Department of **Agriculture and Food**
Department of **Regional Development and Lands**

GOVERNMENT OF WESTERN AUSTRALIA

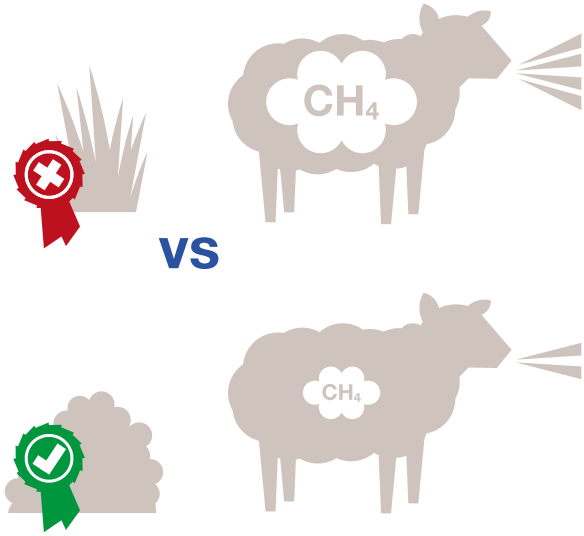
ROYALTIES FOR REGIONS

Carbon Farming in WA

Fact sheet No. 11

PRACTICE: **Managing sheep pastures to reduce methane production**

Description of practice



Feed intake and methane emissions are influenced by the digestibility of the pasture and the concentration of plant secondary compounds such as tannins. Sheep grazing legume pastures consistently produce less methane per kilogram of pasture consumed than sheep grazing grass pastures. The reduction in methane yield can be up to 25 per cent (Waghorn et al. 2002). Managing pastures to maintain a higher proportion of legumes is therefore a strategy that farmers could potentially adopt to reduce CO_2-e emissions.

Outline of procedure

The lower methane yield from legumes, and especially those grown in Western Australia, is likely to be attributed to their lower fibre content and faster rates of passage through the rumen. However, associated with the lower fibre content, the absolute intake of legumes by sheep is higher than that for grasses of the same digestibility, and consequently the absolute emissions from grazing legumes compared to grasses may be less than expected. Furthermore, legume pastures are generally less productive during the winter period than grass pastures, so for farmers who currently have productive pastures there is likely to be a trade-off with lower carrying capacity.

Farmers will need to manage pastures to achieve a higher proportion of legume in the sward. This could be achieved through sowing new legume pastures, especially those demonstrated to produce less methane when consumed, plus grazing practices, which can be used to increase legume seed production and the proportion of legume in the pasture. The proportion of legume to pasture will need to be quantified. Research is also required to define the reduction in emissions associated with different legume levels and different legume species.

The Department of Agriculture and Food is the lead agency and is working with the Department of Regional Development and Lands to deliver this Royalties for Regions funded project.

For more information please refer to agric.wa.gov.au

More Information

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Work done to date

There have been no studies to our knowledge (other than Young et al. 2009, Sheep CRC, unpublished) to quantify the effects of increasing legume content of pastures on whole farm CO_2-e emissions. Modelling by Young et al. examined the financial trade-off between the reduction in CO_2-e emissions and lower winter production from legume pastures. With a carbon price of $23/t and a potential reduction in emissions of 10 per cent from grazing pastures with higher legume content, the benefit of lower carbon emissions is offset if the winter production of the pasture is compromised by between 2.5 and 4 per cent. They concluded that this level of reduction in productivity is highly likely and therefore farmers who currently have productive pastures would be worse off, if managing pastures to increase legume content.

Current level of adoption

We are not aware of any farmers that have manipulated the proportion of legume in their pastures specifically to reduce CO_2-e emissions.

Industry activity

None at this stage. The modelling analyses indicate that farmers with productive pastures are likely to be financially disadvantaged from increasing the proportion of legume in their pastures in order to reduce carbon emissions. This is because the reduction in carrying capacity due to the lower winter productivity of legumes will be greater than the potential compensation received through the Emissions Reduction fund (ERF).

Carbon benefits

Currently none.

Co-benefits

Farmers with degraded pastures can potentially use this opportunity to increase pasture productivity and reduce emissions.

Opportunities

- The practice of maintaining a higher proportion of legumes in pastures is relevant to all sheep enterprises, including purebred merino, merino crosses and composite breeds in all parts of Western Australia, excluding the pastoral zone where legumes fail to persist. The state has about 6500 farms with a total of 14.5 million sheep, of which 8.6 million are breeding ewes.
- However, more research is required to quantify the changes in carrying capacity by managing pastures to have greater legume content. Some legumes such as arrowleaf clover can actually extend the growing season (Thompson et al. 2010) and extra growth in late spring/early summer has a high economic value (Young et al. 2010). There also appears to be significant variation in methane yield between the main legume species used across the agricultural regions of Western Australia (Thompson et al. 2012, unpublished data; Meat & Livestock Australia milestone report), so the potential for alternative legumes to increase profit and reduce emissions cannot be totally discounted.
- Grazing legumes rather than grasses will reduce the level of emissions from livestock per unit of intake and liveweight gain. The level of reduction in emissions could be as high as 25 per cent when comparing pure legume with pure grass swards (Parsons & Chapman 2000).

Risks

- Currently there are no ERF-approved methodologies for reducing emissions from improved pasture and stock management practices.
- There are currently no accurate techniques for measuring feed intake and methane emissions from livestock in commercial grazing situations.
- The ERF additionality test will determine if a sheep enterprise is eligible for carbon credits. If the test determines that the practice of growing novel pastures and using controlled grazing

systems generates both productivity and emissions benefits there is a risk that the practice will be ineligible for recognition under the CFI (Australian Farm Institute 2011).

- A major barrier to the success of these practices is that there is unpredictable variation in methane emissions between animals and across differing environments. The variation needs to be quantifiable using standardised measurements for animal feed intake and methane emissions.
- The potential financial return from an enterprise that is based on carbon offset at present is dependent on the voluntary carbon market and the policies of the Commonwealth and state governments. However, maintenance of the practices will be practical and cost effective because of the associated production benefits.
- A pure legume sward is very difficult to maintain in practice and the clover content of most mixed pastures is often less than 20 per cent. The proportion of clover in a sward also varies within and across seasons, depending on the distribution of rainfall, climate, seedbank content, nitrogen concentration, phosphorous fertility and grazing management (Parsons & Chapman 2000). There are limited publications on seasonal growth patterns of grasses versus legumes, but it is generally accepted that subclover and medic pasture growth is significantly lower than grass-based pastures in winter. Increasing the proportion of legume in a pasture sward typically involves reducing the productivity of the pasture during winter. This leads to a reduction in stocking rate (Young et al. unpublished).
- The reduction in profit from a reduction in winter productivity of between 2.5 and 4 per cent is sufficient to offset the value of the carbon emissions saved.The main risks associated with managing pastures for higher legume content as a technique to reduce carbon emissions are associated with seasonal variation. Pasture composition varies widely between seasons and maintaining a high legume content may be difficult in some seasonal sequences.

Case study

The typical sheep farm in Western Australia runs 1220 ewes, 560 lambs and 170 wethers and rams. This equates to about 2700 DSE. The farm would emit about 550 tonnes CO_2-e per annum from methane and nitrous oxide emissions. Managing the farm to achieve higher legume content could reduce emissions by 55 tonnes. This benefit would be offset by a reduction in winter pasture productivity of between 2.5 and 4 per cent.

Key contacts – Australia

A number of research groups are investgating pastures and shrubs that reduce methane emissions without compromising productivity and profit.

- Dr Andrew Thompson (Department of Agriculture and Food, Western Australia)
- Professor Phil Vercoe (University of Western Australia)
- Dr Dean Revell (CSIRO, Floreat, Western Australia)
- Dr Jason Emms (South Australian Research and Development Institute, Adelaide)
- John Young (Farming Systems Analysis Service, Kojonup, Western Australia)

International work

New Zealand Agricultural Greenhouse Gas Research Centre: this centre is the main international group undertaking work related to pastures and their management on methane emissions from sheep production systems. Significant collaboration is already occurring between NZAGRC and research institutes in Australia, including Western Australia. Several researchers, including Dr Andrew Thompson from DAFWA, are also members of the Livestock Emissions and Abatement Research Network (LEARN), which facilitates the development of practical and cost-effective methods to mitigate the agricultural production of greenhouse gases.

Stakeholders

- Farmers
- State government agencies and research institutions including DAFWA, Murdoch University, the University of Western Australia and CSIRO
- Rural Industry Research Corporations: Australian Wool Innovation and Meat & Livestock Australia
- Department of Agriculture, Fisheries and Forestry (DAFF)

Next steps

Major research, development and extension activities related to the effects of stocking rate and other management strategies on methane emissions are planned under DAFF's Filling the Research Gap – Modelling Research. The most relevant projects within this program include:

- how livestock emissions may be reduced through manipulation of livestock feed systems (Victorian Department of Primary Industries)
- identifying low methanogenic potential shrub and inter-row species for grazing systems (UWA)
- researching how anti-methanogenic plants and products reduce methane production in the rumen (UWA)
- identifying pasture species to reduce methane and emissions intensity in southern grazing systems (UWA)

Key references

Emissions Reduction Fund (ERF), http://www.agriculture.gov.au/climatechange/cfi

Department of Agriculture, Forestry and Fisheries, Filling the Research Gap – Modelling Research, daff.gov.au/climatechange/carbonfarmingfutures/ftrg

Livestock Emissions and Abatement Research Network (LEARN), livestockemissions.net

Meat & Livestock Australia milestone report, mla.com.au/About-the-red-meat-industry/About-MLA/Company-overview/Corporate-documents/Annual-report/Annual-report-2011-12/Promoting-industry-integrity-and-sustainability

New Zealand Agricultural Greenhouse Gas Research Centre, nzagrc.org.nz

Parsons, AJ, & Chapman, DF 2000, 'The principles of pasture growth and utilization' in A. Hopkins (ed.) *Grass: its production and utilization,* Oxford: Wiley–Blackwell, pp. 31–89

Thompson, AN, Kennedy, AJ, Holmes, J & Kearney G 2010, 'Arrowleaf clover improves lamb growth rates in late spring/early summer compared to subterranean clover in southwest Victoria', *Animal Production Science,* vol. 50, pp. 807–816

Thompson , AN, Ferguson, MB, Macleay, CA, Briegel, JR, in preparation 2012, 'Feed-use efficiency in relation to methane emissions in growing Merino lambs'

Waghorn GC, Tavendale, MH & Woodfield, DR 2002, 'Methanogenesis from forage fed to sheep', *Proceedings of the New Zealand Grassland Association,* vol. 64, pp. 167–171

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Young, JM, Thompson, AN & Kennedy 2010, 'Bioeconomic modelling to identify the relative importance of a range of critical control points for prime lamb production systems in south-west Victoria', *Animal Production Science,* vol. *50,* pp. 748–756