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## METHANE AND NITROUS OXIDE EMISSIONS FROM CROPS, AND TUSSOCK BURNING

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**Main Purpose:**                     Decide       Discuss       Note

### **Purpose of Report**

1.     Seek approval from the Agricultural Inventory Advisory panel to include additional sources of emissions from cropping using activity data not previously estimated and change the calculation of tussock burning.
  
2.     Attached to this paper are the reports:
  - a.     *“Factors and activity data to estimate nitrous oxide emissions from cropping systems and stubble, and tussock burning.-final report by Plant and Food Research”.*
  
  - b.     *“Factors and activity data to estimate nitrous oxide emissions from cropping systems and stubble, and tussock burning - 2008 report”.*
  
  - c.     *Completed review forms by Diana Mathers FAR.*

### **Summary**

#### *Background*

3.     New Zealand has an obligation under United Nations Framework Convention on Climate Change Convention (UNFCCC) to report anthropogenic greenhouse gas emissions and removals every year. Emissions are reported in the annual submission of the National Inventory Report submitted to the UNFCCC. New Zealand also has a responsibility under the Kyoto Protocol to reduce emissions growth and if not successful will incur a financial cost.
  
4.     The National Inventory Report forms the basis of any financial cost that the country may have under the Kyoto Protocol. Therefore reported emissions and removals need to be as accurate as possible. New Zealand has a long standing research program in estimating country specific emission factors to aid in the improvement of reported emissions and removals from the land based sectors.

5. Changes beyond the default methodology and emission factors to take account of country specific factors are encouraged and need to be well documented and transparent.

#### *Current Inventory*

6. Cropping contributes to emissions by releasing nitrous oxide from crop residue in agricultural soils, and methane and nitrous oxide from burning some of the crop stubble. Methane and nitrous oxide emissions are emitted from burning savannah (called tussock burning in New Zealand).
7. Until recently New Zealand only reported and accounted for emissions from nitrogen inputs from crop residues from wheat, barley, oats maize, peas, legumes and potatoes. The Expert Review Team (ERT), arranged by the secretariat to the UNFCCC, visited New Zealand in 2010 for an in-country review and *recommended New Zealand continues its efforts to improve its estimates from agricultural soils by accounting for all types of crops grown.*
8. In 2009 as a percentage of carbon dioxide equivalent emissions from agriculture cropping was 0.275 percent, crop residue burning was 0.065 percent and tussock burning was 0.003 percent.

#### *Report*

9. The 2011 report by Plant and Food Research provides updated data on cropping of barley, wheat, maize, oats and seed peas for 2008 to 2010 using Statistics NZ data.
10. Production of sweet corn, squash and onions has been estimated for the inventory for the first time using data from Statistics NZ on the land area for these crops combined with expert opinion on their yield rates.
11. Production data for seed crops (herbage, legume and brassica) has been estimated for the first time using data on area grown, maintained byASUREQuality, and has been converted to production data using expert opinion on yield rates. No activity data for vegetable crop seed can be found for pre-2008. For post-2008 the Foundation for Arable Research (FAR) has started compiling statistics for areas of individual seed crops grown.
12. Data on forage brassica has not previously been collected and nor reported in the inventory. A simple relationship between total brassica area and dairy cattle numbers is estimated. The report then recommends total brassica area is broken down into turnips, swedes, kale and rape by the proportion of individual seed sales in 2011.
13. The report recommends nitrogen inputs for crop residues for all crops, including crops not already in the inventory, are based on parameters used in the OVERSEER model. The OVERSEER parameters include harvest index, root shoot indices, dry-matter content, above and below ground residue.
14. Statistics NZ has collected statistics on crop residue burning since 2003 in the Agriculture Production Survey (APS). There were no data series for crop residue burning prior to 2003. The report recommends using survey information on crop burning rates for Canterbury, where 80 percent of cropping occurs. Surveys estimate

70 percent of wheat stubble is burned (straw being less palatable as a feed), while 50 percent of barely and oat crop stubble is burned.

15. Crop residue data in the APS after 2003 is aggregated for the three cereal crops, so the report recommends continuing the assumption that 70 percent of wheat is still burned, and the area of barley and oats burned is in proportion to the total area of these crops grown.
16. The report recommends using the total consented burn area from 1990 to 2005, and from 2005 that APS data be used. The report acknowledges information on tussock burning is less than perfect and suggests future work to obtain data (eg local authorities, aerial surveys), more studies in a range of tussock grassland types, and research to understand the proportion of non-tussock vegetation that is burned.
17. For the area of tussock burned between 1990 to 2003 the report recommends the total area of land consented for burning be used for the activity data, and for 2005-2010 data on tussock burning be based on APS data from Statistics NZ.
18. Based on trials by Payton and Pearce (2009 cited in report) the report recommends increasing the fraction of tussock area burned ( $FRAC_{BURN}$ ) from the default 0.320 to 0.356.

#### *Proposed changes to inventory*

19. New and additional cropping activity data are included for cropping for the 2012 inventory submission to estimate emissions from crop residue burning, and nitrogen inputs from crop residues.
20. Nitrogen inputs for crop residues for all crops including crops not already in the inventory are based on parameters (harvest index, root shoot indices, dry-matter content, above and below ground residue) used in the OVERSEER model.
21. The  $FRAC_{BURN}$  for tussock is changed from the default 0.320 to 0.356.
22. The total area of consented tussock land for burning 1990 to 2003 is assumed to be burned, this differs to the current assumption of 20 percent. The recommended change does not affect the estimates of emissions during the Kyoto Protocol period, but does improve time series consistency.

#### *Implications for emissions estimates*

23. The additional cropping activity will increase estimated emissions from 1990 to 2009 from N inputs from crop residues by an amount yet to be fully estimated but likely to be much less than 100 GgCO<sub>2</sub>-e.
24. Emissions from crop residue burning are not likely to change because the new crops data are not crops that have their residue burned.
25. The percentage of consented tussock area burned each year from 1990 to 2003 will increase from 20 percent to 100 percent the effect on emissions from agriculture will be very small.

### *Other recommended changes to inventory*

26. The report recommended different emissions factors for NO<sub>x</sub> and CO from tussock burning. Emissions of these gases are reported but not accounted for under the UNFCCC and the Kyoto Protocol.

### **Reviewer comments**

27. The review on the initial report was carried out by Diana Mathers at the Foundation for Arable Research (FAR). Diana acknowledges that there are not a lot of data available for many of these emissions sources and some data needs to be constructed from limited information sets and expert opinion. One of the challenges for inventory reporting is the dynamic nature of the primary sectors, such as seen by the rapid increase in brassica production in response to dairy demand. It will be important to have robust survey collections in place to get information on future changes to this activity.

### **Strategic Risks**

28. The changes may not be accepted by an expert review team organised by the *United Nations Framework Convention on Climate Change* (UNFCCC). However, if this is the case there is an extensive process which is followed in which New Zealand can state its case or change back to the IPCC default before any penalty would be applied.

### **Strategic Opportunities**

29. The values used will now be well documented, therefore meeting the UNFCCC requirement for transparency. The new values extend our completeness of reporting from cropping (comparable with other parties) but will not make a noticeable difference to the total emissions estimate for New Zealand.

## Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

30. *Agree that new and updated activity data - based on Statistics New Zealand data - and methods to estimate cropping data are used for the 2012 inventory submission.*

**Agree / not agreed**

31. *Agree that forage brassica be estimated using a simple relationship with dairy numbers and then apportioned by brassica type based on seed sales in 2011.*

**Agree / not agreed**

32. *Agree nitrogen inputs for crop residues for all crops including crops not already in the inventory, are based on parameters (harvest index, root shoot indices, dry-matter content, above and below ground residue) obtained from the OVERSEER model.*

**Agree / not agreed**

33. *Agree that the area of tussock burned for 1990 to 2003 be based on the total area of land consented for burning,*

**Agree / not agreed**

34. *Agree that for 2005-2010 data on tussock burning be based on APS data from Statistics NZ.*

**Agree / not agreed**

35. *Agree that Fraction burned ( $FRAC_{BURN}$ ) from the default 0.320 to 0.356 for tussock burning.*

**Agree / not agreed**

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**Approved/ Not Approved/ Approved as Amended**

Alice Marfell-Jones  
Manager Information and Analysis  
Chair Agricultural Inventory Panel

Date