

Predictive Power of Dairy Cattle Methane Models Insufficient to Provide Sound Environmental Advice, Study Finds

ScienceDaily (Nov. 5, 2010) — Canadian and Dutch researchers have shown that current equations to predict methane production of cows are inaccurate. Sound mitigation options to reduce greenhouse gas emissions of dairy farms require a significant improvement of current methane equations, according to a study of the Dutch-Canadian team in the journal *Global Change Biology*.

The researchers, from University of Guelph and University of Manitoba (Canada) and Wageningen University & Research centre (the Netherlands), compared the observed methane production of cows with that predicted by nine different methane equations that are applied in whole farm greenhouse gas models. "The prediction accuracy of these equations is small, and the equations are not suitable to quantify methane production of cows," says Dr Jan Dijkstra, senior researcher worker at Wageningen University and adjunct professor at University of Guelph. "The predictive power of methane equations will have to be markedly improved if such whole farm models are used for sound decisions by governments to reduce environmental impact of dairying."

On a global basis, according to the FAO livestock is responsible for some 18% of all greenhouse gases emitted. Methane is the most important greenhouse gas on a dairy farm. The FAO estimates that about 52% of all greenhouse gases from the dairy sector is in the form of methane. Several whole-farm models are available that predict the total amount of greenhouse gases (the sum of CO₂, CH₄ en N₂O) of dairy farms. Such whole-farm models are applied to make an inventory of total greenhouse gas emission on farm, and to estimate the effect of management changes (changes in breeding, nutrition, etc.) on greenhouse gas emissions. Methane is the single most important element in such estimates. Methane is 25 times more potent than CO₂. Hence, the accuracy of estimation of total greenhouse gas emissions of whole-farm models largely depends on the accuracy of the prediction of methane emitted per cow.

The research team compiled a large dataset of actual observations on methane emissions of dairy cattle. The observations were largely derived from respiration chamber experiments, in which methane produced in the gut of the cow is accurately determined. These observations were used to evaluate the predictive power of equations to predict methane production.

The prediction accuracy of all equations was low. The equations hardly account for the effect of dietary composition on enteric methane production. Most equations do not use any dietary information at all, but estimate methane production based on feed intake or milk production. For example, the widely used IPCC (Intergovernmental Panel on Climate Change) equation that predicts methane production based on energy intake of the cow, cannot distinguish the effect of a

higher energy intake on methane due to a rise in feed intake level, from that due to a rise in dietary fat content at the same feed intake level. However, a higher feed intake will increase methane production, whereas a rise in dietary fat content will decrease methane production.

From the analysis, it also appears that the variation in predicted methane production is far smaller than the variation in actually observed methane production. Consequently, the methane equations do not fully represent the range of effects of dietary changes on enteric methane production of cows.

The research team concluded that the low prediction accuracy and poor prediction of variation in observed values may introduce substantial error into inventories of GHG emissions and lead to incorrect mitigation recommendations. For sound inventories and mitigation recommendations, much better methane predictions are required. At present, the researchers are actively developing more detailed and accurate models that predict methane production, based on the fermentation processes in the gastro-intestinal tract of cows.