MPI POLICY AND TRADE
Agricultural Inventory Advisory Panel Meeting
20 November 2014

HILL COUNTRY – DIRECT N_2O FROM EXCRETA (EF_3)

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Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of Report

1. Seek approval from the Agricultural Inventory Advisory Panel to:

   - Include emission factors for direct nitrous oxide emissions from animal excreta (EF_3) reflecting stock type and the effects of slope
   - Implement a methodology for estimating emissions from direct N_2O from livestock excreta on hill country in New Zealand (EF_3).

2. Attached to this briefing paper are the reports:

   - Kelliher et al. (2014), Statistical analysis of nitrous oxide emission factors from pastoral agriculture field trials conducted in New Zealand, Environmental Pollution 186: 63-66
   - Giltrap et al. (2014), Estimating direct N_2O emissions from sheep, beef and deer excretal deposition including the emission factors developed for animal type and slope of the land on hill country soils, MPI Technical paper (in press)
   - Review reports of Giltrap et al. (2014) by Professors Jacqueline Rowarth and Russ Tillman

Summary

Background

3. New Zealand has an obligation under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol to report anthropogenic greenhouse gas emissions and removals every year. Emissions are estimated and reported in the annual submission of the National Inventory Report submitted to the UNFCCC. This reporting requirement is also legislated by the New Zealand Climate Change Response Act (2002).

4. Any future commitments taken by New Zealand to reduce greenhouse gas emissions may have a financial cost based on emissions reported in the National Inventory Report. Therefore reported emissions and removals need to be as accurate as possible. New Zealand has a long-standing

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research program in estimating country-specific emission factors to aid in the improvement of reported emissions and removals from the land-based sectors.

5. Reporting must meet the recommendations in the guidelines provided by the Intergovernmental Panel on Climate Change (IPCC)[i]. Improvements are encouraged to take account of national circumstances beyond the default methodology and emission factors that are recommended in the 2006 IPCC Guidelines, and need to be well-documented and transparent.

Current Inventory

6. The current EF_3 values for direct nitrous oxide emissions from excreta from livestock grazing on pasture are 0.25 per cent for nitrogen in dung and 1.00 per cent for nitrogen in urine for dairy cattle, non-dairy cattle, sheep and deer. These values are applied irrespective of livestock type, land use or slope. As nearly half of New Zealand's national livestock grazes hill country pasture, it was recognised that the currently emission factors may overestimate nitrous oxide emissions.

Proposed Improvement to the Inventory

7. Following two recent studies (Kelliher et al. 2014 and Giltrap et al. 2014), it is proposed that the rates for direct nitrous oxide from livestock excreta deposited in pasture are updated to (a) delineate between livestock category and (b) allow the effect of local slope to be factored into the calculation.

8. Kelliher et al. (2014) statistically analysed 185 field trials between 11 May 2000 and 31 January 2013 to estimate mean emission factor (EF) values for direct nitrous oxide emissions from nitrogen (excreta and urea) applied to pastoral soils in New Zealand delineated by livestock type and slope (table 1).

Table 1: Best linear unbiased predictors for direct N_2O emission factors (%, mean ± SE, n) of the nitrogen sources from Kelliher et al. (2014).

	Lowland	Hill country/low slope	Hill country/medium slope
Dairy cattle urine	1.16 +/- 0.20, 55	0.84 +/- 0.20, 16	
Dairy cattle dung	0.23 +/- 0.05, 20	0.20 +/- 0.07, 4	
Beef cattle urine		0.99 +/- 0.37, 4	0.32 +/- 0.12, 4
Beef cattle dung		0.21 +/- 0.06, 12	0.06 +/- 0.02, 04
Sheep urine	0.55 +/- 0.19, 4	0.40 +/- 0.10, 12	0.16 +/- 0.05, 8
Sheep dung	0.08 +/- 0.02, 12	0.11 +/- 0.03, 8	

9. Giltrap et al. (2014) have developed a methodology to provide national estimates of N_2O emissions from sheep, beef cattle and deer dung and urine across different slope classes. New Zealand Beef + Lamb Economic Survey data were used to calculate the distribution of slope classes across farm types, which were scaled against the national livestock population data from the NZ Statistics Agricultural Production Survey to derive dung and urine N from the MPI Tier 2 Inventory model. To estimate total emissions, a nutrient transfer model estimated excretal N depositions on low, medium and steep slopes, which were then multiplied by values derived from Kelliher et al. (2014) (table 2).

Table 2: Direct nitrous oxide emission factors (%) in Giltrap et al. (2014).

	Low slope	Medium slope	High slope
Beef cattle (and deer) urine	0.99	0.32	0.32
Beef cattle (and deer) dung	0.21	0.06	0.06
Sheep urine	0.55	0.16	0.16
Sheep dung	0.11	0.11	0.11

Effect of changes

10. The methodology has been applied to current (1990-2012) emissions data to demonstrate the overall effect of implementing this methodology into New Zealand's agricultural greenhouse gas inventory. The overall result will be a reduction of nitrous oxide emissions by approximately 15 per cent, or 7,500 Kt CO_2-e during the first commitment period (2008 to 2012) (table 3). (Note that this recalculation will not affect the estimate of emissions that has been published for the first commitment period of the Kyoto Protocol, because this estimate was confirmed and accepted by the UNFCCC during the annual review of national inventories during September 2014.)

Table 3:Impact of new EF_3 emission factors on New Zealand's total greenhouse gas emissions (1990-2012)

Year	Current inventory (KtN_2O)	With revised EF_3 emission factors (KtN_2O)	Current inventory ($KtCO_2$-e)	With revised EF_3 emission factors ($KtCO_2$-e)	Difference ($KtCO_2$-e)	% difference
1990	25.5	18.8	7,594	5,594	-2,000	-26.3%
1991	25.8	19.2	7,696	5,724	-1,972	-25.6%
1992	25.6	19.3	7,632	5,738	-1,894	-24.8%
1993	26.3	20.0	7,833	5,969	-1,864	-23.8%
1994	27.4	21.0	8,161	6,247	-1,914	-23.5%
1995	28.3	22.0	8,421	6,545	-1,877	-22.3%
1996	28.6	22.3	8,519	6,648	-1,871	-22.0%
1997	29.1	22.6	8,664	6,737	-1,927	-22.2%
1998	28.7	22.5	8,548	6,696	-1,853	-21.7%
1999	29.1	22.9	8,680	6,815	-1,865	-21.5%
2000	30.3	23.9	9,025	7,122	-1,903	-21.1%
2001	31.6	25.5	9,403	7,605	-1,798	-19.1%
2002	32.8	27.0	9,767	8,038	-1,728	-17.7%
2003	33.8	27.9	10,073	8,300	-1,773	-17.6%
2004	34.0	28.1	10,138	8,365	-1,773	-17.5%
2005	34.4	28.2	10,237	8,415	-1,822	-17.8%
2006	34.0	27.9	10,117	8,306	-1,811	-17.9%
2007	32.7	26.9	9,731	8,020	-1,710	-17.6%
2008	31.9	26.7	9,511	7,959	-1,552	-16.3%
2009	31.4	26.3	9,343	7,823	-1,520	-16.3%
2010	32.4	27.4	9,649	8,172	-1,477	-15.3%
2011	33.3	28.4	9,920	8,471	-1,449	-14.6%
2012	34.0	29.1	10,142	8,667	-1,475	-14.5%
Total for 2008 to 2012	163.0	137.9	48,565	41,092	-7,473	-15.4%

Reviewer's comments

11. Please note that the reviewers have not completed the standard Inventory review forms for this panel briefing.

12. Kelliher et al. (2014) has been robustly peer-reviewed during the preparation of the manuscript and during the journal publication process.

13. Giltrap et al. (2014) was reviewed by two reviewers: Professors Jacqueline Rowarth and Russ Tillman. Their review reports are enclosed with this briefing together with the authors' responses. Please note that the methodology was described in an earlier paper (Saggar & Giltrap, 2012) and that this earlier

paper was not reviewed by these peer-reviewers. Saggar & Giltrap (2012) was included subsequently as an appendix to the final version of Giltrap et al. (2014).

14. The reviewers do not explicitly recommend whether the methodology should be included in New Zealand's agricultural greenhouse gas inventory calculations, but rather on the robustness of the report.

15. Therefore, we request that the Agricultural Inventory Advisory panel take these two review reports under consideration while discussing whether the methodology can be incorporated into the Inventory.

Uncertainty in estimates

16. The effects of the new values on the level of uncertainty in the inventory have not been quantified. However, Table 1 provides one standard deviation about each of the estimates. The uncertainty estimates in the present Inventory chapter for N_2O from agricultural soils would need to be updated accordingly.

Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

17. ***Agree*** *that the values for the EF3 emission factor (excluding dairy) derived by Kelliher et al. (2014) may be incorporated into future Inventory calculations*

Agree / not agreed

18. ***Agree that*** *the methodology for estimating N_2O emissions from excreta* from *livestock grazing on pasture in hill country provided by Giltrap et al. (2014) can be incorporated into the Agriculture Greenhouse Gas Inventory model.*

Agree / not agreed

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Approved/ Not Approved/ Approved as Amended

Peter Ettema
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Chair Agricultural Inventory Panel

Date

[i] 2000 IPCC Good Practice guidelines and 2006 IPCC guidelines