FUTUREDAIRY information sheet

Less carbon emission

by Santiago Farina and Yani Garcia

FutureDairy studies have challenged the common belief that intensifying a dairy system leads to more greenhouse gas emissions. The results show that focusing on improving productivity is an effective strategy to manage carbon emissions per unit of milk product.

The expected inclusion of agriculture in the Carbon Pollution Reduction Scheme (CRPS) from 2015, is likely to have a significant impact on Australian dairy farming systems and business viability.

World demand for food will continue to increase as the total population increases, so a key issue will be to manage the amount of greenhouse gas emitted per unit of food (eg milk) produced.

The total production of greenhouse gas (GHG) will normally increase with the intensification of a system. However, if farm productivity (output per unit of input) improves with intensification, there could be a reduction in greenhouse gas emission per litre of milk.

The FutureDairy team analysed data from two years of whole-farm studies to calculate the potential greenhouse emissions from three different intensification strategies:

1. increasing stocking rate
2. increasing milk production per cow
3. using a complementary forage system (CFS).

We used a model developed by K. Christie, R. Ranwsley and D. Donaghy in Tasmania*.

The CFS is an intensive crop rotation system that involves growing pasture on 65% of the farm area, with the remaining 35% being used to grow three crops per year on all of the area – a legume, a high yielding crop such as maize and a brassica (forage rape).

Compared with an 'industry average' farm, each of the more intensified systems produced less greenhouse gas per unit of milk solids (see table). The 'industry average' farm produced about 14 tonnes of carbon dioxide per tonne of milk solids, compared with around 10 for each of the intensified systems – that's about 30% less.

Greenhouse gas emission (expressed as tonnes of carbon dioxide equivalent) for dairy farm systems with different levels of intensification.

	Industry average farm	Pasture High milk/cow	Pasture High stocking rate	Complementary Forage System
Stocking rate (cows/ha)	1.77	2.5	3.8	3.7
Milk/cow (L/305-day lactation)	5115	7,759	6,895	7,738
Milk/ha (L/ha/year)	9,053	22,975	31,143	34,499
Grain (t/lactation)	1.2	2.0	1.1	1.0
Home grown feed (% of diet)	62%	60%	50%	82%
Greenhouse gas emitted per unit of food produced (t CO_2/t milk solids)	14.2	10.0	10.6	9.9

Estimates made using Dairy Greenhouse Gas Abatement Strategies (*DGAS*) calculator, developed by Christie *et al.* (2008)*

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There are three reasons for the reduction in carbon emission per unit of milk produced.

First, in the intensified systems, cows were fed to produce more milk, therefore 'diluting' the cost of methane production at maintenance. Methane production from the rumen fermentation process is by far the largest contributor of greenhouse gas from any dairy system (see graph).

Second, the improved quality (digestibility) of the diet of the more intense systems helped reduce methane production. This is because high digestibility diets shift the balance of rumen fermentation towards propionic acid (and relatively less acetate). More propionic acid means more glucose in the liver, more milk in the mammary gland and less methane into the environment.

Third, as farm milk production increases, the amount of carbon dioxide from dairy electricity and fuel use is diluted into a higher volume of milk in the intensified farms.

The complementary forage rotation system had the highest proportion of milk coming from home-grown feed and the lowest greenhouse gas emission per unit of milk produced (see table).

To simplify the calculations, the greenhouse gas emissions were calculated for the milking area and milking herd only. Carbon emissions (per unit of milk produced) increase when dry cows and replacement stock are included. Young and dry stock don't produce milk but still produce methane (up to 60% of the methane produced by a milking cow).

This means that delaying the time to first mating beyond the ideal of 15 months will increase a farm's carbon emission per unit of milk produced. Improving feeding management of heifers and the overall reproductive performance of the herd, will reduce the system's carbon emissions.

Under Australia's pasture-based dairy system, focussing on improving productivity will be an effective strategy to manage greenhouse gas emissions per litre of milk.

* Reference: Christie K, Rawnsley R, Donaghy D (2008). Whole farm systems analysis of greenhouse gas emissions abatement strategies for dairy farms. Dairy Australia UT12945 Final Report.

For more information

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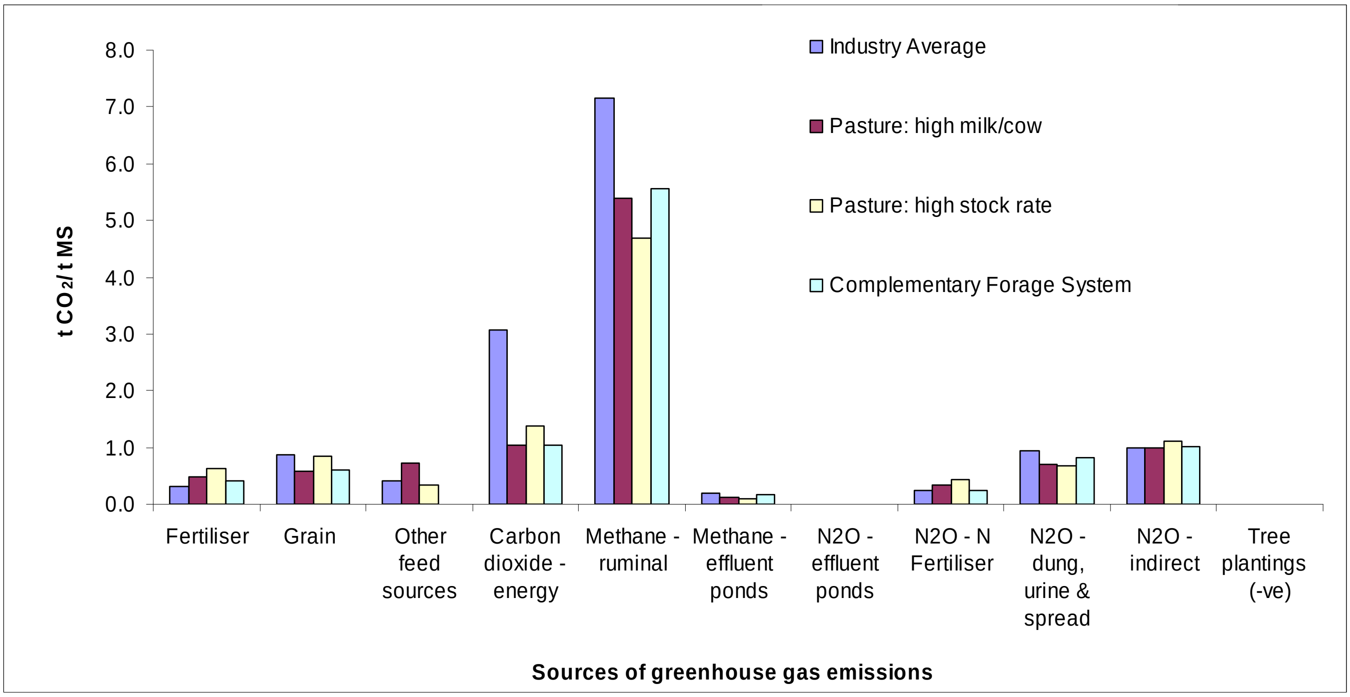

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About FutureDairy

FutureDairy aims to help Australia's dairy farmers manage the challenges they are likely to face during the next 20 years. The challenges are expected to be related to the availability and cost of land, water and labour; and the associated lifestyle issues.

Our activities are structured around two priority areas – Precision farming (including automatic milking and innovations) and Feedbase (forages and feeding). These are the areas where there are opportunities to address the challenges related to water, land and labour resources.

For Precision Farming we are investigating technologies with potential to improve farm productivity, efficiency, labour management or lifestyle. FutureDairy is pioneering the development of pasture-based farming systems that use robotic milking for larger herds. Our research is conducted at Australia's first automatic milking system (AMS) research farm, at Elizabeth Macarthur Agricultural Institute at Camden. Since mid-2009 we have been testing a new concept automatic milking system designed specifically for Australian conditions, while continuing to further develop the farming system around the milk harvesting equipment.

Our Feedbase goal is to develop sustainable dairying systems for the future, with the intensification of home-grown feed to enable more efficient use of land, water and grain. Our trials are being conducted at the University of Sydney's Corstorphine dairy farm and Mayfarm. The investigation is complemented with modelling and component field research in areas of forage production and utilisation.

We are investigating a complementary forage system (CFS) that involves triple cropping on 35% of the farm area and growing pasture on the remaining 65%. Our target is to produce more than 25t DM/ha/y rover the whole farm area, in a sustainable way. The three crops include:

- a bulk crop (eg maize);
- a legume for nitrogen fixation (eg clover); and
- a forage to provide a pest/disease break and to improve soil aeration (eg a brassica).

FutureDairy is now in its second phase. During the first phase, we used existing technology for automatic milking to test the feasibility of robotic milking in a pasture based system. The promising results paved the way for testing a new prototype AAMS with a larger herd during phase 2.

In the first phase, our Feedbase studies tested the feasibility of a complementary forage rotation grown on a small area, both under research and commercial conditions. Phase 1 combined technical research with social research and extension research. During phase 2 we are drawing upon that learning experience to improve our linkages with major extension groups.

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