

Review by Keith Smith of “Recommendations for country-specific EF_1 values for farm dairy effluent (FDE) and urea fertiliser – Draft Final Report” by Tony van der Weerden, Jiafa Luo, David Houlbrooke, Neil Cox, Hong Di, Surinder Saggar, Keith Cameron and Tim Clough, July 2015

Report Introduction

The Introduction explains that the objectives of this study were to provide recommendations on appropriate values for emission factors (EF_1) for nitrous oxide (N_2O) emissions from pastures receiving farm dairy effluent (FDE) and urea fertiliser that are specific for New Zealand, as an alternative to using the default value of 1% of the applied N being emitted as N_2O , in the calculation of the national emission inventory. The work involved (1) making additional measurements to expand the existing EF_1 FDE dataset, and (2) conducting a meta-analysis of FDE and urea fertiliser EF_1 values using all available New Zealand data. These objectives, and the context, are clearly and adequately explained.

Materials and Methods

In the Materials and Methods section, the text is clear and most of the relevant information has been provided; however, the following points should be addressed:

- There should be more detail provided regarding the experimental plot sizes and the number of replicate plots and flux chambers per site, and chamber spacing.
- The text rather suggests that, apart from the spreading of FDE on the replicate 1 m x 1 m plots used for destructive soil sampling, the application of FDE for N_2O emission measurements was only within the chamber rings (in an analogous way to the procedure employed by de Klein et al, 2014, in their experiments with synthetic urine), as opposed to applying FDE to a larger area including the surroundings of each ring. The wording here should be more explicit. If my interpretation that FDE only went into the chamber rings is correct, I think it important that in the Discussion the authors should comment on any impact this might have had on fluxes. Synthetic urine application only within the ring may mimic adequately the real-life creation of a urine patch by a grazing animal, but the spreading by farmers of FDE is not localised in this way; it could be argued that, at least at the drier sites, lateral movement of water in the FDE, under matric suction, after its application within the ring, would produce lower soil WFPS below the ring than if a guard area beyond the ring has also received the same dose. Given that IPCC normally requires peer-reviewed publication of data before

it can be used for EF changes, it is in the interests of this project to forestall possible problems with journal referees on points such as this.

- The addition of a column to Table 1 giving the textural class of all the soils would be welcome.

The gas flux measurement procedure (following de Klein et al, 2014) was fairly typical for this type of study, and seems very appropriate. The use of two well-established analytical centres for the measurement of N₂O by gas chromatography gives confidence in the data and in the reliability of observations of differences between sites.

The sections describing statistical analysis and the meta-analysis are perfectly satisfactory.

Results section

In this section there is adequate information on the soil and ambient conditions prevailing at the experimental sites: temperature, rainfall, soil water-filled pore space values, and soil mineral N (ammonium and nitrate) content, though the caveat above regarding possible lateral liquid transfers beyond the ring limits is relevant here.

The Figures are all clear and their captions adequately describe their contents.

Units: Just a minor point here: all the individually measured flux values in the text and the figures are expressed as mg N₂O-N/m²/hr, but the section on cumulative emissions uses kg N₂O-N/ha, and in Table 3 values are in g N₂O-N/ha. It would be useful if somewhere the interconversion between mg N₂O-N/m²/hr and the widely used g N₂O-N/ha/day is given (even if just in parenthesis), to provide a stepping stone between the chamber measurements and the cumulative totals.

The section on the meta-analysis is fine: clearly and succinctly written.

Discussion section

This section is generally fine. My only comments are:

- (a) There is a need to discuss the implications, if any, of applying FDE only within the rings, as mentioned above in the Materials and Methods section of this review;
- (b) It would be desirable to make more detailed comparisons with similar work carried out in other countries. The only non-NZ paper cited in the last paragraph of sub-section 5.1

is that by Chadwick et al., 2000 (which I am unable to access but I think relates to the UK), and in sub-section 5.2 there is the comment that it is “more challenging to find comparable overseas studies to NZ’s FDE EF₁ studies....”, and the mention only of one overseas (Irish) study. However, there are several other quite recent European studies in which at least some of the treatments provide suitable results for comparison, e.g.:

UK:

Louro, A. et al. (2013), *Agriculture, Ecosystems & Environment*, 181, 1-11.

Misselbrook, T. et al. (2014), *Environmental Research Letters*, 9, Article No. 115006.

The Netherlands:

Velthof G.L. & Mosquera J. (2011), *Agriculture, Ecosystems & Environment*, 140, 298-308.

Schils, R. et al. (2008), *Plant & Soil*, 310, 89-101.

Sweden:

Rodhe, L. et al. (2006), *Soil Use & Management*, 22, 229-237.

Rodhe, L. et al. (2015), *Agriculture, Ecosystems & Environment*, 199, 358-368.

In general, the relevant results in these papers seem compatible with the results obtained in this project, and citation of some of them is likely to strengthen the case for adoption of the recommendation in this report for a lower EF₁ for N₂O from FDE.

Summary and Recommendations section

The summary is satisfactory, and the recommendations are appropriate, given the outcome of the experiments and the meta-analysis. In particular, I support the proposal that separate EF₁ values for FDE and urea should be used.

General Comments

If the relatively minor points raised above are dealt with, the report is suitable for submission, and well capable of being transformed into a publication-worthy paper.



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