entry which then references back to the calculators. The unique aspect of the Farm Carbon story approach is that we are trying to summarise outputs from a range of models (no one model can look at every aspect of the farm) in a way that is easy to interpret visually (farm map and simple table summary). Farmers can use this approach to easily understand the impact of current and changed land management scenarios on carbon emissions and sequestrations.

The Farm Carbon Story approach uses information which is already routinely compiled as part of a well delivered property management plan eg. farm map, soil types, land use areas (cropping, native bush, grasslands etc). In the context of property management planning, the farm map is an ideal way to summarise the overall ‘carbon picture’ of the farm – as it is currently and how different it could be under changed management strategies.

Other information that is required to run the carbon models is available and relevant at a regional scale eg. tree growth curves, typical fertiliser rates. Some unique data is required from the farmer eg. livestock numbers, but data collection is minimal and certainly a fraction of the time compared to getting farmers to enter data in each calculator individually.

Note: Generic farm example shown below. Specific information from the Carbon Story work on the 3 focus farms is not for public distribution.



The Carbon Story for Grassy Hill

2009

Estimations of emissions and sequestrations are based on running models over 100 year period and averaging values on an annual basis.

PROPERTY SIZE - 748ha **FARM SUMMARY**

If I was to continue managing my farm, using CURRENT production practices, the annual 'big picture' carbon story on my farm would be:

Component of my farm's Carbon Cycle	ANNUAL EMISSIONS (tCO_2e)	ANNUAL SEQUESTRATIONS (tCO_2e)	PRESERVED CARBON* (tCO_2e)	Details
Livestock (cattle)	122			50 Steers >1 year,
Livestock (sheep)	872			2000 Breeding Ewes, 25 Rams, 2000 Wethers, 1500 Lambs/Hoggets,
Fertiliser (nitrogen only)	29			Total for Cropping & Pasture
Diesel usage (tractor and pumping)	33			12000 Litres used per year
Electricity Use	53			Assuming 70% Hydro & remainder Brown Coal
Intensive Cropping (100.5ha) on Sand (Midlands) soil (Starting Organic C Content 1.5%)		65	13,351	Rotation of Poppies, Green Manure (Oats), Potatoes - Processing, Barley, Poppies, Barley, Lucerne, Lucerne, Lucerne,
Permanent Pasture (245ha) on Black Cracking Clay (Midlands) soil		0	68,672	Permanent System in Equilibrium (Organic C Content 4.9%)
Native/Semi Improved Pasture (288ha) on Black Cracking Clay (Midlands) soil		0	94,623	Permanent System in Equilibrium (Organic C Content 5.78%)
Permanent Lucerne (80ha) on Black Cracking Clay (Midlands) soil		0	26,739	Permanent System in Equilibrium (Organic C Content 5.88%)
Mixed Species Environmental (24.7ha) on Cressy soil		64	10,412	Planted 1991 ( )
Totals	1,108	129	213,797	* Stored with current land (as of today), but no net annual impact on farm carbon balance. Could be released as emission if land use changes.
Annual flux as a % of carbon preserved on farm	**0.52%**	**0.06%**		

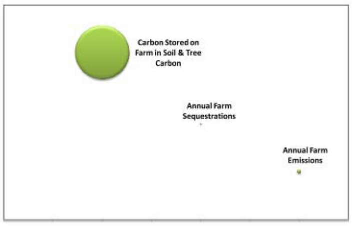
Annual Carbon Balance 979 ($tCO2e$/year) **NET EMISSIONS**

Colour Code Key

Eligible Sequestration Under Australian Kyoto Reporting	In-eligible Sequestration under Aus Kyoto reporting	Emissions accounted for off-farm
On-Farm Agricultural Emissions (not accounted for off farm)	Soil Test Value Not Entered - Default Estimation Only	Model predicts current soil carbon levels are sustainable (no perceptable net change) under current rotation - check current levels against targets to determine suitability

Notes:
Summary data compiled using the outputs of publically available carbon accounting tools. Only emissions occurring on-farm, and dealt with by the calculators detailed below are considered.
Models used are:

Livestock emissions - dairy: DGASFarmer_v1_2 (developed by TIAR)	*http://www.dairyingfortomorrow.com/index.php?id=47*
Livestock emissions - Cattle (BeefGreenhouse V6)	*www.greenhouse.unimelb.edu.au/site/Tools.htm*
Livestock emissions - sheep (SheepGreenhouse V2)	*www.greenhouse.unimelb.edu.au/site/Tools.htm*
Soil carbon: Black Magic (developed by TIAR)	
Plantation sequestratons estimates derived from combination of FullCAM & 3-PG forest models	*www.climatechange.gov.au/ncas/ncat/index.html*
Native vegetation sequestrations derived from FullCAM model (Australia's National Carbon Accounting System)	*www.climatechange.gov.au/ncas/ncat/index.html*



Notes:

Farm Carbon Stories and Soil Sampling for Carbon Story Proof-of-Concept
Bill Cotching, TIAR, undertook extensive soil sampling on 3 trial farms to validate the carbon story approach using Black Magic for predicting soil carbon sequestration. This work is being presented at World Soils Congress, Brisbane in August 2010. Significant findings from this work were that:

- Tasmanian farmers are custodians one of the state's largest carbon 'banks', soil carbon. The huge amounts of stored carbon in soils are retained with good management practices and susceptible to degradation and conversion into CO_2 if management is not sustainable.
- The Black Magic model is a suitable tool for estimating fluxes and storage of soil carbon. However, default starting points for soil carbon in the Black Magic model may need some revisions, and much more accurate figures are achieved when agronomic soil test values for soil carbon are used as the soil carbon starting point.
- While the ARRIS database contains information on starting soil carbon values, this information is likely to be widely variable and agronomic soil test values are much more reliable inputs for soil carbon modelling.

Assessment of soil carbon stores at the farm scale in Tasmania, Australia

William Cotching
Tasmanian Institute of Agricultural Research & CSIRO Sustainable Ecosystems, PO Box 3523 Burnie Tas. 7320, Australia. E-mail: Bill.Cotching@utas.edu.au

Abstract
The measured farm soil carbon stores in the upper 30 cm of soil were 371 to 699 T/ha CO_2 equivalents across the three farms assessed. The highest value occurred on predominantly Dermosols and Ferrosols, which have high clay contents, are under perennial irrigated pasture for dairying, and have a mean annual rainfall of 1242 mm. The lower soil carbon stores occurred on Kurosols, Sodosols and Tenosols which have sandy loam surface textures, are used for cropping and have mean annual rainfalls of 560 – 760 mm. This study demonstrates that farmers are custodians of a large 'bank' of soil carbon which is susceptible to degradation and conversion into CO_2 if management is not sustainable. The calculated farm carbon storage in the upper 30 cm of soils varied depending on the scale of investigation. Broad scale assessment using information from the Australian Soil Resource Information System ranged from being 25 - 82% less than that determined from farm scale information.

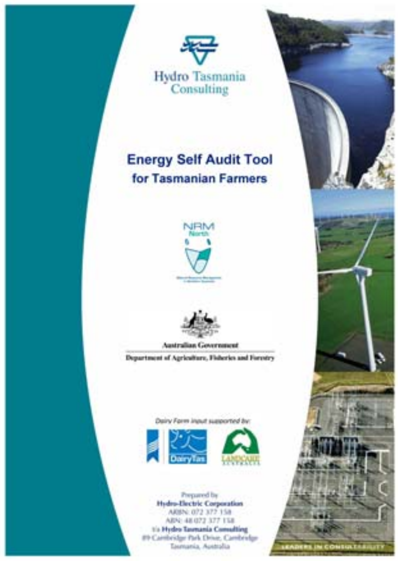
Key Words
Carbon stores, assessment scale

Introduction
Recent concern over the contribution made by agriculture to greenhouse gas production has lead to interest in soil carbon as a potential store for atmospheric carbon (Izaurralde *et al.* 2001; Scholes and Noble 2001). There is also increasing pressure and demand for estimates of current soil organic carbon stocks as well for information on how different farming enterprises can be managed in order to minimise their carbon footprint. It is important, however, that accurate and reliable data are used as the basis for these estimates in order to minimise errors. Some farmers are interested in the 'big picture' of carbon stores and fluxes on their farm rather than just their emissions and sequestrations which are the focus of current carbon accounting using existing carbon calculators such as FullCAM (Richards *et al.* 2005). The farmers involved in this study wanted to see information which is already routinely compiled as part of a well delivered property management plan e.g. farm map, soil types, land use areas (cropping, pastures) used to demonstrate the valuable role that farmers play as carbon stewards.

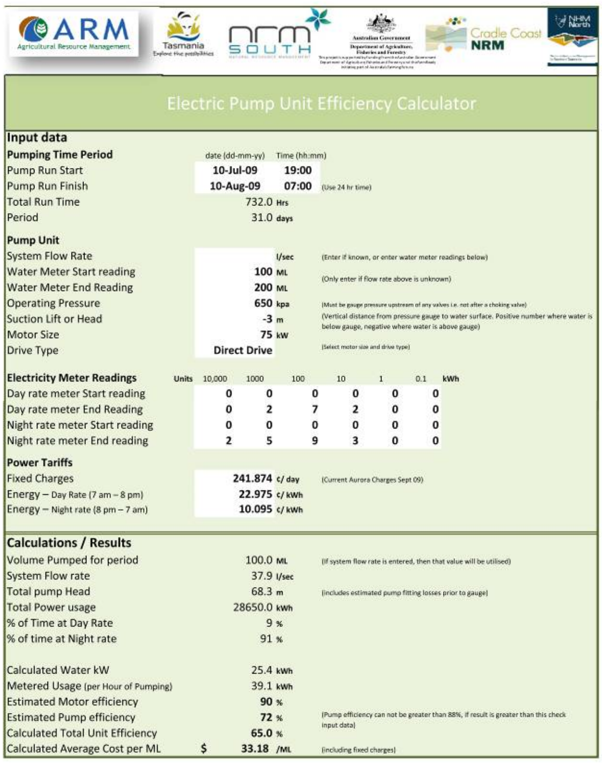
The objectives of this research were to measure current on-farm soil carbon stores by physical measurement, and compare different scales of assessment of farm carbon stores

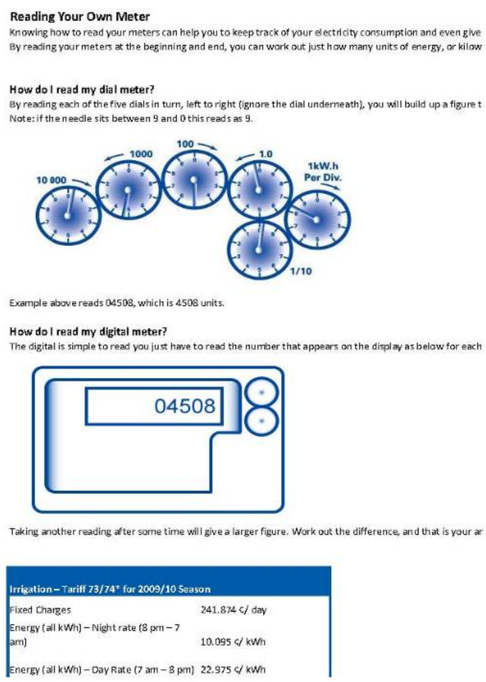
Methods
Three pilot farms were used that were representative of enterprise types in Tasmania. Seventeen sites were selected on each of the three farms. These sites were representative of the soils and topography previously mapped on the properties. Not all mapped polygons were sampled and some large polygons or soils with multiple polygons had multiple samples taken. Measurement of soil carbon was undertaken according to the protocols of McKenzie and Dixon (2006). Sampling was carried out in September. Samples were collected in areas sufficiently far from fence lines, gateways and headlands to avoid these edge effects. Five soil cores were taken along a 60 m transect using a 50 mm diameter push auger. Cores were combined to form a single composite specimen for each of 3 depths, 0-50 mm, 50-100 mm and 100–300 mm. These samples were dried at 40°C for at least 48 hours, ground to pass a 2 mm sieve, and stored in air-tight containers. The samples were then analysed for total carbon by dry furnace combustion (Rayment & Higginson 1992). Bulk density was measured at the sampling site in order to calculate the mass of soil organic carbon (area and depth). Stainless steel cylinders, 60 mm long and 60 mm in diameter, were hammered into the soil at the starting point of the composite sampling transect. Cores were collected from 0-60 mm, 50-110 mm and 150-210 mm depth. Cores with soil intact were excavated and trimmed before the contents were emptied into plastic bags, dried at 105°C, and then weighed. The mass of carbon stored at each sampling depth, to a total depth of 30 cm, was calculated and converted to carbon dioxide equivalents (CO_2e) by multiplying by 44/12. This carbon dioxide mass value was then multiplied by the area of mapped polygons of each soil type occurring on the farm and the totals summed for the entire farm property.

Energy Self Audit Tool for Tasmanian Farmers
Document compiled by Soheil Haee *(B.E. (Hon.s), Grad. Dip. (Sustainable Development),* Hydro Tasmania Consulting, using the information obtained from the farm energy audits. It contains bench mark information for Tasmanian farm energy use, extensive references and energy management action plans and checklists for farmers and consultants undertaking farm energy audits. Available on Farmpoint www.farmpoint.tas.gov.au



Pump Efficiency Calculator Tool
This Excel spreadsheet was developed by James Curran from ARM. This tool helps farmers and irrigation dealers calculate pump efficiencies and compare pump/pressure scenarios and costs. It also has information describing pump efficiency, reading electricity meters, and conversions between commonly used units. Available on Farmpoint www.farmpoint.tas.gov.au





Communication Activities

Activities undertaken to date include:

Presentation at 2009 Tas Landcare Conference. *The Carbon Story* (Duncan Macdonald)

Presentation at 2009 DairyTas AGM. *Energy and dairy farming* (Duncan Macdonald)

Presentation at 2010 Tasmanian Dairy Conference. *The Carbon story for Dairy in Tasmania and on farm actions* (Rachel Brown)

The Carbon Story methodology has been featured as a farmer case study (mixed enterprise property) in the June edition of Carbon Toolkits in Agriculture. http://www.dpi.vic.gov.au/DPI/nrenfa.nsf/childdocs/-7945C583A915FBBDCA25762B001D69A1-905DB27A5369FF11CA25761800077687?open

Ongoing communication and use of technical resources with dairy farmers is planned through a Dairy Australia funded project, Future Ready Dairy Systems.

Funding Acknowledgments

The work specific to dairy farms has been funded by Dairy Tas and Landcare. Some of the development of the technical resources was also funded by NRM North, Tasmanian Government Climate Connect Program and the Australian Government Department of Agriculture, Fisheries and Forestry under the Farm Ready Initiative, part of Australia's Farming Future.

Project Team Acknowledgments

- Duncan Macdonald. Duncan was project leader until he left ARM in January 2010 to go dairy farming himself.
- Rachel Brown, ARM. Rachel took on the project leader role in February 2010.
- Both Duncan and Rachel undertook project co-ordination, technical delivery, facilitation with farmers and communication of outcomes.
- James Curran, ARM (irrigation energy audits and development of pump efficiency calculator)
- Soheil Haee, Hydro Tasmania Consulting (farm energy audits and development of self-audit tool)
- Brian Wood, ARM, (IT support for Excel based tools)
- Bill Cotching, TIAR (Soil carbon inputs, including proof-of-concept fieldwork, for Farm Carbon Story)

The farmers in our focus group were: Cheryl McCartie, Grant Archer and Brian Lawrence. Our sincere thanks to all for their time, input and suggestions. Thanks to Mark Smith at DairyTas for assistance in project development and management.

Appendix 1 – Summary of main climate change issues identified by farmers for Tasmanian agriculture

Based on collation of feedback from 8 leading Tasmanian farmers, representing a cross section of farming enterprises.

There is a minefield of information about climate change, some of which is confusing and contradictory. What do you think Tasmanian farmers need to know now? Responses ranked in order of general overall group priorities, plus comments.

Priority	Topic	Comments from individuals and from group discussion
Higher	The science of climate change and the greenhouse effect	• Farmers need to understand the science so they are in a position to argue the policy. However, need to keep info straight forward. Many farmers just need the basic facts eg. is it real? • Need to merge the climate variability and climate change concepts as we grapple to understand practical short to medium term adaptations to variability yet be strategic about the overall change. • Need to understand what the uncertainties/unknowns are....what is fact/what is fiction?
	Implications for water resource management (including Hydro)	• What are potential scenarios re water availability? • Rainfall/evaporation/temperature rates may change dynamics of water availability for stock water and irrigation
	Farm greenhouse gas emissions and use of carbon calculators	• Use to benchmark farming practices • Models/tools can be extremely varied so need to be sure about appropriate ones to use, and rigorous science/debate will need to be behind models Govt agencies/NRM bodies/ local bodies and community take on board as in to many instances models are not reflective or accurate enough and community gets the wrong message about farming • C cycles in grazing systems. Methane emissions vs C sequestered in pasture and trees.
	Predictions for changed agricultural practices	• Potential scenarios for stock, pasture and water management • Irrigated farms will face more challenges than dryland as will need more water to produce same amount of grass/crop per ha
	Carbon offset schemes and carbon trading	• Need to know the options, but concerns that schemes being pushed at present are not as beneficial to farmers as they make out. Some dubious players in market too. • Practicality for farming families eg. 100 years on title for accredited tree plantings is a negative
	Climate change policies	• Need to have a big picture grasp on climate change policy so can understand the implications for farmers • Need to know the reality of govt positions nationally and internationally • Maybe some strength in a trans-Tasman agricultural approach on climate change
	Climate predictions	• Climate *variability* is the most important at present to get a handle on as climate change predictions are still inherently unreliable
	Implications for financial risk and farm insurance	• Increased volatility will challenge individual businesses depending on their feedbase systems/efficiencies etc. Farm adaptation will be not only be physical on farm stuff but adapting to the industry/company/govt stuff too.
Lower	Detail of the CPRS	• Many changes likely. Not worth spending time on this until things are clearer....although important to understand timelines of what is proposed when.

What aspects of your farm business do you feel are most impacted by climate change and/or climate change policies now?

- Water availability (decreased rainfall), policy and water security
- Changed seasonal patterns and impacts on production (eg. crop yields – soil carbon, pumping costs for irrigation, diesel usage; eg. pasture growth...particularly for dryland pastures)
- Drier, warmer and longer summers leading to greater costs in filling feed gaps
- We should be looking at opportunities for storage and utilisation of our relatively abundant water resource – some farms are pursuing this, but better a statewide push needed
- Uncertainty with policy – international, national and state. Uncertainty with how schemes with be implemented.
- ETS and farming being left out until 2015 and start date on benchmarked data
- More time spent off-farm learning/inputting into the climate change debate
- Concern about which products to buy eg solar energy etc as not sure if product claims suit TAS. We are a grass based system so more vulnerable than PMR or TMR systems and planning for any changes in regard to this are restricted by infrastructure/ financial constraints. Have halted all plantings on property to see how it all pans out. General energy consumption on farm is a concern

What aspects of your farm business do you feel will be most impacted by climate change and/or climate change policies in the future?

- Time and costs involved with compliance, and potential impact on profitability? How do we pass on the costs of CPRS? Rising cost of inputs as carbon taxes are passed onto farmers and difficulty in passing on these costs in production
- Time spent in meetings/learning about compliance/paperwork etc.
- Water availability, policy and security
- How will Tasmanian farmers leverage good outcomes so we can compete nationally and internationally?
- Production impacts on livestock and cropping enterprises. Govt policy settings will determine whether they are negative or positive.
- Control costs for emerging weed, pest and disease threats.
- How will farmers manage changes in biodiversity that are driven more by climate change than by on-farm practices?
- Carbon offsets to decrease farm carbon footprint
- What will be the implications for ongoing continuity of some farming families? Marginal areas will become increasing non-viable and there are important social considerations with families leaving the land.
- Whether the powers that be have the good sense to treat primary food production differently and allow a concession on emissions/unit basis.
- Whether a cap model could be applied to each farm based on production figures/feedbase system and whether we go over or under we pay or refund would have planning and financial implications rather than pay for all carbon and too hard to measure?
- Much more research into farm systems will need to be done to understand the trend of carbon used in each one as impossible to measure it all at this stage and no doubt in future.
- Also whether animal genetics to decrease emissions (eg microbial gut stuff) comes at a reasonable cost/timeframe

There are many topics under discussion as ways to reduce farm carbon footprints/offset livestock emissions. What topics do you think are most relevant right now for Tasmanian farmers?

Topic	Comments from individuals and from group discussion
Changing production practices	• How to conserve soil C – eg. direct drilling, minimal till, changing rotations and crops grown • Pastures – especially N management • Feeds and feeding regimes for livestock. Management of feed additives. • Plant breeding including GMOs. Biotechnology may bring benefits but will they be available to Tas farmers? • Impacts of changed land use eg. land clearing, establishing plantations • Holistic approach to carbon emissions/capture in farming systems • Most efficient irrigation practices
Farm and household energy efficiency	• Irrigation design • Options for renewable energy on farm
Marketing and C offset schemes	• Explore opportunities for farmers to gain from 'feel good' markets eg. Tas products to be promoted as C neutral • Assist farmers to understand differences in commercial and regulated carbon offset schemes and what the different implications and financial opportunities are • Reforestation of marginal land (and potential agroforestry options)
Farm planning	• Farm action plans for fire management, including plantation management