Improved nitrous oxide emission factors for cattle and sheep excreta deposited in New Zealand hill country

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Introduction

- Grazed hill country is characterized by large spatial variation in soil properties, due in part to topographical differences in excreta deposition patterns as a result of animal behavior.

- It has been suggested that nitrous oxide (N_2O) emissions from excreta on steep (>25°) slopes may be lower than on moderate slopes (12-25°).

- **This research provides field data to determine background N_2O emissions and emission factors (EF_3 – the percentage of deposited animal excreta-N emitted as N_2O; %) for animal excreta deposited in the autumn-winter period on moderate and steep slopes.**

Methodology

- Trials were carried out on medium and steep slopes at four New Zealand hill country sites differing in soil type, with two commencing in autumn 2014 and the other two in autumn 2015.

- At each site, areas of moderate and steep slopes were selected and fenced off from further grazing for at least two months.

- Plots for gas and soil sampling were established and treatments were applied. Treatments were:

beef cattle < urine / dung
sheep < urine / dung
control (no urine or dung)

- There were five replicates on both moderate and steep slopes.

- Gas and soil sampling were carried out over a 4-6 month period following excreta application.

- N_2O emissions were measured using a closed chamber technique and EF_3 values were calculated.

Acknowledgements

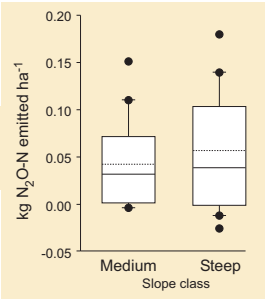
This study was funded by the Ministry for Primary Industries, New Zealand.

Ministry for Primary Industries
Manatū Ahu Matua

We acknowledge the extensive input by technical staff of AgResearch and Landcare Research.

Results & Discussion

- Within a slope class, total background N_2O emissions from the control plots were generally very low and exhibited large variation.



Box and whisker plots of total N_2O-N emitted from control areas for each slope class.

- Nitrous oxide emission factors were generally very low, with the averages being less than 0.1% of excreta-N, and highly variable.

EF_3 values (regions combined) with their 95% confidence intervals (CI).

Excreta type	Animal type	Slope class	Mean (%)	Lower CI (%)	Upper CI (%)
Dung	Cattle	Medium	0.048	0.010	0.100
		Steep	0.035	0.000	0.083
	Sheep	Medium	0.024	-0.008	0.068
		Steep	0.000	-0.026	0.036
Urine	Cattle	Medium	0.049	0.010	0.101
		Steep	0.021	-0.011	0.063
	Sheep	Medium	0.043	0.005	0.093
		Steep	-0.007	-0.031	0.026

- The low EF_3 may reflect the low soil fertility status of these hill land soils.

- The EF_3 values measured on both steep and medium slopes in this study were generally lower than those measured on the low slope.

- The EF_3 from sheep urine was significantly higher on the medium slope than on the steep slope.
There was a tendency (non-significant) for higher EF_3 values for sheep dung, and higher beef cattle urine and dung, on the medium slopes than on the steep slopes.

- EF_3 values for beef cattle dung tended to be higher than for sheep dung on both slope classes.

- Overall, the low emission rates and the natural variability associated with hill country landscapes meant that there were few statistically significant differences in EF_3 between the treatments.

Conclusions & Future Research

- N_2O emissions from animal excreta in the hill country appear to be affected by a complex range of physical and biological factors.

- The EF_3 values generated in this study will help to provide direction for further research for refining New Zealand's agricultural greenhouse gas inventory.

- As N_2O emissions from hill country constitute approximately half of the total agricultural N_2O emissions in New Zealand, changes in IPCC EF_3 values could mean a significant reduction in New Zealand's total greenhouse gas inventory should further measurements confirm these findings.