

***Reducing Greenhouse gas emissions from Livestock Agriculture  
in Manitoba***

*For*

**MANITOBA CLIMATE CHANGE TASK FORCE**

**Public Consultation Sessions**

*By*

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## ***GHG emissions from Agriculture in Manitoba***

Manitoba's greenhouse gas (GHG) emissions are different from other provinces, in that it has a high emissions (7,200 kilotonnes of CO<sub>2</sub> equivalent) coming from the Agriculture and lower emissions (1400 kilotonnes of CO<sub>2</sub> equivalent) from Energy (Manitoba and Climate Change: A primer 2001; Fig 1). Manitoba Agriculture emissions are made up of 65% of nitrous oxide (N<sub>2</sub>O) from fertilizer, manure use, and soil tillage and 30% methane (CH<sub>4</sub>) from enteric fermentation and manure management from livestock production systems, with 4% carbon dioxide (CO<sub>2</sub>) (Manitoba and Climate Change: A primer 2001).

## ***Impact of climate change on livestock production***

Some of the impacts of increased temperatures and decreased precipitation as a result of climate changes on livestock include:

- \*Stress on animals
- \* Poor quality feed
- \* Shortage of water
- \*New diseases and insect infestation.

## ***Main information needed regarding potential impact of climate change***

- \*Impact of microbial communities on plants, in particular those that could introduce anti nutritive or toxic compounds into the animal/human food chain.
- \*Impact of microbial communities in soils and water that could, over time, promote entrance of toxic or pathogenic elements into the human or animal food chain.

## ***Mitigation strategies***

Unlike other sectors where the burning of fossil fuel constitute the major greenhouse gas, the dominant GHG's (CH<sub>4</sub> and N<sub>2</sub>O) associated with livestock agriculture are produced as a result of natural biological processes of microbial breakdown of feed components. Microbial enteric fermentation in the gastrointestinal tract of livestock can produce CH<sub>4</sub> gas as a by- product. On average about 4-12% of gross energy intake (GEI) is converted to CH<sub>4</sub> gas. Ruminants with their large fore-stomach contribute the most per head per day. Cattle production, in particular, the cow calf sector is increasing in Manitoba. Mitigation strategies require use of Canadian data-not IPCC to be effective.

An indirect emissions from the livestock sector is from manure in storage and on land. If manure decomposes anaerobically (stockpiling or liquid/slurry storage) much of the carbon in the

manure is converted to CH<sub>4</sub> gas. Nitrous oxide is produced in aerobic conditions as a result of nitrification of NH<sub>4</sub> into NO<sub>3</sub><sup>-</sup> or anaerobically from denitrification of NO<sub>3</sub><sup>-</sup> to N<sub>2</sub> when movement of oxygen is limited (Janzen et al. 1999).

Data under Western Canadian conditions is required if we are to establish policies or best management guidelines for greenhouse gas mitigation as well as odor management, soil health and water quality. Solutions must work for the long term as storage facility and application equipments are expensive and in frequently replaced during the life of an operation.

Greenhouse gas emissions from enteric fermentation and manure handling, storage and land application for Manitoba's livestock population was estimated to be 1700 and 940 kt CO<sub>2</sub> equivalent respectively in 1997 (Neitzert et al. 1999). The numbers are increasing as Manitoba's head increases e.g. the breeding herd of hogs increased by 4.7% in 2000 from 1999, with about 5.3 million hogs marketed in 2000 compared to 4.3 million hogs marketed in 1999. Calf numbers rose by 0.6% from the 1999 level. It has been estimated in 2001 that manure from livestock production in Manitoba, can replace about 50% of fertilizer use in the province. This is a good opportunity to reduce indirect GHG emissions related to fertilizer use if further information on proper management and application of manure are developed.

### *Options for reducing enteric GHG emissions*

#### *1. Promotion of high quality forages in ruminant feeding and grazing systems*

\*Use of high quality forages. A Manitoba study showed that CH<sub>4</sub> emissions of grazing steers that had access to high quality pastures declined by 50% compared to emissions from matured pastures (Boadi et al. 2000).

\*Use of legumes in grazing rotations. McCaughey et al. (1999) observed lower CH<sub>4</sub> emissions (7.1% of GEI) from alfalfa-grass pasture than grass-only pastures (9.5% of GEI) in Brandon.

#### *2. Feed and Animal Management (Improved Animal efficiencies)*

A very effective way of reducing GHG from animals and economically profitable for adoption by producers. In general when productivity of animal is improved, CH<sub>4</sub> emission per unit of product is reduced because feed energy associated with maintaining the animal is reduced.

##### Some practical methods

\*Formulate and evaluate diets to avoid overfeeding and under feeding of nutrients (protein and minerals)

\* Diets formulated by certified animal nutritionist

\* Forage and by products should be tested (very variable)

\* Use of rotational grazing instead of continuous grazing

\* Balance rations to stage of life cycle (Phase feeding of swine) reduces excess nutrients and volume of manure

\* Penning and Grouping strategies to meet nutrient needs (by age sex, size)

- \* Improve feed efficiencies with enzymes to enhance nutrient retention and reduce nutrient excretion (eg amylase and B-glucanase in poultry rations)
- \*Use of high grain to forage ratios in rations can reduce CH<sub>4</sub> emissions to 2-3% of GEI (Johnson et al. 1996).
- \*Grinding and pelleting of feed (20-40% of total CH<sub>4</sub> emissions)
- \*Control feed in storage--loss of nutrient to environment (e.g spoiled silage)
- \*Good bunk management to reduce wastage and losses
- \*Proper health and improving reproductive performance would improve animal efficiencies and reduce methane per unit of product.

### ***3. Feed Additives***

Use of ionophores (monensin, lasolocid) commonly used in beef feedlots e.g. Monensin added at 24 ppm in a diet of dairy cows decreased CH<sub>4</sub> emissions by 28% (Kinsman et. al 1997). Impact has not been long lasting on farms (microbes adapt to ionophores over time).

### ***4. Addition of fats to grain diets***

It is known that there is a reduction in the amount of feed fermented with additions of fats. Methane emission was reduced by 33% when 4% canola oil was added to a diet containing 85% concentrate in a feedlot study (Mathison et al. 1997). Fats cannot be added to diets more than 5-6% of ration, as excessive amount depress fibre digestion. Fat addition will involve additional cost to the ration.

### ***5. Compounds that inhibit CH<sub>4</sub> production***

Compounds that reduce CH<sub>4</sub> productions (e.g. bromoethanosulfonate (BES)) has been successful in reducing CH<sub>4</sub> emission by 71%, but its effects only lasted 3 days in sheep (Dong et al. 1997). There are concerns of adaptation and toxicity to animal and has therefore no practical application yet. More studies are need to verify these concerns.

### ***6. Growth hormones***

Bovine somatotropin (BST) has been observed to decrease CH<sub>4</sub> emissions by 9% in US dairy herd, but is not approved for use in Canada, due to concerns over hormones in milk and meat products.

## ***Options for reducing GHG emissions from manure***

### ***1. Reducing dietary protein***

A cost effective way of reducing nitrogen excretion from diets . Pomar (1998) indicated that about 50% of the total nitrogen excreted by pigs could be reduced by modifying the composition of the diet without any impairment on performance, by balancing amino acids composition of diets, and phase feeding.

### **2.Improving feed efficiency**

There is reduction in nutrients excreted in manure when feed efficiency is improved eg. For growing-finishing pigs, a 0.1% decrease in feed to gain ratio there is a 3% decrease in nitrogen excretion (Henry and Dourmad 1992).

### **3. Type of handling system in barns**

More CH<sub>4</sub> emissions have been observed with liquid or slurry handling systems, which support anaerobic conditions. In solid manure management, such as poultry systems where broilers are kept on dry bedded manure packs (about 25% moisture) lower CH<sub>4</sub> emissions have been reported (Tessier and Marquis 1999). Patni and Jackson (1996) observed that ammonia loss in poultry manure from high rise, deep pile system was greater (0.8-5.3 kg/h) than shallow gutter system (0.7-2.4 kg/h).

### **4. Type of manure storage system**

The type storage system is known to affect amounts of GHG emissions (Pattey et al. 1997). Carbon loss through CO<sub>2</sub> was about 29% of the total carbon content for dairy cow manure and 20% for beef manure. Methane, CO<sub>2</sub> and N<sub>2</sub>O emissions expressed in CO<sub>2</sub> equivalent were smallest for compost than for the other storage method. Slurry emitted the most, with 3.9 times those from compost in dairy manure and about 17 times more than compost in beef manure. Stockpile emitted 2-3 times more CO<sub>2</sub> equivalent GHG than compost. These results indicate that aerobic storage such as composting may reduce GHG's from livestock manure. Methane was dominant gas in both the slurry and the stockpile, while N<sub>2</sub>O represented most of the compost emissions and a significant portion of the stockpile emission. The CH<sub>4</sub> contribution from the 3 storage types is shown in Table 1.

Table 1. Methane emissions from manure stored under different conditions (kg of CO <sub>2</sub> equivalent per wt. of initial dry manure )		
Storage type	CH <sub>4</sub> from beef manure*	CH <sub>4</sub> from dairy manure*
Compost	0.005	0.038
Stockpile	0.097	0.247
Slurry (3 months)	0.332	0.524

\* Pattey et al. 1997

<sup>1</sup>Adapted from Desjardin and Mathur 1997

### **5. Type and Time of Land Application of manure**

It has been observed that fall application of manure may lead to high level of denitrification prior to winter and in early spring (Tessier and Marquis 1998). It has been shown that liquid manure applied in band may produce more N<sub>2</sub>O than manure applied uniformly on the soil surface, as the former creates more condition favorable for denitrification by concentrating the nitrogen and carbon (Janzen et al. 1999). Injecting the manure directly into the soil or

cultivation of land immediately after application can reduce N-volatilization by about 90% compared to normal surface spreading (De vos et al. 1998).

### ***Concluding remarks***

The choice of application of the potential mitigation strategies and adoption into the industry will primarily depend on the cost associated with it. Strategies that are cost effective, and have no potential negative effects on livestock production hold a greater promise. Adjustment of manure storage systems involves high investment cost, and high cost per unit of emission reduction and may not be adopted easily. Modification of diets in terms of its nitrogen and carbon content seem to have a dual impact on both enteric and manure GHG emissions and is cost effective, therefore provincial funding to support more studies is needed. Furthermore there is a great deal of uncertainty associated with emissions from the manure management systems, including loss of N associated with different handling systems, storage and application and therefore reduction strategies cannot be effectively assessed. More research into the various sectors of the manure management system should be encouraged by the Manitoba government. This is particularly important given the active development of regulation regarding manure storage and application by the province and individual municipalities. Information exchanges between researchers and farmers should also be frequent to provide new and sustainable options for adaptation. This can be achieved through field days, workshops and tours to research demonstrations .

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