New Zealand Greenhouse Gas Inventory
Approval for change to emission factor, parameter or methodology

Reviewer	Mike Bown, Beverley Thomson, Paul Muir On-Farm Research
Date of review	September 2013

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Inventory sector[1]	Agriculture
Name of EF, variable or category	Nitrogen excretion rates
Current value of emission factor, variable or methodology Tier	Nitrogen excretion rates for sheep, cattle and deer partitioned into urine and dung.
Suggested value of emission factor, variable or methodology Tier	$N_{urine}\% = (34.4 + 10.5 \times N_f\%) \times N_{ex}\%$
Use from year (start year)	1990 to current year
Recommend that a change to the new value or methodology is approved	Yes

Please comment on whether the supporting review or report sufficiently covers the following topics and provides adequate justification for a change.

	Yes/no	Comment
Is the need for a change well documented?	Yes	The review provides a well-reasoned argument for refining the equation using the best, most relevant data available at the time (up to 2010).

	Yes/no	Comment
Is the proposed change scientifically defensible?	Yes	The proposed change is based on analysis of an extended dataset of nitrogen balance studies in peer-reviewed articles and MAF reports up to and including 2009. The data analyzed was particularly relevant to New Zealand pasture fed ruminants. The analysis of a larger, relevant dataset (more data points) improves confidence in the validity of the proposed equation compared to previous versions. At present the model assumes that this equation is applicable to dairy, cattle, beef cattle, sheep and deer. The review does not provide any information to change that assumption at present.
Has any documentation been peer-reviewed or published?	Yes	Some of the data published in MAF reports which relate to Nitrogen balance studies and N_2O emission factors

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[1] Energy, Industrial Processes, Solvents, Agriculture, LULUCF, Waste.

		discussed in this review (Luo *et al.*, 2009) appears to have been subsequently published in a peer-reviewed journal (van der Weerden *et al.*, 2011).
Is the proposed methodology, EF or variable consistent with IPCC GPG?	No	Not applicable. New Zealand uses a methodology that is beyond the level required of a simple tier 2 method and is comparable with the modeling used in Australia for pasture based systems.
Is the equation or methodology comparable with any other countries?	Yes	Australia also adopts a methodology which is beyond a simple tier 2 method for partitioning N excretion between urine and faeces. The Australian approach is to calculate N excreted in faeces from equations relating to the biology of feed protein digestion in the rumen. N_{urine} is then calculated by subtracting N retained by the body and faecal N from N intake. The New Zealand approach is to relate N_{urine} to N intake based on balance studies. N_{faeces} is then calculated as the difference between total N excreted and $N_{\urine.}$ Since the urinary N is the main contributor to N_2O, the NZ method is likely to be better as it estimates N_{urine} directly, reducing the compounding errors from estimating faecal N.
Is the level of uncertainty reported?	Yes	Yes. Statistical confidence values (standard errors of means) are reported for both slope and intercept factors for the linear equation proposed.
Is there a comparison with IPCC default emission factors, variables or Tier 1 methodology	No	Not applicable.
Any recommendations for future work, new results or data that could be considered.	Yes	The review acknowledged there is bias in the dataset due to a predominance of values derived from lactating dairy cows. Only a few values came from dry-stock and beef cows and only one value from sheep. Nevertheless, the review made a valid case for combining data from dairy, beef and sheep values and applying the same equation to all stock classes. However, it appears that no data from N balance studies in deer have ever been analyzed in relation to this equation. Therefore, at present, there appears to be no hard evidence to support the

		application of this equation to deer. Additional data from N balances studies for beef cattle, sheep and deer would improve confidence in the equation and its applicability to all species. These data could come from unpublished data (if available) and/or experimental N balance work.
General comments if any on the paper and the approach.	Yes	The paper was well researched and data was reported and discussed thoroughly. The limitations to the data and analysis were acknowledged and opportunities for improving predictions identified.

References

Luo, J., van der Weerden, T., Hoogendoorn ,C., de Klein, C. (2009) Determination of the N$_2$O emission factor for animal dung applied in late autumn in three regions of New Zealand. Prepared for MAF.

Van der Weerden, T.J., Luo, J., de Klein, C.A.M., Hoogendoorn, C.J., Littlejohn, R.P., and Rys, G.J., (2011). Disaggregating nitrous oxide emission factors for ruminant urine and dung deposited onto pastoral soils. *Agriculture, Ecosystems & Environment*, 141 (3–4), 426–436.