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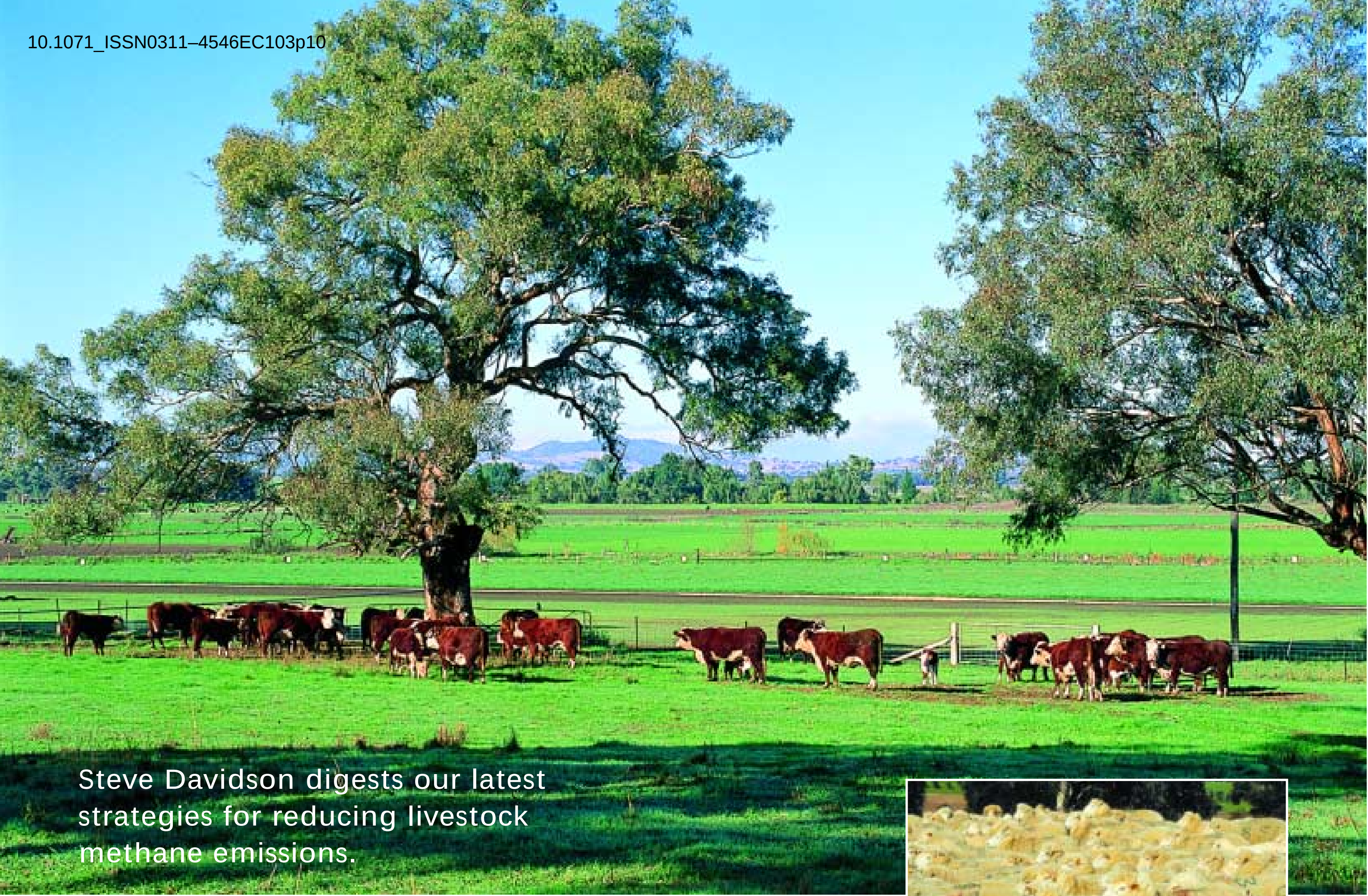


Steve Davidson digests our latest strategies for reducing livestock methane emissions.

Bad breath

Livestock are the third largest source of greenhouse gases in Australia, after the better known energy and transport sectors.

By belching their way through digestion, ruminant animals such as cattle and sheep produce 13% of Australia's greenhouse gas emissions. In New Zealand the figure is 46%, in stark contrast to the 3–4% produced in other developed nations. Much of this gas is methane, a by-product of fermentation in the rumen (main stomach) of the animal, by microbes called 'methanogens'. Globally, livestock produce 80–103 million tonnes of methane a year.

As a signatory to the Kyoto Protocol, Australia must limit its annual greenhouse gas emissions resulting from human activities during 2008–2012 to 108% of net 1990 emissions. Reaching this target, without limiting industry options for expansion, will require agricultural practices and technologies that reduce the gaseous waste emitted by our farmyard friends.

At a Bureau of Rural Sciences workshop entitled Meeting the Kyoto Target: Implications for the Australian Livestock Industries, scientists discussed two possible ways of capping national livestock emissions. One was to increase productivity per head while reducing animal numbers. The other was to use 'clever technologies' to reduce methane emissions per unit of feed intake.

The first strategy has already proved effective in the Queensland dairy industry where productivity has increased dramatically in the past decade, from an average of 2924 litres of milk per head in 1988 to 4046 litres per head in 1996. Total herd emissions of methane declined by 6% due to an 11% reduction in animal numbers, while feed intake by the herd remained constant.

But to further reduce methane emissions, while simultaneously maintaining stock numbers and increasing productivity, requires tinkering with the processes of fermentation in the rumen.

Livestock feed additives that counter methane-generating microbes in the rumen have two modes of action. They either inhibit hydrogen production, or increase the use of hydrogen in other chemical reactions. Either way, they reduce the quantity of hydrogen available for the microbes and, since these need hydrogen in order to produce methane (and energy for their own growth), this reduces methane emission. Oilseed supplements, such as whole cottonseed, may prove effective in this regard.

Scientists have also found that an antibiotic called monensin reduces methane production in ruminants, although its effectiveness drops off with repeated use. It has the advantage of being commercially available for both lot-fed and free-range animals, as a controlled-release intra-ruminal capsule, and it could prove a useful short-term tool against emissions.

The second approach to capping national livestock emissions, by using 'clever technologies', has also seen some advances. At least three potential methane-intervention strategies are in development.

The first involves a vaccine against methanogens. Dr Suzanne Baker of CSIRO Animal Production has found that methanogens can produce antigens distinct from those of other rumen organisms. This means it should be possible to vaccinate animals against methanogens without affecting other rumen organisms.

In Baker's experiments, vaccinated sheep had higher concentrations of antibodies against methanogens and their rumen fluid produced significantly less methane than that of unvaccinated animals. If it proves successful, this vaccination strategy will allow treatment of free-range animals, which predominate in Australia.

A second strategy, being investigated by Dr Keith Joblin of AgResearch in New Zealand, is the use of bacteria called acetogens to divert hydrogen away from methane-making microbes. Unlike methanogens, acetogenic bacteria convert CO_2 and H_2 to acetate (CH_3COOH) rather than to methane. Acetate is not a greenhouse gas and, better still, is a nutrient for the farm animal. Acetogens occur naturally in the gut of ruminants, humans, wood-eating termites and elsewhere. The trick is to boost their numbers in the rumen. But it will probably be many years before methods of promoting acetogen activity are commercially available.

The third strategy under investigation is the use of biological and chemical agents for controlling methanogens and associated microbes, or for inhibiting the release of hydrogen. One example is a common food preservative, nisin, which kills bacteria. Nisin is reported to reduce methane emissions by 36% in ruminants. But it would have to be re-evaluated and re-registered for use in animals before it could be put to use against global warming. This could possibly be achieved within a few years, while the search for new agents continues.

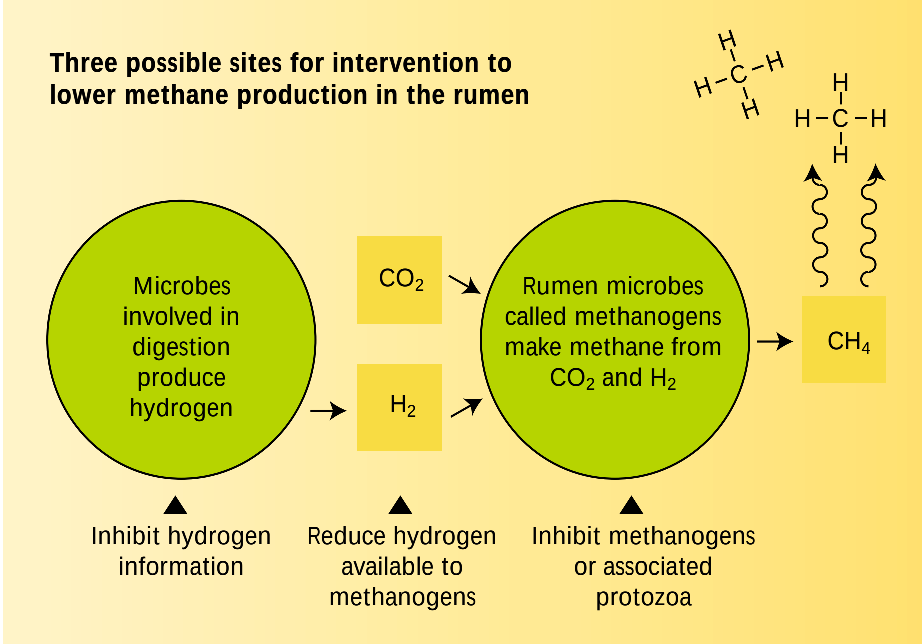
Other approaches to methane reduction include selection for animals that, for unknown reasons, normally produce little methane. Low-methane lines of sheep or cattle could result.

It is likely that one or more of these technologies will be commercially realised and the advantages to our livestock industries, not to the mention the environment, are many. These include an environmentally responsible, 'clean and green' image for the sector and improved productivity. Should the new technologies be developed here in Australia, opportunities for export earnings may follow. However, realisation of these benefits will require a substantial increase in research and development expenditure.

If the livestock sector can reduce emissions and if emission trading eventuates, farmers will also have emission permits to sell – a new source of income. Furthermore, under proposed Kyoto flexibility mechanisms, Australia may gain greenhouse 'credits' through use of methane-reduction technologies.

Taking a broader view, by contributing to the mitigation of global warming, Australia will avoid both tarnishing of its international reputation and, as yet unspecified, penalties or trade sanctions for failing to meet our Kyoto target. Finally, given that global warming could affect our agricultural sector through climate change, it is probably in the industry's own best interests to take a responsible proactive role in reducing methane emissions in the paddock.

A report on the workshop Meeting the Kyoto Target: Implications for the Australian Livestock Industries, is available from the BRS. Associated scientific papers are published in the Australian Journal of Agricultural Research, *Vol 50 No 8 (1999).*



Fermentation in the rumen (main stomach) of sheep and cattle is a normal process performed by microscopic bacteria, protozoa and fungi; it helps the animal digest otherwise indigestible tissues in grasses.

One waste product of this 'vat on legs' is the odourless gas methane (CH_4), which emanates mostly from the front end of the beast.

Methane in the rumen is formed by a range of microbes known as methanogens, using carbon dioxide (CO_2) and hydrogen (H_2).

Below: Experiments by CSIRO's Dr Suzanne Baker have shown that methane production in sheep can be reduced by vaccinating against methanogens.

Bottom: Another strategy is the selective breeding for animals that naturally produce less methane.