

Review

Examining the New Zealand methane emissions dataset to obtain updated predictions of methane emissions from sheep suitable for incorporation into the national greenhouse gas inventory

General comments

This report is an important step towards improving the characterization of methane emissions from the New Zealand sheep flock. It attempts to demonstrate that new data collected under controlled conditions can be used to develop specific equations for sheep under or over one year of age. This is not a trivial task and fraught with the myriad of ways the data can be interpreted. While simplicity is often the most elegant it may not always be the best solution. Personally, I shudder with log transformed data because you just can't convert it readily to meaningful numbers. While this is a good attempt at a difficult question, it is probably somewhat "light on" and needs to provide more detail and comparative analysis.

In general the report lacks the rigour and attention to detail that is required for a document of this type. In many places, simple omissions and mistakes have gone uncorrected and some of grammar is difficult to follow. There were times when I was quite at a loss to understand what was being conveyed. I recommend a thorough review of the report before final publication. It is also light on in terms of references. It would be useful to make comparisons with inventories in other countries for example.

The existing method for calculating NZ methane emissions from sheep is to use two methane yield estimates, one for sheep under 1 year of age and another for sheep over one year of age. That these two estimates are very different and cannot be substantiated by any stated biological reason should be good cause for re-evaluating emissions estimates. Some discussion about this needs to be included in the introduction. However, it can be argued that there are biological differences that may be of importance. For example I would assume that the vast majority of sheep in NZ over 1 year of age would be reproductive females, whereas sheep under 1 year of age would be a mix of castrates, males and females. Also, sheep under 1 year of age would be smaller and consume less feed. This latter point may be important as many of the equations result in greater differentiation at higher intakes.

The authors have opted for the use of two equations, one for sheep over one year of age and another for sheep under one year of age, with the later equation including a term for diet quality (ME estimated by NIRS). While statistically (using your methods) this approach provides a better explanation of the data, does it really have a useful impact on national emissions estimates? I would argue that it adds a level of complexity that is not really justified. The fact that it appears to be important may be a reflection of the population tested and may have less specific use on the national sheep flock. In my re-interpretation of Table 7, in 2012 the combined equation was only 873 tonnes different to the use of two separate equations.

Table 7 re-interpreted

Year	Current method	separate equations 5 & 6	Combined equation 4	% change relative to current method	
				separate	Combined
1990	455,520	467,272	458,488	2.58	0.65
2012	288,996	285,500	284,627	-1.21	-1.51

An issue I have had trouble with is how representative the sheep used in chambers are of the national flock. Based on some reverse engineering (and assuming a GWP of 21) it appears that the intake of “ewes” in NZ averages 2.3 kg/d and “lambs” 1.2 kg/d (see maths below). These means are well outside the range of intakes used in the calorimeter studies. Since intake is such a critical predictor of emissions, does it make sense to be nit-picking within the dataset when clearly it is impossible to be representative of the whole NZ flock?

Estimating NZ sheep DMI from Ym and inventory

	g ch4/kg DMI	kg CO2 equiv?/yr		DMI (kg/d)	
	Ym	1990	2012	1990	2012
>1 yo	20.9	309	365		
<1 yo	16.8	114	159		
		kg methane/yr			
>1 yo	20.9	14.7	17.4		
<1 yo	16.8	5.4	7.6		
		g methane per day			
>1 yo	20.9	40.3	47.6	1.93	2.28
<1 yo	16.8	14.9	20.7	0.89	1.23

When establishing a novel method for estimating national emissions, it is essential that the new method has been rigorously developed. In general, I find the report to be lacking in statistical detail. There is no evaluation of selecting one method over another and how the eventual method was arrived at. For example the decision to log transform the data implied non-linearity, but there is little information given to support this. The difficult issue of a positive intercept is another question that is not adequately dealt with. I would also have liked to have seen appendices with the original data included.

Of some concern was the preponderance of comparisons between the “original” data set and the “combined” data set. Since about half the data in the combined is from the original, I wonder how valid such a comparison is? I would like to see comparisons between “original” and “additional” – just how different are these two datasets and their resultant equations on a log-transformed basis?

These represent my major concerns. I have also annotated the text with track changes.