MPI POLICY AND TRADE
Agricultural Inventory Advisory Panel Meeting
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CORRECTION OF NEGATIVE NITROGEN EXCRETA VALUES

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Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of this paper

1. To seek approval from the Agricultural Inventory Advisory Panel to modify the existing methodology for calculating the amounts of nitrogen excretion (N_{ex}) from young livestock in the first few months of their life.

2. A report outlining this issue in more detail is also attached:

    a. Rollo, M, 2017 (unpublished) *Reporting of negative Nitrogen excreta values in the Agricultural GHG Inventory Model (AIM)*

Background

3. In order to calculate nitrous oxide emissions in the *Agricultural Soils* category of the agricultural greenhouse gas inventory, nitrogen excretion (N_{ex}) amounts need to be determined for each livestock subcategory. N_{ex} is calculated by subtracting the nitrogen (N) retained in an animal (e.g. for growth, milk production, and wool) from the nitrogen intake by an animal. The following equation shows how N_{ex} is calculated for sheep.

Nitrogen excretion for sheep (Equation 1):

$$N_{ex} = N_i - (N_m + N_{lwg} + N_{wool})$$

Where:

N_{ex} = Nitrogen excretion per animal (kilograms (kg) of nitrogen (N) per day)

N_i = Nitrogen intake per animal (kg N/day)

N_m = Nitrogen retained in milk per animal (kg N/day)

N_{lwg} = Nitrogen retained in live weight gain per animal (kg N/day)

N_{wool} = Nitrogen retained in wool growth per animal (kg N/day)

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4. For very young animals, part of the nitrogen intake comes from suckled milk or milk powder. The following equations show how nitrogen intake is calculated for sheep, and shows how a term (z3) is included to account for nitrogen intake through milk.

Nitrogen intake for all other sheep (Equation 2):

$$N_i = DMI \times PAST_N$$

Where:

N_i = Nitrogen intake per animal (kg of nitrogen per day)

DMI = Dry matter intake per animal (kg/day see Section 4.1.1)

$PAST_N$ = Nitrogen content of pasture consumed by dairy cattle, expressed as a percentage of total pasture dry matter (see appendix 19)

Nitrogen intake for sheep less than 1 year old for September to December (Equation 3):

$$N_i = (DMI \times PAST_N) + z_{3lamb}$$

Where:

DMI = Dry matter intake per animal (kg/day see Section 4.1.1)

$PAST_N$= Nitrogen content of pasture consumed by sheep, expressed as a percentage of total pasture dry matter (see appendix 19)

Z_{3lamb} = nitrogen intake through milk per animal (kg of nitrogen per day)

5. In the current version of the AIM, the equations estimating nitrogen retention are not linked to the equations estimating nitrogen intake. The AIM currently allows for a situation where (for a particular animal class and month) retention can be greater than intake. This means that the associated nitrogen excretion values can be negative, which is a physical impossibility.

6. In the current AIM, N_{ex} values for animals in the first few months of life are calculated as negative, due to a combination of low nitrogen intake values and (relatively) high nitrogen retention values.

7. This problem exists for all four major species (dairy, beef, sheep and deer). The negative values flow through the model calculations and cause N_2O emissions to be lower than they otherwise would have been.

8. This error has been present in the model and recognised for a number of years, but its correction has not been seen as an issue as the impact it would have on the inventory (see table 2) is small.

Table 2: Comparison of emissions estimates before and after negative N_{ex} value correction, 1990 to 2015

Emissions (kt CO2-e)		1990	2015	Change in emission outputs between 1990 and 2015 (kt CO_2-e)	Percentage change in emission outputs between 1990 and 2015
Total emissions from Agriculture (kt CO_2-e)	2017 (1990-2015) emissions estimate *without* negative N_{ex} correction	33,122.90	38,419.60	5,296.70	16.0%
	2017 (1990-2015) emissions estimate *with* negative N_{ex} correction	33,218.40	38,477.10	5,258.70	15.8%
	Difference in emission estimates compared to current inventory	95.5	57.5	-38.00	
	Percentage difference in emission estimates	0.29%	0.15%		

9. Further details on this error are in the attached document *Reporting of negative Nitrogen excreta values in the Agricultural GHG Inventory Model (AIM)*.

Proposed improvement

10. To fix this problem, the inventory team is proposing that any negative N_{ex} values calculated in the AIM are set to zero before being used in further calculations of N_2O emissions.

11. Although this proposed solution would improve the accuracy of the inventory, it is acknowledged as a 'superficial' solution. A more elegant solution should be explored, which could involve the linking of nitrogen retention with nitrogen intake, to ensure that the retention value does not exceed the intake value.

Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

12. ***Approve*** that the Agriculture Inventory Model be modified to ensure that any nitrogen excretion values *initially* calculated as negative are set to zero, with these new zero values being used in the rest of the AIM

Agree / not agreed

Joel Gibbs
Policy Analyst

Approved/ Not Approved/ Approved as Amended

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

Date