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Enteric Fermentation Issues for the NT

BACKGROUND

In response to a specific request from the JSC Secretariat, this department provides comments in relation to enteric fermentation, options for abatement and possible costs involved under a Carbon Pollution Reduction Scheme.

Importance of NT Cattle Industry

Total NT cattle population increased by 30% to 1.7 million head from 1990 to 2005 (ABS Year Books) and in 2006 represented 6.4% of the nation beef herd. The cattle industry generates in the order of $250 million directly and $750 million indirectly annually into the NT economy (NT Department of Business, Economic and Regional Development). In 2007, nearly 250,000 head (or 45% of total turnoff) were exported mainly to SE Asia. The pastoral industry also manages about 45% of the Territory (600,000 km^2) and this is increasing with the indigenous pastoral development program.

NT Livestock Emissions

In June 2008, the Northern Territory Government published a discussion paper on NT Climate Change Issues. One of the issues raised was the greenhouse gas emissions from ruminant livestock (enteric fermentation) which account for nearly 17% (or 2.3 Mt CO_2-equivalent) of the NT's total greenhouse emissions in 2005 and is the third largest source of emissions in the NT inventory after savanna burning and the stationary energy sector.

Enteric Fermentation

Animals produce methane (CH_4) gas in a process of digestion that involves the fermentation of feed by methane producing micro-organisms (methanogens) in the gut. This process, called enteric fermentation, occurs in the hind gut (caecum and colon) of pigs, horses and donkeys, and in ruminant animals (cattle, buffalo, sheep, goats and camels) this mainly occurs in the fore-stomach (or rumen). The gas is expelled from the rumen or the hindgut into the atmosphere.

Measurements
The Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks in Agriculture (2006) uses country specific methodology to estimate CH_4 emissions from beef cattle in the tropical regions of Australia. Using this methodology, a beef cattle herd profile in the NT is estimated to produce an average of 60 kg CH_4/head/year (1.26 t CO_2-equivalent) compared with IPCC's default value of 53 kg CH_4 (1.11 t CO_2-equivalent) for cattle in the Oceania region (IPCC 1997).

Methane emissions from manure (faeces/urine) produced by grazing cattle are generally considered negligible, but nitrous oxide (N_2O) gas emissions could be significant because of the high global warming value of N_2O (ie 310 x CO_2). Using IPCC methodology, some 7 kg CH_4 and 11.3 kg N_2O (or total of 3.5 t CO_2-equivalent) is potentially lost from paddock excreta per head per year. The Australian methodology accounts for emissions of CH_4 and N_2O from the manure of free-range cattle under Agricultural Soils, but judging by the relative low value of 0.5 Mt CO_2-equivalent recorded in the NT greenhouse gas inventory (State and Territory Greenhouse Gas Inventories 2006) it appears that these emissions were not accounted for in the Territory.

Emissions from feral animals including camels, brumbies, donkeys and buffaloes which are estimated to be about 0.6 Mt (Price *et al.* 2007) have also not been included in the NT inventory.

Emissions Thresholds
Territory pastoral properties with cattle herds of around 13,000 heads are likely to be close to the threshold (25 kt CO_2 equivalent/year) for direct emitters, resulting in about 75 properties in the NT being liable if agriculture was covered under the proposed Carbon Pollution Reduction Scheme.

MITIGATION OPPORTUNITIES AND OBLIGATIONS

Abatement Options
In the past, research focussed on ways to lower CH_4 production (methanogenesis) in cattle because some of the energy available for animal production is lost to methanogenesis thereby reducing feed efficiency. Now the focus is on inhibiting CH_4 production in the rumen because of its role as a greenhouse gas. So any technologies that increase feed efficiency of cattle diets will also help to reduce methane emissions.

Continuation of programs to maximising feed efficiency and performance of cattle herds is therefore the key to lowering CH_4 emissions per unit of productivity (or emissions intensity) in the first instance, until new cost-effective technologies for inhibiting CH_4 microbes have been developed. Examples of ways to manage livestock emissions are given below.

Improving Production Efficiency: Desk top calculations using Australian methodology indicate that CH_4 emissions per unit productivity potentially fall by 18% in tropical beef herds when pregnancy rates increased from 55% to 75%, showing that increasing reproduction efficiency also brings about improvements in emissions intensity. Programs such as the Meat & Livestock Australia funded Northern Australia Heifer Fertility Project aims to increase weaner production per breeder in NT herds which will also lead to reduced emissions per unit productivity.

Grazing Management and Feed Quality: CH_4 production was found to be lowest in terms of unit productivity (ie live weight gain) in Brahman cattle that were fed on grain based diets, higher with good quality pasture, and highest on native pasture (Kurihara *et al* 1999).

Best practice grazing management will therefore ensures lowest emissions intensity for extensively grazed beef herds in the NT. Graziers therefore need continuing access to training programs such as Meat & Livestock Australia's EDGEnetwork Grazing Land Management (GLM) workshops on strategies to increase profit and sustainability.

Breeding for Feed Efficiency: Cattle that utilise feed more efficiently produce less CH_4 as well as bring cost benefits to both intensive and extensive cattle operations. This is a genetic trait that can be bred for by selection and is being trialled on Breedplan as a feed efficiency measure called the Net Feed Intake (NFI) Estimated Breeding Value (EBV). The economic and greenhouse gas mitigation importance of NFI EBV is also part of a larger initiative being undertaken by the Beef CRC in Armidale, NSW, which hopes to reduce methane production by 20% in a third of national beef herd by 2012. Pastoralists would therefore be encouraged to consider the NFI EBVs when buying bulls.

Feed Additives: These are currently used in cattle rations to improve feed efficiency which also has the effect of reducing CH_4 production in the rumen. One compound in particular is the ionophore monensin (Rumensin®) which actively inhibits methanogenesis with verified claims of 20% reduction in CH_4 emissions (www.etvcanada.com). However, the repeatability of these claims by researchers conducting field trials is proving to be difficult. Rumensin® is currently available in controlled release capsules and in dry season proprietary licks for extensively grazed cattle herds.

Emerging Technologies: Australia and New Zealand are investing a great deal of research funding into the development of new technologies for reducing emissions in cattle. For example, studies are ongoing to inhibit CH_4 rumen micro-organisms by using anti-methanogenic antibodies (vaccine). Work is also in progress to find suitable replacement microbes such acetogens (found in marsupial digestion systems) which compete for the same rumen hydrogen source as methanogens but produce energy-yielding acetate instead of CH_4 (PGGRC 2007).

It is quite conceivable that effective methane abatement technologies for extensive beef cattle grazing systems will be available within the next 5 years in addition to the ongoing strategies of beef research programs to improved production efficiency.
By 2015, it is anticipated that a 25% reduction in methane emissions per unit productivity could be achieved with the ongoing development and implementation of the above programs. This would at least stabilise livestock emissions within expected industry growth.

Points of Obligation for Reporting
The Commonwealth Government recognises that a practical method of measuring emissions from agricultural systems needs to be developed before it can be included in a Carbon Pollution Reduction Scheme no earlier than 2015. Options for coverage include:

- Directly from farm business
- Indirectly from processors or suppliers
- Combination of both (hybrid).

The advantage of making farm businesses the point of obligation for reporting is that it promotes efforts to reduce emissions at source by changing management practices. Thus large pastoral companies and processors that exceed emissions thresholds would be liable for reporting under the National Greenhouse and Energy Reporting System (NGERS), while smaller farm business would be required to develop an emissions management and audit strategy as part of an accredited property management planning (PMP) program.

Funding
Commonwealth funding will continue to be required to underpin R&D and capacity-building programs in relation to pastoral production and impact of climate change in the NT. Additional costs to producers of implementing mitigation strategies would need to be met initially by the government in the form of rebates etc. Funding may also be sought to control the relatively large populations of feral animals that range in the Territory.

Current research funding on improving productivity (eg Meat & Livestock Australia R&D Program) and capacity building through demonstration and training should continue (eg Landcare, Caring for Country etc) ($450,000/3 yrs).

Further funding may be needed to fast-track the trialling of new abatement technologies ($250,000/3 yrs) and for auditing and developing emissions management strategies as part of accredited PMP program ($750,000/3 yrs).

The implementation of new abatement technologies (eg vaccines, capsules etc) by pastoralists would also require Government assistance in the first instance to cover costs until benefits are reflected in profitability. It is anticipated that these costs would be similar to current practices of implanting hormonal growth promotants (HGPs) to increase weight gain in cattle which are costed at $4 to $5 per head. Total funds required therefore would depend on the NT cattle population which could reach 2 million heads in the near future, thus $10 million would cover the initial treatment for methane abatement.

The Northern Territory Government agencies may also seek Commonwealth funding to assist with a program to controlling feral animal populations particularly camels and donkeys that populate central Australia. Because of the remoteness of the area and the need to use helicopters to find and shoot feral herds, the operational costs of this program will be high (between $10-50 per kill (1989) depending on population density (Bayliss and Yeomans 1989)). The population control of 500,000 head of feral animals could therefore cost significantly more than $25 million in today's terms.

In summary, total funding requirements over 3 years are expected to be:

1. R&D and Capacity Building: $450,000 (from existing funding sources).
2. Trialling of new abatement technologies: $250,000 (additional funding).
3. On-farm emission abatement strategies: $750,000 (additional funding).
4. Farmer assistance with new abatement technology: $10 million.
5. Feral animal control: < $25 million.

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