MAF POLICY

Agricultural Inventory Panel Meeting

27 November 2009

A COMPARISON OF GREENHOUSE GAS EMISSIONS FROM THE NEW ZEALAND DAIRY SECTOR CALCULATED USING EITHER A NATIONAL OR A REGIONAL APPROACH

Authors: Andrea Pickering

Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of Report

1. The purpose of this paper is to summarise the report delivered to MAF on regionalising the dairy emissions in the National Greenhouse Gas Inventory and inform panel members of any alterations in the proposed methodology outlined in the report.

2. Attached to this paper is the report and a review carried out by Dave Clark of DairyNZ.

Summary

3. By calculating greenhouse gas emissions at a national level it is assumed that the model which describes these emissions is linear. However, due to differences in productivity in the various regions, this is potentially untrue. It may not be feasible to adopt a regional model for all species due to limited amounts of data at a regional level that is available. However, dairy statistics provided by the Livestock Improvement Corporation (LIC) are detailed and provide much of the required information at a region level. There has been rapid expansion of the dairy sector into the South Island, a generally higher producing region than the North Island. It was therefore determined that calculating dairy emissions at a regional level should be investigated.

4. Data sources consist of the Agricultural Production Survey carried out annually by Statistics New Zealand, and Dairy Statistics reported by the LIC.

5. The report found that calculating emissions of methane and nitrous oxide at a regional level made little impact on the 1990 emission estimates. However, due to the non-linear properties of the model, estimates for 2006 were being over estimated and hence

by calculating emissions on a regional level, national CO_2-equivalent emission estimates were reduced by 2.3% for this year.

6. This reduction was a due to a reduction in methane emission estimates. Estimating nitrous oxide for each region based on drainage class did not change estimates. This maybe due to lack of stocking rate by drainage class data at a regional level.

7. It was recommended in the report by AgResearch that MAF move to estimating dairy emissions on regional bases. Incorporating updated South Island dairy pasture data collected by Lincoln University over 2006 and 2007 into the inventory was also recommended, but not estimating nitrous oxide at a regional soil drainage class level.

Proposed changes to inventory

8. Calculate the dairy methane emissions at a regional level by running the Tier 2 Inventory model for each region.

Proposed changes to initial report and justification

9. **Regions** – In the initial report it was suggested that the calculations be carried out on LIC regions. However, it has been determined that calculating emissions will be on regional council regions. This is because:

    a. It will be more beneficial as all other data reported by Statistics New Zealand is reported at this aggregation, ensuring comparisons.

    b. If in the future sheep and beef can be calculated on a regional level, it would be better to have all livestock calculated using the same regions i.e. not LIC and Meat and Wool New Zealand regions

    c. As LIC report most of the productivity data at a Local Territory Authority (LTA) level it is possibly to aggregate the productivity data up into regional council regions

10. **Calculation year** – Due to the automation of the Tier 2 Inventory model emissions will be able to be calculated on a calendar year.

11. **Milk production** – In the original report it appears that for 1990 the herd testing figure for milk production is used. This figure is inflated due to "good" herds being tested. Also, although the report indicates that milk production is available at a regional level, it is actually only available at the "mega" region level. Mega regions consist of only six areas in which all regions are aggregated into. These are Northland, Auckland, Bay of Plenty/East Coast, Taranaki, Wellington/Hawkes Bay and the South Island. In 1991/1992 no surveys were carried out and therefore there is no regional data. Parameters reported also change over the years. Therefore:

    a. For years 1990 and 1991 milk production was calculated at a regional level by multiplying total milk fat by 100 and dividing by milk fat percentage to obtain total milk produced in each region. This results in a national total milk yield no different than 1% to that currently used.

b. For 1992 ratios were determined for each region from other years and applied to the national milk yield currently used.

c. From 1993 – 2003, with addition of information in these years milk calculations were changed. Litres of milk produced per cow was first determined by multiply average milk fat per cow by 100 then dividing by percentage milk fat. This was then multiplied by the number of cows to obtain total milk in each region. This equation resulted in a closer estimate of total national milk production when regions were added together compared to the calculation used in 1990 and 1991.

d. From 2003 litres of milk per cow is reported for each region and therefore this is multiplied by the number of cows to obtain the regional total. When summed up this matches the total national milk yield value currently used.

12. **Cattle weight** – the report indicates that there are "mega" region weight data in 1990 and weight data for all 17 LIC regions for 2006. There is in fact no weight data until 1997. After that it is only reported on a "mega" region scale. Therefore from 1997 cow weight is determined as per the report for 1990. For 1990 – 1996 a relationship between each breeds average weight and the currently reported national average cow weight is determined and then applied to those breeds for those years. The reported proportions for each breed in each "mega" region are then applied to these weights.

13. **Dairy cattle populations** – Statistics New Zealand reports the four classes required for the calculation of the Inventory at a regional council level.

14. **Aggregating productivity data up into regional council regions** – All productivity is either reported or calculated at a LTA level. Using the Statistics New Zealand definitions of which LTA's are in which regional councils, productivity is then aggregated up into regional council regions.

15. **Diet quality** - MAF is currently undertaking more work in this area and therefore will not change what is currently used until this work has finished. The same diet quality is therefore applied to all regions.

Response to reviewer comments (Appendix 1)

16. The proportion issue that Dave has found has been avoided by the use of Statistics NZ regional dairy population data.

17. Dave Clarks comment on diet quality justifies the decision not to include it until further work has been carried out.

Strategic Risks

18. Due to the increase in the uncertainty of data such as the population (smaller sample sizes), the overall uncertainty of the Inventory will potentially be increased.

19. A lot of assumptions are involved in the calculations of the early years including missing data.

Strategic Opportunities

20. New Zealand will be meeting the UNFCCC obligations of continual improvement.

21. Improvements in dairy productivity may be reflected more easily in the Inventory.

Recommendations

It is recommended that the Agricultural Inventory Panel:

22. **Agree** that the calculations for dairy emissions be carried out at a regional level using the methodology outlined in the report with the amendments as per this paper.

Agree/Not Agree

23. **Agree** that a further piece of work should be undertaken which re-analyses the uncertainty around the methane emissions of dairy based on a regional calculation.

Agree/Not Agree

Andrea Pickering
Senior Policy Analyst

Approved/ Not Approved/ Approved as Amended

Alice Marfell-Jones
Manager Monitoring and Evaluation
Chair Agricultural Inventory Panel

Date

Appendix 1:
Review of "A comparison of greenhouse gas emissions from the New Zealand dairy sector calculated using either a national or a regional approach." A report prepared for MAF by Harry Clark (AgResearch) – August 2008.
Review requested by Andrea Pickering (MAFPolicy)
Reviewer: Dave Clark (DairyNZ)
Date: 12 November 2009

Preamble
I was asked to review methodologies used in this report rather than the actual numbers used. The report makes the following recommendations taken verbatim from p1 Executive summary and recommendations:

MAF should consider moving immediately to estimating dairy cattle emissions on a regional basis.

MAF should consider incorporating the updated Gibbs (2008) pasture quality data into a regional based dairy cattle inventory.

There appears to be no benefit to using regional soil drainage categories at present. Any changes in this direction need to be delayed until regional data are available on stocking rate by drainage class.

Commentary on estimating dairy cattle emissions on a regional basis

1. The primary sources containing data on cow numbers, breed, liveweight and milk production from MAF and LIC are robust, defensible and the best we have. They provide a good historical record and the strong likelihood that they will continue to be available in at least their current detail in the future (see 3.1).
2. The report uses the 17 LIC regions. The quality of this information and its historical record provide a sound base for developing a regional system (see 3.2.1). I note in Andrea Pickering's covering email to me that MAF have decided to use Regional council regions rather than LIC to give consistency with sheep and beef data. This is a good option.
3. The method used to account for milk production and composition are all defensible and any errors related to assumptions made here are unlikely to be of major import (see 3.2.3.1).
4. The methods used to account for the effect of cattle breed and age on liveweight are sound. I don't think our estimates of cow liveweight are very accurate and this may be an area requiring further data collection (see 3.2.3.2).
5. The allocation of dairy population to region is obviously of importance if a regional approach is used! However, as a first approximation the approach taken is simple and justified. If a regional approach is adopted then any anomalies would have to have high priority for correction (see 3.2.3.3).

6. Given the dataset available on diet quality the approach taken was the only feasible one (see 3.2.3.4).
7. Table 3. Although specifically asked not to critique the numbers I couldn't help making some comparison of changes from 1990 to 2008 in Table 3. The proportion of "calves and rising 1-year-olds" to "milking cows and heifers" in **1990** was **21.1%** (e.g. for Northland 61964/293706 *100) whereas the proportion of "calves and rising 1-year-olds" to "milking cows and heifers" in **2008** was **18.2%** (e.g. for Northland 51013/280764 *100). The same proportions apply to each region. Given the expansion of the dairy industry in the 1990-2008 period and the differential changes in different regions I find it intuitively difficult to accept that the proportion of replacement stock has declined. I would need extra information to find this change defensible. Replacement stock are quite an important contributor to total GHG emissions and therefore any future inventory, national or regional should consider obtaining more accurate numbers for this class of stock on a regional basis.

Commentary on incorporating Gibbs (2008) pasture quality data into a regional based dairy cattle inventory

1. I commend the major effort that Dr Gibbs has made in collecting such a large dataset from South Island dairy farms.
2. I am unaware of the status of any report on this project. Peer review, ideally to a science publication level, is highly desirable if this data is to be used for future Inventory calculations.
3. I am concerned about the defensibility of the approach taken here mainly because the data are from a restricted subset in terms of the total industry and from areas where conversions to dairy have resulted in the planting of new pastures often associated with irrigation and high nitrogen fertiliser – all factors that will tend to increase pasture quality. They also represent only one time point and so lack a historical comparison to 1990 pasture quality. New Zealand enteric methane research has been generally unable to show much effect of pasture composition on methane emission per unit of feed. (see Waghorn, G.C., Woodward, S.L., Tavendale, M., Clark, D.A. 2005. Inconsistencies in rumen methane production – effects of forage composition and animal genotype. *Proceedings of the 2nd Greenhouse Gases and Animal Agriculture Conference. pp.139-142.*)
4. On the basis of the above points are do not find the argument for including pasture quality very convincing.

Commentary on using soil drainage categories

1. At first sight the use of three drainage classes appears to be an over-simplification, despite the obvious importance of soil water as a determinant of nitrous oxide emissions. It was not completely clear to me why the postulated approach was rejected, but I assume because there is likely to be an interaction with stocking rate as mentioned. It is possible that a number of other management factors may also interact with drainage class. Some possibilities are: the greater use of winter grazing off on poorly drained soils, the extent of artificial drainage on different soil classes, the use of stand-off areas and reduced use of N fertiliser on soils where pasture utilisation is

poor in winter-early spring. I agree with the author's conclusion that more data are needed to enable a full assessment of this approach.

Conclusions

I agree with the report's recommendations to move to a regional based approach for calculating dairy cattle GHG emissions and not to use regional soil drainage categories at present. The methodologies used are sound and defensible.

I do not agree with the recommendation to incorporate updated Gibbs (2008) data into any inventory at this stage. Peer review and publication and a more extensive dataset together with more compelling research data are needed before incorporation.