Greenhouse Gas Emissions From Swine Production

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Background

Greenhouse gases (GHG) are atmospheric gases that absorb and re-emit long-wave radiation released by the earth back to the surface and include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The concentration of GHG in the air has increased over the last 1000 years, which is at least partly attributed to human activities. Concerns over the effect of this increase on the global climate have led to the Kyoto protocol, an agreement that aims at reducing GHG emissions worldwide. Canada's commitment to climate change mitigation includes an important role for the agricultural sector. In the 2002 "Climate Change Plan for Canada", the federal government proposed that reduction of greenhouse gas emissions due to crop and animal production practices could be used in flexible compliance mechanisms, such as a domestic emission trading system and domestic offsets, to meet reduction targets of Large Final Emitters (LFE).

Emissions from Swine Production

In 2003, agriculture-related GHG emissions totalled 62 Mt CO_2 eq[3], and contributed 8.4%[4] of total national emissions in Canada. Animal-related emissions were estimated to account for nearly 50% of emissions from Canadian agriculture. These emissions were due to: 1) enteric fermentation in ruminants releasing methane (~22 Mt), and 2) microbial processes in animal manure resulting in methane and nitrous oxide emission (~7.8 Mt). In addition, part (~6.6 Mt) of N_2O emissions originating from soils was due to the application of animal manure to crops and excretion of manure on pasture and paddocks by grazing animals. Swine production related GHG emissions were mostly due to methane production during storage of liquid manure (~2 Mt or 3.4%), with a very small fraction coming directly from the animals, and a portion of the N_2O emissions from soils after manure application (~14% or ~1 Mt). Hence, manure storage appears to be the highest source of GHG emissions from swine production. However, some of our recent measurements under Canadian climatic conditions show that the current CH_4 emission estimates for liquid swine manure stored in outdoor tanks may be too high (factor of 1.7).

Mitigation Measures

There are several techniques that have been suggested to reduce gas fluxes from manure storage; composting, anaerobic digestion, diet manipulation, covers and solid-liquid separation. These techniques also are often associated with increases in efficiencies of nutrient (carbon and nitrogen) utilization on the farm. While some studies have demonstrated the effectiveness of treatments in reducing GHG emissions (eg. 30% reduction with aerobic composting of liquid swine manure with wheat straw), there is a lack of quantitative data showing the GHG reduction potential of mitigation measures. In addition, issues of cost and practicality remain for most of these techniques.

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[3] CO_2 equivalent are a way of expressing emissions of all greenhouse gases (CO_2, CH_4 and N_2O) in one type of unit. For this we use a measure of the global warming potential of each gas (GWP), where CO_2 has a GWP = 1, CH_4 has a GWP = 21, and N_2O has a GWP = 310. Hence, the emissions of CH_4 are multiplied by 21 and of N_2O by 310 and all emissions added to give a total GHG emission in CO_2 equivalent.

[4] Note that this amount does not include energy use associated with agriculture.