MPI POLICY AND TRADE
Agricultural Inventory Advisory Panel Meeting
24 November 2016

NEW EMISSION FACTORS FOR FARM DAIRY EFFLUENT AND UREA

Authors: Alice Ryan

Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of this paper

1. This paper seeks agreement from the Agricultural Inventory Advisory Panel to recommend new emission factors for nitrous oxide emissions from farm dairy effluent (FDE) and urea fertiliser.

2. Attached to this paper are the reports:

    a. van der Weerden T, Luo J, Houlbrooke D, Cox N, Di H, Saggar S, Cameron K, Clough T. 2015. Recommendations for country-specific EF1 values for farm dairy effluent (FDE) and urea fertiliser. Report prepared for MPI.

    b. Review of *Recommendations for country-specific EF1 values for farm dairy effluent (FDE) and urea fertiliser* by Prof Keith Smith.

    c. The inventory change approval form completed by Prof Keith Smith.

    d. van der Weerden T, Luo J, Cox N, Di HJ, Podolyan A, Phillips RL, Saggar S, de Klein CA, Ettema P, Rys G. 2016. Nitrous oxide emissions from urea fertiliser and effluent with and without inhibitors applied to pasture. Agriculture Ecosystems & Environment 219: 58–70.

    e. van der Weerden T, Cox N, Luo J, Di HJ, Podolyan A, Phillips RL, Saggar S, de Klein CAM, Ettema P, Rys G. 2016. Refining the New Zealand nitrous oxide emission factor for urea fertiliser and farm dairy effluent. Agriculture Ecosystems & Environment 222: 133–137.

Background

3. The addition of nitrogen to agricultural soils from livestock excreta, fertiliser and other sources causes nitrous oxide emissions. Research has recently been carried out to improve emissions estimates for two of these nitrogen sources: farm dairy effluent[1] and urea fertiliser. These sources contribute 0.4%

[1] In the inventory this category is called 'Animal manure applied to soils'.

Policy and Trade Branch
Resource Policy directorate
Pastoral House, 25 The Terrace, PO Box 2526
Wellington 6140, New Zealand
Telephone: 0800 00 83 33, Facsimile: +64-4-894 0300
www.mpi.govt.nz

and 1.9% of total agriculture emissions, respectively. The emissions are calculated by multiplying the amount of nitrogen added to the soil with a specific emissions factor.

Emissions factors currently used in the inventory

4. The current emission factor for farm dairy effluent (FDE) is 1%. This emission factor is also used for nitrogen inputs to the soil such as synthetic fertilisers (non-urea) and crop residues. It is the same as the Intergovernmental Panel on Climate Change (IPCC) default value.

5. The current emission factor for urea fertiliser is 0.48%. This is a New Zealand-specific value that was implemented into the inventory in 2015 based on work by Kelliher et al. (2014)[2]. It is lower than the IPCC default value of 1%. New Zealand's lower emission factor value compared with the IPCC value is attributed to the type of fertiliser used in New Zealand and lower application rates.

Research findings

6. The study by van der Werdeen et al. (2015) carried out field trials to measure emissions from FDE and generate new data. This new data was combined with the existing data set on emissions from FDE and urea, and a meta-analysis was carried out to determine new emission factors for FDE and urea.

7. The analysis calculated new emission factors for each nitrogen source based on the bias-corrected mean. The overall mean value for the combined FDE and urea emission factor was 0.48%. The emission factor for FDE was 0.26%, and the emission factor for urea was 0.59% (Table 1).

8. *Table 1: Mean emission factors and confidence intervals for FDE and urea fertiliser, along with current and proposed emission factors for the inventory.*

Nitrogen source	Mean emission factor (%) and (n)	95% confidence interval	Current emission factor (%)	Proposed emission factor (%)
FDE	0.26 (24)	0.00 – 1.12	1	0.3
Urea fertiliser	0.59 (26)	0.00 – 1.48	0.48	0.6
Combined FDE and urea fertiliser	0.48 (50)	0.00 – 1.32		

9. Although the differences between the emission factors for FDE and urea were not statistically significant, the authors recommended separate emission factors. This is due to the difference in characteristics of these two nitrogen sources. Urea is a readily available source of N while FDE contains both organic N and readily available ammoniacal-N. The authors also recommended that the emission factors be rounded to one decimal place to recognise the large range in confidence intervals.

10. The new emissions factor for FDE is lower than the IPCC default of 1%. This could be expected because New Zealand has country specific emission factors of 1% for urine and 0.25% for dung, and FDE is a mixture of both urine and dung.

[2] Kelliher, FM, Cox N, van der Weerden TJ, de Klein, CAM, Luo J, Cameron K, Di HJ, Giltrap D., Rys G., 2014. Statistical analysis of nitrous oxide emissions factors from pastoral agricultural field trials conducted in New Zealand. Environmental Pollution 186, 63-66.

11. The revised emission factor for urea fertiliser (0.6%) is higher than what was recently recommended by Kelliher et al (2014), (0.48%). The authors suggest this is due to the addition of new data, and the effect of the bias correction compared with the previous analysis.

Proposed improvement to inventory

12. It is proposed a new emission factor for FDE of 0.3% be established. Emissions from FDE would now be disaggregated from other nitrogen inputs which currently use an emission factor of 1%.

13. It is also proposed that the emissions factor for urea fertiliser be revised from 0.48% to 0.6%.

Estimated impact on inventory

14. The table below shows how the new emission factors, if implemented in the inventory, would affect agriculture emissions estimates. The revised emission factors lead to lower emissions in 1990 and higher emissions in 2014.

Table 2: Impact of new emission factors for FDE and urea on emissions estimates in 1990 and 2014

	Total agriculture emissions ($kt CO_2$-e)		Change between 1990 and 2014 ($kt CO_2$-e)
	1990	2014	
Total emissions (current inventory)	34,351.1	39,585.3	5,234.2
Total emissions (revised emission factors)	34,310.0	39,666.6	5,356.6
Change between current and revised inventory (kt)	-41.1	81.3	122.4
Change between current and revised inventory (%)	-0.12%	0.21%	

Reviewer comments

15. The reviewer recommended that the changes to the proposed new emission factors be approved, and agreed that the changes were well-documented and scientifically defensible.

Strategic risks

16. Country specific methodologies, and changes to these, are heavily scrutinised by an expert review team under the United Nations Framework Convention on Climate Change (UNFCCC). There are unlikely to be issues with these changes because there are sound scientific reasons why the emission factors differ from the IPCC default values. Furthermore, review teams are particularly concerned with changes that result in higher emissions in the base year and lower emissions in the latest inventory year, compared to previous inventory submissions. Revising these emission factors would have the opposite effect to this.

17. Methods and emission factors implemented in the inventory should be robust enough to remain unchanged for a number of years. The revised emission factor for urea will be the second change within two years. This could generate a perception that the evidence for changing this emission factor is not robust enough. However the change is a minor one and is backed up by scientific publications. Implementing emission factors with only one decimal place to reflect the large confidence intervals is also a sensible approach.

Strategic opportunities

18. Under the UNFCCC, countries should consider ways to improve their inventory. By continuing to develop new methodologies that best suits its circumstances, New Zealand is showing that it is meeting its UNFCCC obligations.

Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

19. ***Recommend*** that new emission factors be adopted for:

    a. Farm dairy effluent, 0.3%

    Agree / not agreed

    b. Urea fertiliser, 0.6%

    Agree / not agreed

Alice Ryan
Senior Policy Analyst

Approved/ Not Approved/ Approved as Amended

Gerald Rys
Principal Science Advisor, Science and Skills Policy
Chair Agricultural Inventory Panel

Date