

REPORT TO THE Initiative sponsored by the Government of Canada, Action Plan 2000 on Climate Change CATTLE industry

Greenhouse Gas Mitigation Program for Canadian Agriculture

Program partners and purpose

Promoting awareness and encouraging adoption of livestock, soil and nutrient management practices which reduce or remove atmospheric greenhouse gases

THE GREENHOUSE GAS Mitigation Program for Canadian Agriculture (GHGMP) is a \$21 million Government of Canada initiative funded under Canada's Action Plan 2000 on Climate Change. Of this funding, \$6.6 million has been used by three livestock industry groups – the Canadian Cattlemen's Association, Canadian Pork Council, and the Dairy Farmers of Canada – to achieve the program's objectives. An additional \$8.7 million has been utilized by the Soil Conservation Council of Canada to achieve the same objective with crop producers through delivery of the Soils and Nutrient Management component of the program. The five-year funding commitment ended March 31, 2006.

The Canadian Cattlemen's Association (CCA) invited beef and forage associations, applied research partners, producer groups and others to submit funding proposals for projects which would either demonstrate or communicate information about beneficial management practices believed to reduce greenhouse gas (GHG) emissions from cattle production systems or increase carbon sequestration on pasture soils in Canada.

Why would beef producers be interested in reducing GHG emissions?

There are two primary reasons:

1) Many management practices that reduce GHG emissions are also known to increase environmental sustainability and/or production efficiency while improving the profitability of the operation.

2) The adoption of practices that result in verifiable, quantifiable reductions in GHG emissions from cattle or cat-

tle manure or increases in carbon sequestration in soils and grasslands may provide the producer with an opportunity to receive revenue from a "carbon credit" or "carbon offset" trading market, which is expected to develop in future years.

Focus Areas

The beef cattle, forage and rangeland scientific communities have indicated that practical means for producers to reduce the "absolute" amount of naturally produced methane being emitted from the rumen of beef cattle are currently limited. Producers can, however, reduce the GHG emission "intensity" from their beef operations by maximizing the production efficiency of their operations. That is to say, management practices that result in more pounds of beef being produced from the same amount of inputs (on a sustainable basis, of course) will, in turn, result in reduced GHG emissions per pound of beef produced. Based on this understanding, the CCA encouraged proposal submissions related to the following subject areas:

- 1) Improving feed use efficiency
- 2) Improving pasture/rangeland quality, health and productivity
- 3) Special feed additives and forage species
- 4) Managing manure to reduce nutrient loss

This report contains information about the many projects to which the CCA allocated GHGMP funding. Many of the demonstrated management practices that are believed to mitigate greenhouse gases provide numerous other environmental and economic benefits. Producers may also discover their operational practices already contribute to the reduction of greenhouse gas emissions. ■

GHG PROJECTS: LINKS TO PRODUCTION AND PROFITS

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GrowSafe feeding system

Improving feed use efficiency

New technology and increased awareness provide Canadian cattle producers with tools to improve overall cattle feeding efficiency

FEEDING A PROPERLY balanced ration and selecting cattle with the genetic potential for improved feed efficiency were two of the key practices demonstrated by projects aimed at improving feed use efficiency. Projects included:

RATION BALANCING WORKSHOPS — More than 50 north-east Alberta cattle producers learned how to improve their feed management efficiency after participating in one of seven ration-balancing workshops organized through Lakeland College at Vermilion, Alta. over the 2004/2005 winter. Similar workshops were also planned for early 2006.

The two-day workshops were designed to show producers how to use the popular Cowbytes software developed by Alberta Agriculture, Food and Rural Development, explains Steve Pylot, head of livestock instruction at Lakeland College.

Through use of computer software, using results of their own forage analysis, and in bear-pit discussion, producers learned how to make the most efficient use of their feeds by formulating a basic, well-balanced ration for cattle. At the same time, they learned improved feed efficiency also benefits the environment. By balancing winter feed rations, methane emissions from beef cattle can be reduced due to the improved feed utilization and enhanced overall production efficiency of the herd.

Key observations showed a well balanced ration can be made using lower-quality forage, which improves overall feeding economics.

Similar ration balancing workshops, supported in whole or in part by the beef sector GHGMP, were also staged in Manitoba, Saskatchewan and northeast British Columbia.

For more information, contact Steve Pylot, Lakeland College, (780) 853-8469.

ADVANCES IN NET FEED EFFICIENCY — In three years of research and demonstrations, including a recent bull test supported in part by the beef sector of the GHGMP at Olds College in southcentral Alberta, GrowSafe Systems technology was used, making it possible to precisely measure the feed intake of individual animals and generate data needed to produce Expected Progeny Difference (EPD) ratings on bulls

with above-average net feed efficiency. Some of the first bulls with an EPD for feed efficiency are available in 2006.

For more information, contact Neil French, Olds College, (403) 556-4722.

NEW NDF TEST IMPROVES RATION BALANCING — An improved test for measuring the fibre digestibility of forages will help Canadian livestock producers get more value out of feed supplies, says Dr. Vern Osborne, a researcher at the University of Guelph.

The test, using near infrared spectroscopy (NIRS) technology, will provide a more accurate and faster analysis of the neutral detergent fibre digestibility (NDFd) of forages over the current method, which is more time consuming and only provides an estimate of NDF. The new test is expected to be ready for use in late 2006.

"The technology will help determine the true value of forages, making it possible to develop more accurately balanced feed rations," says Osborne. "We expect producers will be able to cut down on the amount of purchased energy products used in rations. We have been overfeeding cattle for decades simply because we didn't have an accurate measure of fibre digestibility."

Along with leading to more accurately balanced rations, the test will also help producers determine the best forage varieties to grow and the best feed storage practices. By measuring fibre digestibility producers will have a better understanding of how they can get a higher energy value in their forages. A more accurate test will help producers to better predict an animal's dry matter intake and performance while consuming the forage.

"With a true evaluation of the NDF digestibility, producers will have a clearer picture of the energy coming from the forage and be able to adjust rations and reduce the amount of added corn, barley or other energy sources," says Osborne.

More accurately balanced feed rations will help improve overall livestock feed efficiency, which helps reduce the amount of greenhouse gas emitted into the environment.

For more information, contact Dr. Vern Osborne, University of Guelph, (519) 824-4120 ext. 53691. ■

Improving pasture/rangeland quality, health and productivity

A wide range of improved management practices are available to help Canadian beef producers get more value out of the forage resource

IMPLEMENTING management practices that help producers improve the quality and quantity of native and tame grass pastures can play a part in reducing greenhouse gas emissions. Along with improving overall productivity of cattle, improved management practices contribute to several environmental benefits.

Among the key benefits, improving forage quality improves feed efficiency which reduces the amount of methane produced by cattle for every pound of feed eaten. Developing grazing systems that increase the longevity of both native and tame grass pasture means more carbon can be sequestered in the soil from the atmosphere. As well, maintaining productive pastures and extending the grazing season means cattle can harvest more of their own feed, which also reduces the use of feeding equipment and the burning of fossil fuels.

More than 20 demonstration projects were designed to increase awareness of improved forage and range management practices. They included:

ALBERTA'S SUSTAINABLE GRAZING MENTORSHIP PROGRAM — An innovative program administered by the Agricultural Research and Extension Council of Alberta (ARECA) was launched in 2002 with the purpose of connecting livestock producers with an

expert or mentor who could provide advice on improved pasture management and feeding strategies.

A team of 14 grazing mentors was established in the province, explains Dee Ann Benard, ARECA executive director. Through ARECA, livestock producers seeking grazing management advice are matched with one of the mentors. The mentor could be a producer or professional consultant in the local area or a producer from elsewhere in the province with specific expertise.

Under the program, the producer gets up to 16 hours of the mentor's time including at least one on-farm visit as well as follow-up telephone and email consultation. The \$700 cost for mentorship services is shared by ARECA, the beef sector of the GHGMP and the producer. Any producers wanting more than the initial 16 hours of service can arrange further compensation with the mentor directly.

Through the consultation process, producers gain improved pasture and forage management skills.

For more information, contact: Dee Ann Benard, ARECA, (780) 416-6046.

ONTARIO GRAZING CLUBS AND GRAZING MANAGEMENT EXTENSION — Co-ordinated through the Thames Valley Soil and Crop Improvement Association, the goal is to establish several grazing clubs across the province.

Three clubs were established in 2005 – one in Grey County, another in the Peterborough area and a third on Manitoulin Island. More clubs are planned.

The purpose of each club, explains Cathy Dibble, project co-ordinator, is to increase producer awareness and understanding of the best management practices in establishing forages and managing pastures.

The clubs, with any-

where from 10 to 40 beef producer members, meet several times a year to discuss grazing management practices. Often an extension specialist with the Ontario Ministry of Agriculture, Food and Rural Affairs will lead the discussion.

Along with meetings, the clubs also organize grazing management demonstrations to showcase practices such as rotational grazing systems, forage stand improvement techniques and improved pasture watering systems.

Future plans include staging one to three-day pasture management schools and workshops and also to develop reference binders and other resource materials.

For more information, contact Cathy Dibble, Thames Valley Regional Soil and Crop Improvement Association, (519) 463-6374.

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Producers attend 2005 MB Provincial Grazing Tour

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TIMED GRAZING IMPROVES PRODUCTIVITY — Supported by the beef sector of the GHGMP, 40 cattle producers from southeast Saskatchewan participated in a one-day field day hosted by the S.E. Saskatchewan Holistic Management Club on the ranch of Neil and Barbara Dennis of Wawota, Sask. Participants got a first-hand look at how timed grazing and holistic management practices have dramatically improved both native and domestic forage productivity and quality over the past decade.

The one-time 1,200 acre mostly-grain farm, now a combination of native grass land and tame grass forages, is a prime example of how changing management has more than doubled the productivity of the forage resource in seven years.

Through an intensively managed grazing system that includes pastures seeded to tame species such as crested wheat grass, meadow brome, sanfoin and alfalfa as well as some annual forages, the land-base now produces more than enough forage to support between 750 and 1000 head of yearlings, up from about 330 head in 1998.

As well, through timed grazing management some 25 native grass and forb species are also beginning to re-establish on land long-seeded to domestic grass. The ranch also provides habitat for an ever-increasing population of wildlife and upland game birds.

Along with the environmental benefits, the improved carrying capacity and average daily gains have increased the returns from about \$20 per acre in 2000 to about \$75 per acre in 2004.

For more information, contact Neil Dennis, Wawota, Sask., (306) 739-2896. ■

Special feed additives and forage species

Established sainfoin, Neil Dennis operation, Wawota, Sask.

Vegetable oil supplements and legumes provide numerous benefits

DIFFERENT FEED INGREDIENTS and forage variety selection can also help reduce greenhouse gas emissions and improve beef cattle productivity.

A new look at feeding practices that make use of prairie-grown oilseed crops, as well as using non-bloating legumes and managing native grasslands strategically, can provide cattle producers across the country with useful options.

Six demonstration projects were designed to demonstrate the value of edible oil feed additives and the importance of forage species selection. They include:

FEEDING DEMONSTRATIONS USING EDIBLE OILS IN BEEF CATTLE RATIONS — Two commercial beef cattle feedlots in Saskatchewan and Alberta fed about 1,300 head of yearlings over a 160-day feeding period in 2005, replacing some of the wheat and barley in a conventional ration with canola, sunflower seed and flax seed.

Using more edible oil crops in feedlot rations not only benefits beef production but can also increase market opportunities for oilseed producers, says Vern Racz, director of the Prairie Feed Resource Centre. The use of edible oils in rations has been researched

extensively over the years for several reasons. Oils were originally fed to increase production efficiency, but recently there has been renewed interest in their ability to reduce emissions of rumen methane (a greenhouse gas) and their potential to produce meat and milk products with enhanced human health benefits.

In the feeding demonstrations, the oilseeds represented between eight to 10 percent of the dry matter content of the ration. In the different diets the canola and flax seeds were crushed as they were mixed with barley or wheat while the sunflower seeds were fed whole.

In similar feed research conducted by Agriculture and Agri-Food Canada, oilseeds used in feed rations reduced rumen methane gas emissions anywhere from 22 to 33 percent.

Along with looking at feedlot performance, the project also evaluated the fatty acid profile of carcasses to determine if there was an increase in the beneficial Omega 3 fatty acids.

The overall project evaluated how feeding edible oilseeds can be expected to impact feedlot cattle performance, reduction of greenhouse gases, changes in meat quality characteristics and economics. Two new manuals are



Feedlot rations containing sunflower seed

being produced by the Prairie Feed Resource Centre through the project to advise livestock nutritionists and cattle feeders in the proper use of incorporating edible prairie-grown oil seed crops in beef finishing rations. One manual provides an overview for producers on how crops such as canola, sunflower and flax can be used in cattle rations while the second manual is a technical guide providing livestock nutritionists with details on how to properly use the edible oil crops in rations.

For more information, contact Vern Racz, Prairie Feed Resource Centre, (306) 966-5622.

INCORPORATING TANNIN CONTAINING LEGUMES INTO GRAZING SYSTEMS — While legumes such as alfalfa are generally regarded as an excellent forage for grazing livestock, concern over the risk of pasture bloat forces many producers to either avoid legumes in pastures or use them on a limited basis.

Research and demonstration projects conducted by Dr. Alan Iwaasa at Agriculture and Agri-Food Canada's Semi-arid Prairie Agriculture Research Centre in Swift Current, Sask. are evaluating the potential of using tame legume species such as sainfoin and cicer milkvetch either as replacements for alfalfa or in a complementary grazing system with the legume.

Sainfoin and cicer milkvetch are legumes that contain tannins, which reduce the risk of frothy bloat. Tannins are naturally occurring plant polyphenols – acidic chemicals – that bind and precipitate proteins. Along with high nutritional value, tannin containing forages may contribute to a 10 to 15 percent reduction in rumen methane production in grazing livestock. However, much of this research has been done in New Zealand and only recently have Canadian research studies been initiated to evaluate the methane mitigating potential of certain Canadian tannin legumes.

Depending on the growing conditions and time of harvesting, sainfoin and cicer milkvetch forage biomass yields can be equal to or greater than 20 percent lower yielding than alfalfa.

Sainfoin has the reputation of being short- to medium-lived with a deep branched taproot and hollow stems. Sainfoin flowers about two weeks before alfalfa and at this stage is very nutritious and is preferred by grazing cattle. Cicer milkvetch is very long-lived with a rhizomatous root system and hollow stems. Cicer milkvetch starts growing about three weeks later in the spring than alfalfa. Both legumes maintain forage quality better than alfalfa as the crop matures.

Iwaasa continues to evaluate grazing trials aimed at developing a management system that increases the longevity of the forage stand and utilizes sainfoin, alfalfa and cicer milkvetch over an extended grazing season, making the best use of the legumes at the optimal stage of maturity. Also, research is evaluating the potential use of tannin containing legumes under grazing as a possible method to reduce methane emissions.

Linking to Dr. Iwaasa's work, the GHGMP provided funding for a project carried out by the Saskatchewan Watershed Authority which saw several producers establish new pasture stands containing cicer milk vetch and sainfoin.

For more information, contact Dr. Alan Iwaasa, Semi-arid Prairie Agriculture Research Centre, (306) 778-7251. ■



Establishing legumes, East Central Research Station, Saskatchewan



Managing manure to reduce nutrient loss

Several practices help producers get greater value out of the manure resource

SOME UNIQUE ADDITIVES, as well as improved management and manure application practices, are helping Canadian livestock producers get more value out of this important nutrient source. Over a range of seven projects that involved everything from harnessing the energy of manure to produce electricity to improving the productivity of forages, producers learned how to make more efficient use of nutrients while reducing greenhouse gas emissions. Projects included:



Methane collection equipment on steer — Dr. Alan Iwassa

VOLCANIC MINERALS HELP TAME MANURE GASES — A manure composting demonstration project at Olds College indicates that two naturally-occurring volcanic minerals, added to compost windrow, can help reduce odours and possibly greenhouse gas emissions. Aluminum silicates can adsorb certain gases (e.g. ammonia and nitrogen) and sequester reactive ions such as ammonium and hydrogen ions. Retaining these compounds in

Increasing awareness about GHG mitigation

Understanding the basics of how greenhouse gases are generated helps producers design management strategies to reduce emissions

UNDERSTANDING IS AN IMPORTANT part of implementing management plans that minimize greenhouse gas emissions. Greenhouse gas emissions usually represent losses of energy or nutrients, two important and often expensive inputs on beef cattle operations. An important message in 12 demonstration projects staged across the country is that practices that help reduce greenhouse gas emissions in modern farming and ranching operations also tend to help improve overall production efficiency. Projects included:

QUEBEC AND ATLANTIC CANADA PRODUCERS CALCULATE GREENHOUSE GAS EMISSIONS — Nine Quebec livestock producers used a computer-based calculator developed by the Canadian Cattlemen's Association (CCA) with federal funding to estimate the greenhouse gas emissions of their respective operations. In Atlantic Canada, the Eastern Canada Soil and Water Conservation Centre helped five producers to do the same with a GHG Farm Calculator introduced by Agriculture and Agri-food Canada.

Working with data entry worksheets, they provided a

Sinks and Sources Tour Guide

A 48-page booklet called the Greenhouse Gas Sinks and Sources Tour Guide will help Canadian livestock producers better understand what greenhouse gases are and how modern livestock production practices can influence greenhouse gas emissions.

Written by Saskatchewan farmer and consultant Lee Pengilly, the booklet uses a comfortable, folksy style to explain the fundamentals of natural systems such as water cycling, plant succession, mineral cycling and energy flow. The booklet also shows

how those systems are affected by farming and livestock production practices.

The booklet provides an opportunity for producers to do a self-guided assessment of their individual farming operations and determine the sources or sinks of greenhouse gas emissions on their farms.

Some 5,000 copies of the guide were printed and are available for distribution to beef producers, industry associations, extension specialists and 4-H clubs across Canada.

For more information, contact the Canadian Cattlemen's Association, (403) 275-8558 or Lee Pengilly, (306) 728-5484.

the compost could reduce the amount of methane and nitrous oxide released during the composting process. The aluminum silicate products – zeolite and perlite – are commonly used in a number of industrial applications. In the second year of the project the compost material was applied to field crops and forages. The performance of the crops under compost was compared to crops produced with commercial fertilizer.

For more information contact Dr. Abimbola Abiola, Olds College, (403) 556-4798.

BALE GRAZING EFFECTIVELY DISTRIBUTES MANURE NUTRIENTS — Winter feeding cattle on pasture versus a conventional feed yard provides a range of benefits to livestock, the forage resource and the environment, according to two years of research and demonstrations at the Western Beef Development Centre (WBDC) at Humboldt, Sask.

The project looked at the pros and cons of feeding cattle in three different systems that included controlled bale grazing on pasture, feeding processed hay on pasture and feeding cattle in a feedyard, explains Dr. Bart Lardner, senior research scientist with WBDC.

The pasture-based feeding systems provided the most benefits, says Lardner. The bale grazing system involved providing cattle access to strategically-placed whole round bales on pas-

ture. Portable electric fencing was used to limit livestock to only those bales needed over a two or three day feeding period.

Under the second system, large round bales were shredded every one or two days with a mechanical bale processor producing a windrow of processed hay for cattle on pasture. And in the third system, which was more traditional, cattle were fed hay rations daily in a feed yard.

The pasture-based systems produced the greatest benefit, says Lardner. Manure was evenly distributed across the pasture, eliminating the need to mechanically spread manure in the spring. Forage production under the pasture-based feeding systems was considerably higher than on areas where similar rates of manure from the feed yard were mechanically applied.

With more nitrogen lost in feed yard manure due to volatilization, runoff and leaching, forage yields on pasture treated with mechanically spread manure was about one-third lower than on fields that received manure directly from overwintering cattle.

Improved manure management, and the need for less equipment which reduces burning of fossil fuels, under the pasture-based feeding systems could also reduce the overall production of greenhouse gas emissions.

For more information, contact Dr. Bart Lardner, Western Beef Development Centre, (306) 682-2139 ext. 249. ■

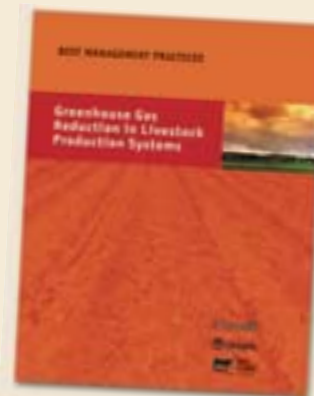
range of input and output information for their farms that covered the past, present and future. They entered data for 1990 and 2003 and looked ahead to 2012, explains Nathalie Cote with the Federation des producteurs de bovines du Quebec.

The information required for each year covered a range of practices including animal management, manure management, land management, fertilizer inputs, feeding, bedding and energy inputs. The software estimated the expected rate of key greenhouse gas emissions for each of the years.

In the Quebec project, producers were able to see how improved management practices between 1990 and 2003 had reduced production of key greenhouse gases such as carbon dioxide, methane and nitrous oxide and how planned improvements through to 2012 would reduce greenhouse gas emissions even further. In Atlantic Canada, producers were able to input "what if" scenarios to see how greenhouse gas emissions changed under different management scenarios, says Gordon Fairchild of the ECSWCC.

Case studies were prepared on three of the nine farming operations participating in the project in Quebec and for five of the producer operations in Atlantic Canada. These Case Study sheets are available by contacting Nathalie Cote, Federation des producteurs de bovines du Quebec, (450) 679-0530 ext. 8460 in Quebec, or Gordon Fairchild, Eastern Canada Soil and Water Conservation Centre in New Brunswick, (506) 475-4040 .

BEST MANAGEMENT PRACTICES BOOKLET FOR ONTARIO LIVESTOCK PRODUCERS — "Best Management Practices for Greenhouse Gas Reduction in Livestock Production Systems" was ready for distribution in early 2006.



Co-ordinated through the Ontario Cattlemen's Association (OCA) with input from several technical advisors, the 50-page BMP guide is designed to explain the basic relationship between greenhouse gas emissions and livestock production practices, explains Isabel Dopta, OCA policy advisor.

Best management practices are proven farm management practices that protect the environment while improving production

efficiencies and offering a reasonable return on investment. Greenhouse gas related BMPs reduce emissions or improve "sinks" for carbon dioxide.

Along with explaining the basics about greenhouse gases and agriculture, the booklet is divided into nine chapters that deal with genetics and breeding, nutrition and water management, proper animal handling and welfare, energy conservation and production, manure storage handling and treatment, nutrient planning and application, pasture and grazing management, crop and cropland management, and best management practices for livestock and natural areas.

The BMP booklet, available to all livestock producers, is distributed through Ontario Cattlemen's Association and Ontario Ministry of Agriculture, Food and Rural Affairs network.

For more information, contact Isabel Dopta, Ontario Cattlemen's Association, (519) 824-0334. ■



GHG 101

ACCORDING TO ENVIRONMENT Canada's 2003 Greenhouse Gas Inventory, agriculture was the source of 8.4% of Canada's annual Greenhouse Gas (GHG) emissions. The beef cattle industry accounts for about two to three percent of Canada's total emissions, and comes from the following sources:

A) METHANE (CH₄) FROM ENTERIC FERMENTATION IN THE RUMEN — During the normal digestive process, micro-organisms in the cow's rumen break down carbohydrates in the feeds into simple molecules for absorption into the bloodstream. Methane gas is a by-product of such fermentation in the absence of oxygen, as is the case in the rumen. Some of this methane enters the blood stream, is carried to the lungs, and from there is exhaled by the cow. As well, some of it is emitted by eructation (belching), while a very small amount is released later in the digestive process by flatulation. Beef cattle contribute about 83% of the methane emissions from enteric fermentation by ruminants in Canada.



B) METHANE (CH₄) AND NITROUS OXIDE (N₂O) FROM MANURE MANAGEMENT — During the handling or storage of livestock manure, both CH₄ and N₂O are emitted. The magnitude of the emissions depends upon the quantity of manure handled, manure properties and the type of manure management system.

Shortly after manure is excreted, it begins to decompose. If little oxygen is present, the decomposition will be mainly anaerobic and thus produces CH₄. Typically, poorly-aerated manure management systems (e.g. slurries) generate large quantities of CH₄ but smaller amounts of N₂O, while well-aerated systems (solid manures) generate little CH₄ but more N₂O.

The production of N₂O during storage and treatment of animal waste occurs during nitrification and denitrification of nitrogen contained in the manure. Nitrification is the oxidation of ammonium (NH₄⁺) to nitrate (NO₃⁻), and denitrification is the reduction of NO₃⁻ to N₂O or nitrogen (N₂). Generally, as the degree of aeration of the waste increases, so does the amount of N₂O produced (Canada's Greenhouse Gas Inventory 1990-2003, Environment Canada).

Nitrous oxide and methane contribute about equally to the total amount of greenhouse gas emissions emitted as a result of animal manure management in Canada. ■

More information on the Web

More information, including a complete list of projects, longer versions of many of the articles in this report and a complete copy of this report in PDF format, is available

on the Web. For more details, check the CCA's Greenhouse Gas Mitigation Program for Canadian Agriculture pages: www.jpcs.on.ca/biodiversity/ghg/index.html



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