MPI POLICY AND TRADE
Agricultural Inventory Advisory Panel Meeting
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UNCERTAINTY OF AGRICULTURAL SOILS EMISSIONS

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Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of this paper

1. Seek approval from the Agricultural Inventory Advisory Panel to use a new methodology for calculating the uncertainty of nitrous oxide emissions from agricultural soils.

2. Attached to this paper are the reports:

    a. Kelliher, F., Henderson, H., & Cox, N. (2016). The uncertainty of nitrous oxide emissions from grazed grasslands: A New Zealand case study. Manuscript submitted to journal for publication.

    b. AgResearch. (2011). Analysis of N_2O emission factor data from field trials and N_2O emissions inventory uncertainty assessment - Final report.

    c. Review of *The uncertainty of nitrous oxide emissions from grazed grasslands: A New Zealand case study.* Donna Giltrap

    d. Change approval form completed by the reviewer Donna Giltrap.

Background

3. The assessment of uncertainty is an important part of the greenhouse gas inventory compilation. New Zealand is required to provide estimates of uncertainty as part of its inventory submission each year, and is encouraged to look for ways to reduce uncertainty. Uncertainty estimates can be used to help determine research priorities and to evaluate different methodologies for calculating emissions, with the aim of improving the accuracy of future emissions estimates.

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4. One of the major sources of agricultural greenhouse gas emissions in New Zealand comes from a category known as *Agricultural Soils*. This category encompasses a number of processes, for example:

    - direct N_2O emissions caused by urine and dung deposited by grazing animals, and the addition of fertiliser to soils

    - indirect N_2O emissions caused by volatilisation, leaching and run-off.

5. In terms of emissions, agricultural soils are the second largest component of the agricultural inventory. In 2014, emissions from this category were 8,526 kt CO_2-e, or 22% of total agricultural emissions.

6. However, despite being only the second largest component of the agricultural inventory, agricultural soils make the largest contribution to the uncertainty of the national inventory. Because of this, it is important that the methodology used to calculate uncertainty from this category is sound.

7. For the 1990, 2002 and 2012 inventories, the uncertainties in agricultural soils emissions were assessed using a Monte Carlo simulation, and the outputs from the 2012 assessment are used to calculate the uncertainty in agricultural soils emissions in the current inventory.

8. The Monte Carlo assessments have found that agricultural soils uncertainty is mostly associated with emission factors, specifically EF3 (emission factors for dung and urine deposited by grazing stock), which is mostly caused by natural variance in weather, climate and soil type.

Report by Kelliher, Henderson, and Cox (2016)

9. The report written by Kelliher, Henderson, and Cox (2016) proposes an alternative to the Monte-Carlo simulations which have previously been used to estimate uncertainty of N_2O emissions from agricultural soils. This alternative is described as an analytical method (in comparison to Monte-Carlo which uses numerical methods), and was also discussed in a 2011 report published by AgResearch. To calculate uncertainty, the proposed method uses the fractional standard error (FSE) values of the inputs (used to calculate N_2O emissions from agricultural soils) and a root-mean-square approach.

10. In the current inventory, the agricultural soils emissions calculation is estimated to have an uncertainty (at the 95% confidence level) of +/- 74%.

11. When using the method outlined by Kelliher, Henderson, and Cox (2016) the estimated uncertainty for agricultural soils emissions for 2014 was +-61%. A Monte Carlo analysis would give an uncertainty off the same data of -35% and +91%. Like the earlier Monte-Carlo analyses undertaken in the past, most of the uncertainty is due to the variability in emission factors

12. The writers have found no evidence that the proposed analytical method has been used elsewhere, which may be due to the lack of country-specific emission factor data for analytical soils. The Intergovernmental Panel on Climate Change (IPCC) notes that any proposed improvements to uncertainty calculations are consistent with best practice as long as the motive for a change is justified and is accompanied by appropriate documentation.

Proposed improvement

13. It is proposed that that the current methodology used to calculate N_2O emissions uncertainty from agricultural soils be replaced with the analytical method outlined by Kelliher, Henderson, and Cox (2016).

14. If this new methodology is adopted, the uncertainty estimates for agricultural soils will be higher than in the current inventory. The IPCC guidelines note that increases in uncertainty estimates can reflect a more realistic assessment of the limitations of current knowledge. In the case of agricultural soils, the high uncertainty reflects a lack of understanding of the causes of variability in nitrous oxide emissions. The inventory team is in the process of procuring research to better understand the causes of variability in nitrous oxide emissions.

Reviewer comments

15. The manuscript by Kelliher, Henderson, and Cox (2016) was sent to a reviewer to provide feedback on its content and quality. The completed review is provided in the attached documentation. The reviewer also completed a change approval form (also in the attached documentation) which comments on whether the report provides adequate justification for a change in the methodology used to calculate uncertainty.

16. While the reviewer noted that the analytical approach was sound, there would need to be a few changes to ensure that the method accounted for new sources of emissions recently included in the agricultural soils category. The reviewer also recommended that the Monte-Carlo simulation be re-run with *weighted* mean emission factor values rather than the unweighted EF measurements, in order to allow a comparison with this method and the proposed analytic method.

17. The reviewer commented that the proposed method was scientifically defensible and recommended that the new methodology be adopted, subject to a few modifications.

Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

18. ***Recommend*** that the method outlined in the manuscript by Kelliher, Henderson, and Cox (2016) be used to estimate emissions uncertainty from agricultural soils

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