A decision support framework for greenhouse gas accounting on Australian dairy farms

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The livestock industries contribute 12% of Australia's greenhouse gas (GHG) emissions and the principal emissions associated with livestock are methane from enteric fermentation and nitrous oxide from soils. While emitting relatively little GHG compared to the beef cattle and sheep industries, the dairy industry is expanding rapidly and also has greater opportunity to utilise dietary additives, modify diets and manage fertiliser usage than do the extensive livestock industries. A computer based model was developed for spreadsheet or internet use by which the GHG emissions from dairy farms can be calculated, displayed, and the effects of management changes on emissions evaluated.

The model used equations from the NGGIC (1998) as the basis for estimating enteric and effluent methane as well as nitrous oxide from fertiliser, excreta and effluent. These equations required input data on herd numbers, structures and animal weights, together with estimated pasture digestibility and crude protein content. Additional information on the diesel and electricity consumption on the farm, together with nominating the fossil fuel source used for electricity generation was required to complete the calculation of total GHG emissions from the farm. While the model was not designed to fully describe carbon sinks, the option to include tree plantings to sequester atmospheric CO_2 was included.

An example of the profile of emissions of CO_2, N_2O and CH_4 and their sources in tabular and pie–chart form are shown in Figure 1. The GHG are from a 275 cow herd grazing 100 ha of improved pasture (75% dry matter digestibility) fertilised annually with 200 kg N/ha. Emissions of CH_4 and N_2O, tonnes, are expressed as CO_2 equivalents; CO_2e is (CH_4 x 21) and (N_2O x 310). Effects of altering the herd, pasture, fertiliser or crop structure on the level and origin of emissions could be observed.

The model was tested across 40 farmlets, with emissions ranging from 544–1463 g CO_2e/L milk, 3–7 t CO_2e/cow/annum and 5–45 t CO_2e/ha/annum. The model provides a valuable tool to quantify the sources of dairy GHG emissions and evaluate the consequences of management choices on enterprise emissions against the criterion used for national greenhouse gas accounting.

NGGIC (1998). Workbook for livestock 6.1 with supplements 1998. National Greenhouse Gas Inventory Committee, Canberra, Australia.

Outputs	t CO_2e/farm
Energy	88.0
CH_4 - Enteric	**825.7**
CH_4 - Effluent	**3.7**
N_2O - Effluent	**0.7**
N_2O - N Fertiliser	121.7
N_2O - Soils	14.1
N_2O - Dung & Urine	542.8
Tree plantings (after 1990)	-204
Total Emissions	**1393**

Summary	t CO_2e/farm
CO_2	88
CH_4	829
N_2O	679

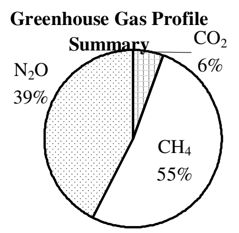

Figure 1 GHG emissions from a 275 cow herd grazing 100 ha of improved pasture expressed as tons of CO_2 equivalents (CO_2e) per annum. Calculated with model at www.nitrogen.landfood.unimelb.edu.au