SOIL CONSERVATION COUNCIL OF CANADA
CONSEIL DE CONSERVATION DES SOLS CANADA

Global Warming and Agriculture

Livestock

Our last information sheet explored the relationship between global warming and methane. It was pointed out that livestock, and mainly ruminant livestock, are responsible for about 30% of North American methane emissions. However, it may be irresponsible to label livestock as global warming culprits without taking a broader look at the picture. Indeed, it can be argued that livestock could be an ally in our struggle to stop or slow global warming.

Part of the argument in favour of livestock is based on what cattle eat. Cycling of carbon through plants can play a role in the reduction of greenhouse gas levels. Plants use carbon dioxide from the air for growth and reproduction. The carbon in the carbon dioxide is taken up by the plants and stored in leaves, stems and roots. The most important players in this plant-carbon recycling, with regards to global warming, are the roots.

For perennial plants, such as grasses and legumes used to feed most ruminant livestock (approximately 73% of beef cattle feed), the amount of carbon stored below the ground in the roots is approximately the same as is stored in the leaves and stems above ground. This carbon is needed to get the plants going again in the spring. In contrast, the roots of annual plants, such as cereals, are shallow and much less extensive. The energy they need for regeneration is stored in the seed. In the case of grains, this carbon is harvested and transported for use by people or livestock.

The roots of perennials are constantly dying and regenerating, and through this process much of the carbon they contain is buried beneath the soil surface. In other words, the carbon is sequestered and thus removed, for a period of time, from the global carbon cycle. As much as 50% of the roots may die and regenerate each year. The carbon that is sequestered might otherwise be returned directly to the atmosphere as carbon dioxide, thereby adding to the problem of global warming.

Because perennial plants are more effective in sequestering carbon than annual plants, replacing crop land with permanent grass cover increases carbon sequestration. This is especially so for marginal land that has been eroded or otherwise degraded.

As well, partial replacement of annual crops by perennial hay and pasture in crop rotations can provide benefits that go beyond direct increases in carbon sequestration. Wind and rain erosion can be reduced, soil organic matter replenished, water penetration into the soil enhanced and soil salinity problems can be checked. All of these enable the soil to provide for more and healthier plants leading to more photosynthesis, this leading to more carbon sequestration, and so on.

In addition, properly managed harvesting of above ground plant material through grazing or mechanical means stimulates regrowth of plant material, thereby increasing the amount of carbon sequestered.

As well as encouraging the production of perennial plants, ruminants can affect green house gas production though their recycling of carbon material. Ruminants consume leaves and stems and, depending on such things as digestibility of the plant, the season, and climatic conditions, will return 25 to 60% of the carbon to the soil with their feces. Much of this carbon is incorporated into the soil organic matter to sustain and increase the physical and chemical properties of the soil.

Grazing and pasture management play an important role in the relationship between cattle and global warming. Keeping cattle on pasture for longer periods of time allows them to harvest their own feed and thereby reduce fossil fuel usage. As well, pasturing reduces methane emissions from manure and carbon dioxide emissions created by manure treatment and disposal. A large portion of the cattle finished in feedlots could be finished at pasture with careful man-

agement of the pasture and provision of appropriate amounts of grain and other supplements. The price to pay would be the increased variability of meat quality going to the consumer.

A management system with cattle grazing on pasture can influence carbon levels by both releasing and taking in (sequestering) carbon. The affect livestock have on global warming depends on the balance between this give and take.

For example, Table 1 estimates how one cow and calf would impact on the carbon balance in a two hectare mixed native grass pasture. This is based on animals being kept on pasture for 150 days a year.

Because methane has 21 times the global warming potential (GWP) of carbon dioxide, a more accurate picture can be created by converting the greenhouse gas figures in table one into units of global warming. If this is done it can be estimated that a cow and calf will remove 20.65 units of GWP per day, while they emit 6.46 units per day. This would give a net reduction in GWP of 14.19 units per day. In a grazing season of 150 days, 2,127.9 units of GWP gases would be removed from the atmosphere.

Calculations for the remaining 215 days of the year assume that the cow and calf will emit a similar amount of carbon dioxide and methane to the atmosphere, and there would be no removal of carbon dioxide and methane from the atmosphere by pasture and soil during the winter. Based on these assumptions, it can be estimated that the net removal of GWP over a full year would be 739 units.

Table 1
Carbon balance in a mixed native grass pasture (2 hectares) grazed by one cow and calf

Carbon sinks:	**Carbon sources:**
ı atmospheric carbon dioxide taken up by pasture	ı respired carbon dioxide from cow and calf
ı atmospheric methane absorbed by the soil	ı eructated (belched) carbon dioxide from cow and calf
ı manure carbon incorporated into the soil	ı eructated methane from cow and calf
ı carbon in pasture eaten by cow and calf	ı methane from manure of cow and calf
ı carbon passed from cow to calf in milk	ı carbon dioxide from manure of cow and calf
ı carbon retained by calf as growth	ı methane from decomposition of plant matter
Estimated total carbon sinks: 20.73 kg carbon/day	Estimated total carbon sources: 2.99 kg carbon/day

From these calculations, it can be concluded that cattle need not be a liability in the struggle to stop or slow global warming. Indeed, grazing beef cattle could be an integral part of climate change mitigation.

The following measures would assist in this process

- Promotion of correct management of pasture lands through research and extension
- Transformation of degraded crop land to permanent pasture
- Integration of perennial forage into cropping practices
- More backgrounding and finishing of cattle on pasture

Sources

Cohen, R.D.H., (in press). Handbook on climatic change and agriculture: Implication from the livestock industries. Scientific Issues and Reports - Centre for Studies in Agriculture, Law and the Environment. University of Saskatchewan. Saskatoon, SK

Cohen, R.D.H., December, 2000. Methane: The issue, the science, the solution. Powerpoint presentation delivered to the Agriculture Greenhouse Gas/Climate Change Workshop. Saskatoon, Sask.

Janzen, H.H., R.L. Desjardins, J.M.R. Asselin, and B. Grace. 1998. The health of our air: Toward sustainable agriculture in Canada. Agriculture and Agri-Food Canada. Ottawa, Ontario.

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