



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada

Methane Production from Beef Cattle in Forage- Based Production



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**¹Research Scientist – Grazing/Ruminant Nutrition
(AAFC-Swift Current Research and Development Centre)**

**Western Beef Development Centre 17th Annual Field Day,
June 21st, 2016 “The Climate for Cows & Cows for the
Climate”, Termuende Research Ranch,
Lanigan, Saskatchewan**

Canada 

Swift Current Research and Development Centre - Semiarid Prairie Agricultural Research Centre (SPARC)

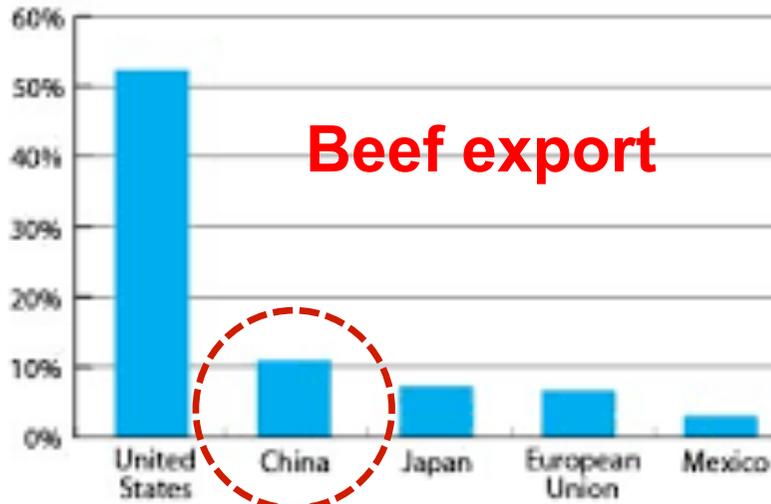


New research facility under construction (labs and offices)

- Swift Current Research and Development Centre was established in 1920 with strong forage research programs;
- Since 1930 research with native species in the area of range management and ecology has occurred.

Changing Time

Canada's Top Export Markets in 2014



Beef export

Restaurant in Beijing



ANGUS 安格斯 Grill

ANGUS 安格斯 Grill

餐厅营业时间
Restaurant Operating Hours
每天午餐: 11:30-14:30, 晚餐: 18:00-22:00, 周末休息: 23:00-00:00
Lunch: 11:30-14:30, Dinner: 18:00-22:00, Happy hour: 23:00-00:00

| Appetizers 开胃菜 | From the Grill 烧烤类 | Sauces 酱汁 |
|---|---|--|
| Roast Duck and Cranberry Tortellini Roasted with apple, roasted mushrooms, apricot jam and herb. 烤鸭佐越莓意大利饺, 风干番茄松露汁 | 100 Days Grain-fed Beef Filet Mignon 220gm/330gm 100天优质谷饲牛里脊排 220克/330克 | Choose a sauce to go with your main course (自选) (限1份) Dijon Mustard Sauce 26.00 大藏芥末汁 |
| Freshly Sliced Beef Carpaccio High olive oil, balsamic vinaigrette and kohlrabi mushroom and parmesan crusting. 新鲜牛肉薄片配舞茸和帕玛芝士片 | Certified Angus Rib Eye Steak 220gm/330gm 注册安格斯牛肉眼排 220克/330克 | Green Pepper Sauce 20.00 绿辣椒汁 |
| Deep Fried Herb-Crusted Mozarella With pineapples and extra virgin olive oil. 脆皮马苏里拉奶酪和鲜菠萝佐橄榄油配特辣橄榄油 | Certified Angus Strip Loin Steak 220gm/330gm 注册安格斯牛外脊排 220克/330克 | Wild Mushroom Sauce 20.00 蘑菇汁 |
| Baked Snails Burgundy Style With herb and garlic butter. 传统布根地式焗蜗牛 | 350 Days Grain-fed Wagyu Beef Sirloin Steak 220gm 350天谷饲和牛牛外脊排 220克 | Marinara Wine Sauce 20.00 玛莎红酒酱汁 |
| Glazed Baked Normandy Oyster 佐黄油焗生蚝 | 350 Days Grain-fed Wagyu Filet Mignon 220gm 350天谷饲和牛牛里脊排 220克 | Black Pepper Sauce 20.00 黑椒汁 |
| Goose Liver Terrine Homemade goose liver terrine served with foie gras. 自制精选法式鹅肝卷 | 150 Days Grain-fed Beef T-Bone Steak 450gm 150天谷饲T骨牛排 450克 | Garlic Herb Butter 20.00 香草蒜茸黄油汁 |
| Lobster and Avocado with Passion Fruit Puree 牛油果龙虾沙拉配热情果酱 | Grilled Australian Lamb Chops 330gm 澳洲羊排 | Béarnaise Sauce 20.00 香草荷兰士汁 |
| House Greens Sautéed with hand-picked tomatoes, olives and honey balsamic vinaigrette dressing. 绿色鲜蔬沙拉配橄榄油、意大利黑醋汁 | Norwegian Salmon Steak 300gm 挪威三文鱼 | Mint Jelly 20.00 薄荷酱 |
| Romaine Lettuce Classic Caesar salad with parmesan and anchovies, eggs and garlic croutons in dressing. 凯撒沙拉 | King Prawns (3) 330gm 精选大虾 | Sides 焗烤类 |
| Soup 汤类 | Rib Eye Steak with Bone 1KG 澳洲带骨里脊 | Fettuccine Alfredo 30.00 宽身意面和芝士奶油汁 |
| Lobster Bisque With cream, shallots and lobster. 龙虾汤配鲜贝及角子 | Angus Grill Specialty 安格斯特色推荐 | Spaghetti Napolana 22.00 意大利细面和香蒜番茄汁 |
| Cream of Mushroom Topped with chicken milk cream. 鲜奶蘑菇汤 | Roasted Codfish 208.00 With roasted potato and sauté cream sauce. 柚子膏焗烤鲑鱼配鲜奶和松子酱汁 | Potato Wedges 22.00 土豆角 |
| Beef Tea Flavored with Truffle 黑菌牛肉羹 | Peanut Encrusted Grouper Fish 168.00 With sautéed asparagus and oyster sauce. 身石斑鱼排配炒松花和香茅土豆及洋葱酱汁 | Mashed Potatoes 22.00 土豆泥 |
| Cod Fish and Vegetables Soup 意大利鳕鱼蔬菜汤 | Spicy Miso Salmon Fillet in Clay Pot 148.00 With teriyaki sauce and wild mushrooms. 辣味炒鲑三文鱼配香草土豆及蟹味菇 | French Fries 22.00 薯条 |
| Burgers and More 汉堡及其它 | Australian Veal Tenderloin and Spanish Duroc Ham Roll 258.00 With jus and jus de viande. 西班牙杜洛克火腿卷澳洲小牛腩配特南瓜酱和火腿肉片 | Parmesan Risotto 22.00 帕玛芝士焗饭 |
| Wagyu Burger 200gm with Bacon and Cheese 158.00 With soft buns, pickles and cheddar mushrooms. 和牛汉堡包200克配薄肉、奶酪、烤蘑菇、炒洋葱 | B.B.Q. Pork Ribs 450gm 148.00 烧烤猪排450克 | Vegetables and Side Salad 蔬菜类 |
| Risotto and Asparagus 98.00 With parmesan and cream. 鲜芦笋焗饭配牛肝菌 | French Lamb Shank with White Beans Ragout 188.00 松子羊腩配香松土豆 | Grilled Asparagus 45.00 铁片芦笋 |
| Risotto with King Crab 128.00 With orange wedges and crab for extra. 香橙皇帝蟹饭 | Surf and Turf Combinations 海鲜美馐 | Fried Wild Mushrooms 30.00 铁煎合时蔬 |
| Penne Ragout and Smoked Salmon 118.00 With a creamy red sauce, lemon, capers. 意大利肉碎酱配三文鱼、奶油和罗汁和柠檬角 | 100-days Grain-fed Beef Filet Mignon 165gm King Crown (2) 180gm 258.00 100天优质谷饲牛里脊排165克配挪威三文鱼130克 | Fresh Albed Salad with Balsamic Vinaigrette 30.00 什锦生菜配香酱汁 |
| Sautéed Linguine with Clams 118.00 With garlic sauce, olive oil and fresh herbs. 辣炒意大利扁扁配文蛤、橄榄油、新鲜香草 | Certified Angus Strip Loin Steak 165gm Norwegian Salmon 130gm 218.00 注册安格斯牛外脊排165克配挪威三文鱼130克 | Green Beans, Shallots & Toasted Garlic 30.00 蒜茸豆苗 |
| | Chef's Recommendation 厨师长推荐 | Broccoli Flowers sprinkled with Hazelnut Crumbs 30.00 西兰花配坚果碎 |
| | Vegetarian Dish 素食菜品 | Dessert 甜点甜品 |
| | Spicy Dish 辛辣食品 | Tiramisu with Raspberry Sauce 68.00 Italian classic with mascarpone, coffee and cocoa. 意大利提拉米苏慕斯 |
| | 220gm/克 = 7.5oz/盎司 | Panna Cotta 48.00 意大利奶冻 |
| | 330gm/克 = 11oz/盎司 | Fudge Chocolate with vanilla sauce 58.00 热巧克力蛋糕配香草汁 |
| | 450gm/克 = 15oz/盎司 | Apple Crumble Pie with Vanilla Ice Cream & Fresh Fruit 48.00 苹果派配香草冰激凌 |
| | | Seasonal Fruit Platter 58.00 时令水果盘 |
| | | Mixed Cheese Platter 108.00 Served with crackers, nuts and dried fruit. 奶酪拼盘 |

安格斯扒房位于酒店一层, 期待您的光临!
Angus Grill is located at hotel Lobby Level.
预订请拨打电话: (010) 5099965
For reservations please call: (010) 5099965

All Prices are in RMB and Subject to 15% Surcharge
人民币标价, 另加收15%服务费

What is sustainable beef?

- As a socially responsible, environmentally sound and economically viable product that prioritizes the planet, people, animals and progress.
- Natural resources include environmental stewardship, reducing net GHG emissions, air and water quality etc.



In Saskatchewan we can produce Sustainable Beef

Sustainable Beef



Canadian Roundtable for Sustainable Beef

- This is not a government program

Buying verified sustainable beef



JBS, Cargill, Tyson, Walmart, Costco and McDonalds

- Retail and processing sectors are interested to what they see as a growing demand from consumers in North America and Globally

Sustainable Beef – Who CARES?



North America

Canada's farm population (2011)

- 1 out of every 50 Canadians, or 2.0% of the total population is from a farm.
Most people are from the city now!
- In Ontario the farm population accounts for 1.4% of the population.
- In Saskatchewan the farm population accounts for 10.3% of the population and is the highest.

USA the farm population is less than 1% of the population (2012)

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✓ Environmentally certified
✓ No artificial hormones
✓ Free range
✓ Guaranteed tender



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Greenhouse Gas Emissions

WHAT IS ENVIROMEAT'S POSITION ON THIS ISSUE? :

Enviromeat ran a forum to get the latest information on Agriculture Greenhouse emissions and what we as beef and lamb producers can do to reduce our impact on greenhouse emissions.

KEY POINTS :

Consensus view of +2500 climate scientists:

- 90 % probability that CC is due to human activities.
- CO₂ , CH₄ and N₂O are highest in recorded and inferred history
- Primarily due to combustion of fossil fuels, agriculture and land-use changes.
- Agricultural Processes contributed 16.5% of the Australian National Sectoral Gas Greenhouse Emissions in 2004

PUBLICATIONS TO DOWNLOAD:

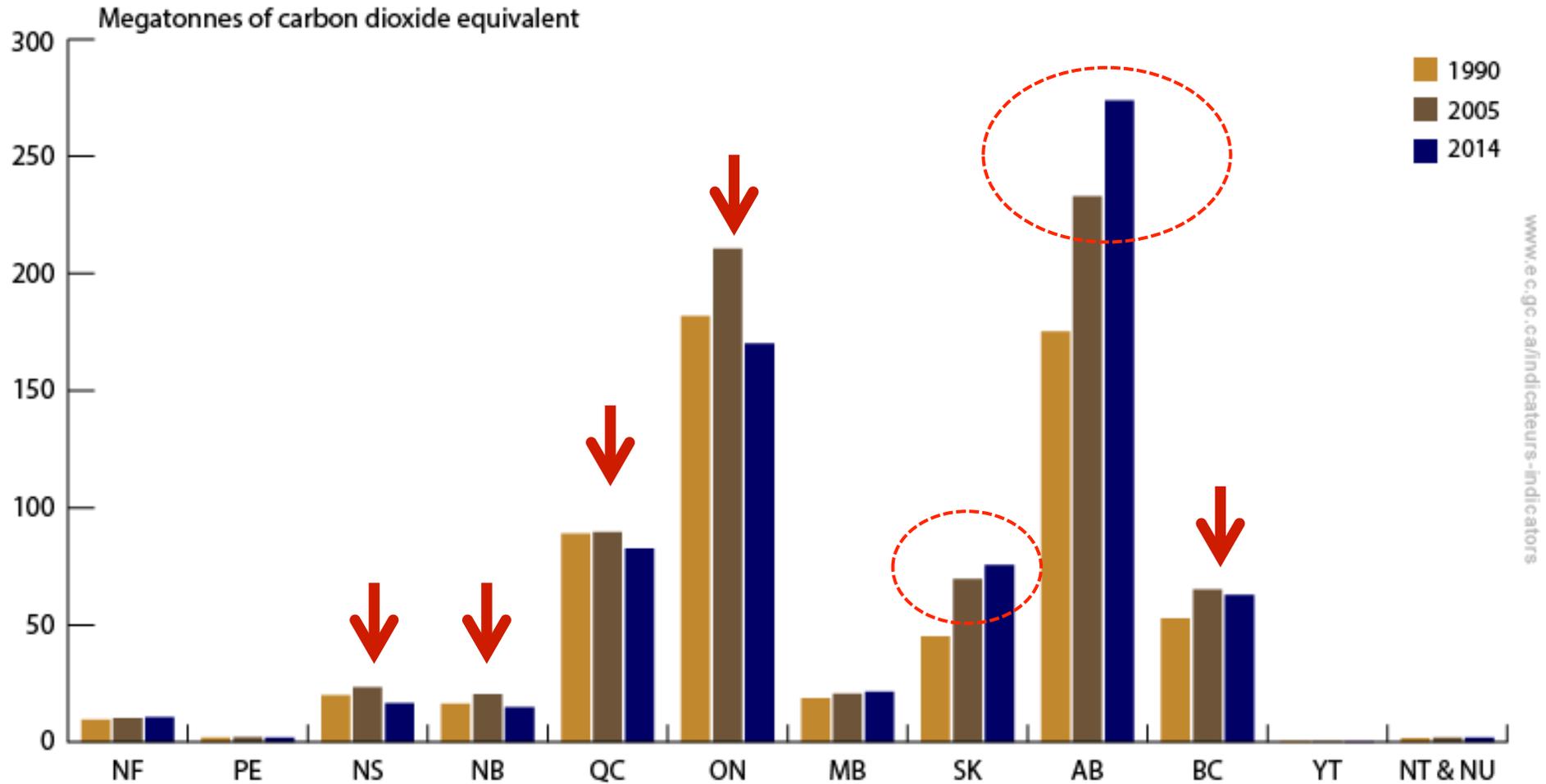
- Updating Your EMS to Cover Greenhouse Gas Emissions (June 2007)
- A Draft Operating Procedure for Carbon Sequestration (June 2007)
- A Draft Operating Procedure for Lowering Off-Farm Greenhouse Gas Emissions (June 2007)
- A Suggested Operating Procedure for Lowering On-Farm Greenhouse Gas Emissions (June 2007)
- Greenhouse Forum Evaluation Document
- Soil Health and Management of Soil Organic Carbon by Dr. Peter Fisher, Department of Primary Industries Paper presented at the Gippsland Greenhouse Forum

<http://www.enviromeat.com.au/greenhouse.php>

2009-01



Greenhouse gas emissions by Provinces (2014)

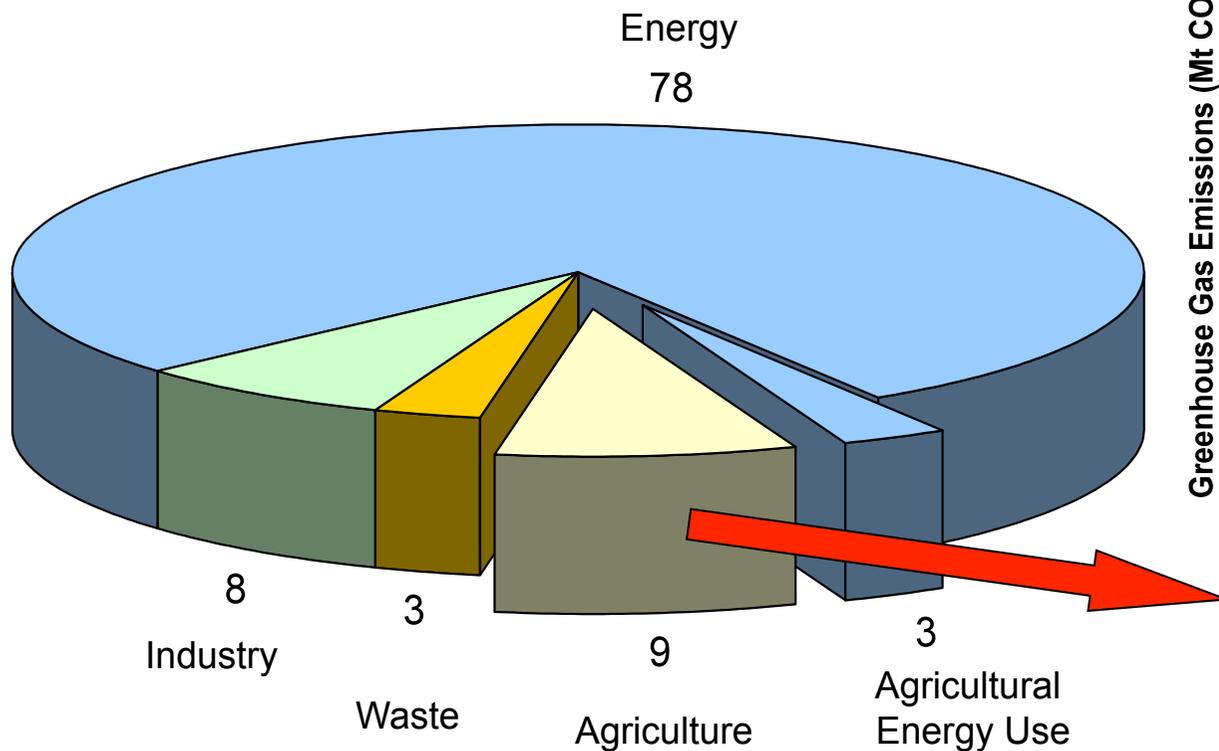


Environment Canada 2016

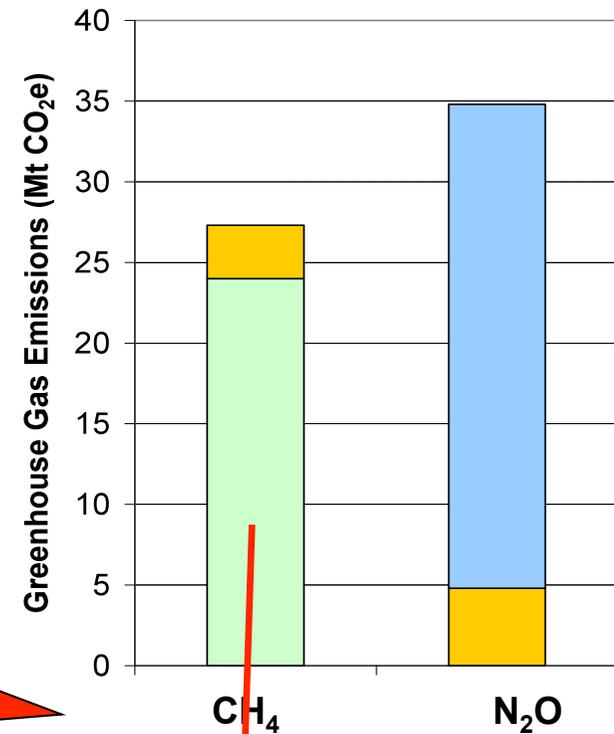
Main agriculture greenhouse gases for the livestock sector

- For the agriculture sector the main greenhouse gases (GHG) are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).
- GHG emissions from the livestock sector are mainly from ruminant digestion (enteric) and manure management. Methane is the major GHG produced from enteric fermentation (digestion).

Canadian Agricultural GHG Emissions in 2001 (2014 = 9.9%)



Share of National GHG Emissions (%)



44% 56%

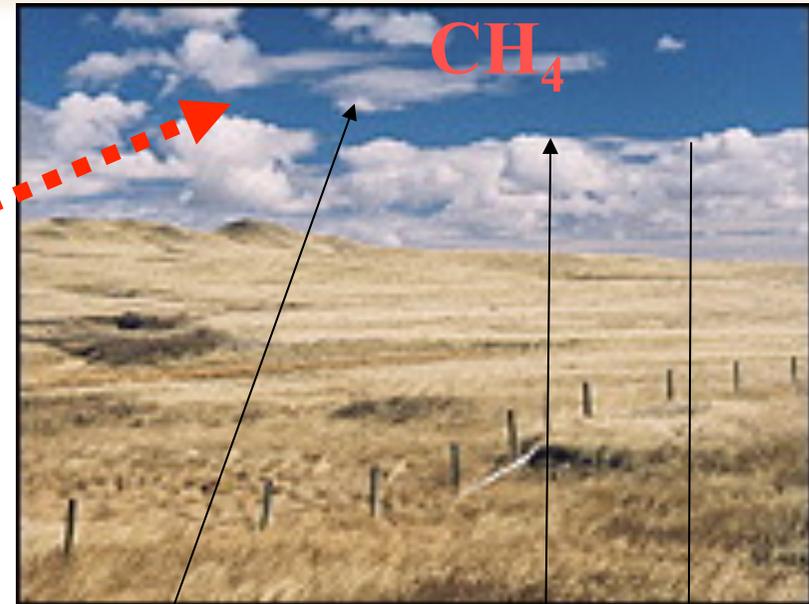
- Agricultural Soils
- Manure Management
- Enteric Fermentation

Methane Cycle

-has 23 times the GWP
of carbon dioxide

Rumen digestions

83%



CH_4

Wet

Dry

Liquid Manure

CH_4

Decomposition of Organic Matter in Absence of Oxygen

Why should beef producers be interested in reducing CH₄ emissions

- Many management practices that reduce GHG emissions also can increase environmental sustainability and/or production efficiency.
- About 3 to 12% of the energy consumed by ruminants is converted to CH₄ and released into the atmosphere (loss production).



Why should beef producers be interested in reducing CH₄ emissions

- Adopting feeding strategies that will reduce the amount of energy lost as CH₄, can **improve feed conversion efficiency, improve animal productivity** and is good for the environment.



Potential win + win situation!!!

Better forage & grazing management reduces CH₄ = higher animal weight gains and good for the environment!

Why should beef producers be interested in reducing CH₄ emissions

- Theoretically a 20% reduction in CH₄ could allow growing cattle to gain in a 90 – 120 grazing period an additional 6.75 kgs (15 lbs) or 9.0 kgs (20 lbs).
- Even a 5 – 10% in a 90 grazing period an additional 1.7 kgs (4 lbs) or 3.4 kgs (7.5 lbs).
- **Just by doing good grazing management!!!!**



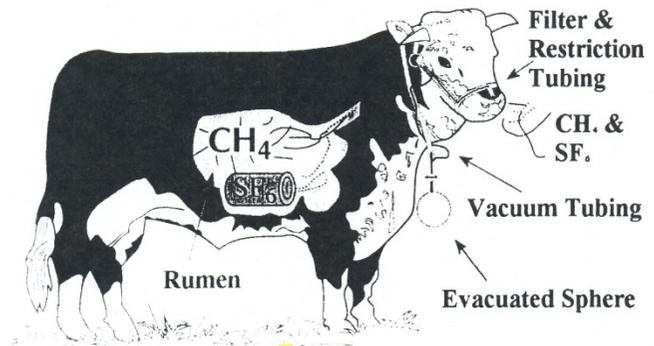
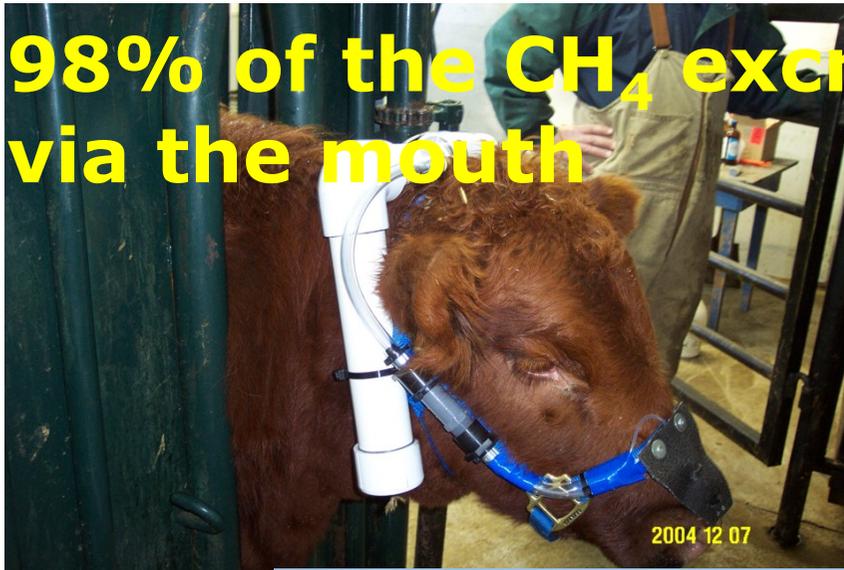
Some Methods of Reducing Enteric Methane Emissions and their Potential Effectiveness for Grazing Systems



Not able to share some information on grazing systems or supplementation effects on methane emissions.

The SF₆ Methane Collection System – ideal for grazing studies to measure methane emissions

98% of the CH₄ excreted via the mouth



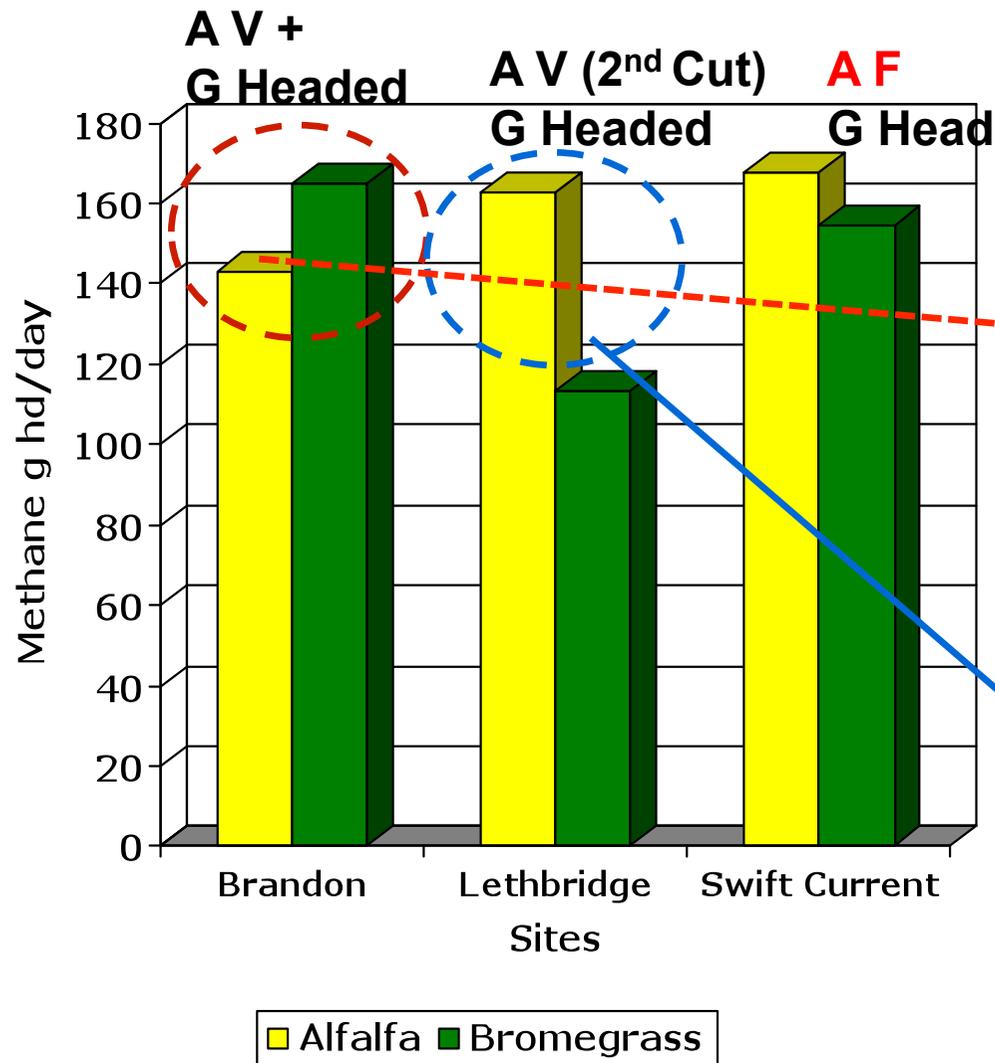
Dad are you Doing FART research? !!!

Forage Species and Pasture Management

- Inclusion of legumes in the forage diet (digestibility feed efficiency and improves forage quality).



Grazing study at three locations comparing alfalfa vs grass



- **CH₄ emission** varied based on forage quality and grazing behavior.
- Brandon was the only locations that showed CH₄ reduction (14%).
- Swift Current no differences in CH₄ emissions.
- Lethbridge results show higher CH₄.



Take Home Information

- Lots of things can affect whether the forage + grazing management is able to consistently result in reducing CH₄ emissions rates.
- Environment factors affect plant growth and ability to grazing the forage at the right or ideal stage of maturity and forage quality.
 - **Brandon** had more moisture and were able to graze the alfalfa at the vegetative stage. While the drier condition at **Swift Current increased maturity and** resulted in no difference in CH₄ emissions from AF vs G headed.

Take Home Information

- At Lethbridge, animal behavior and grazing preference was important.
 - Even though the alfalfa at the 2nd cut was vegetative the animal in the particular paddock did not settle down and were constantly on the move.



More research is needed to determine dietary selectivity

Is alfalfa grazed first and then the grasses or



Take Home Information

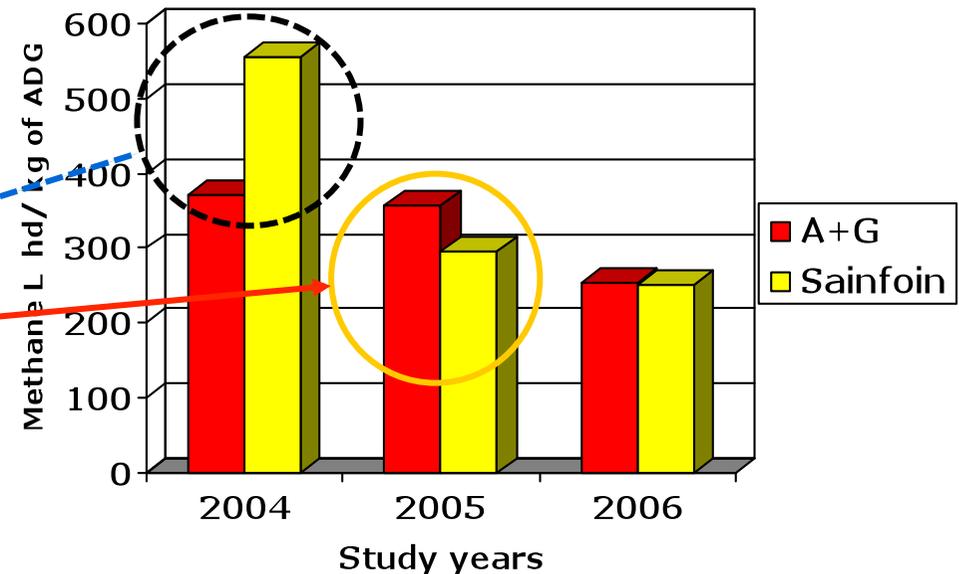
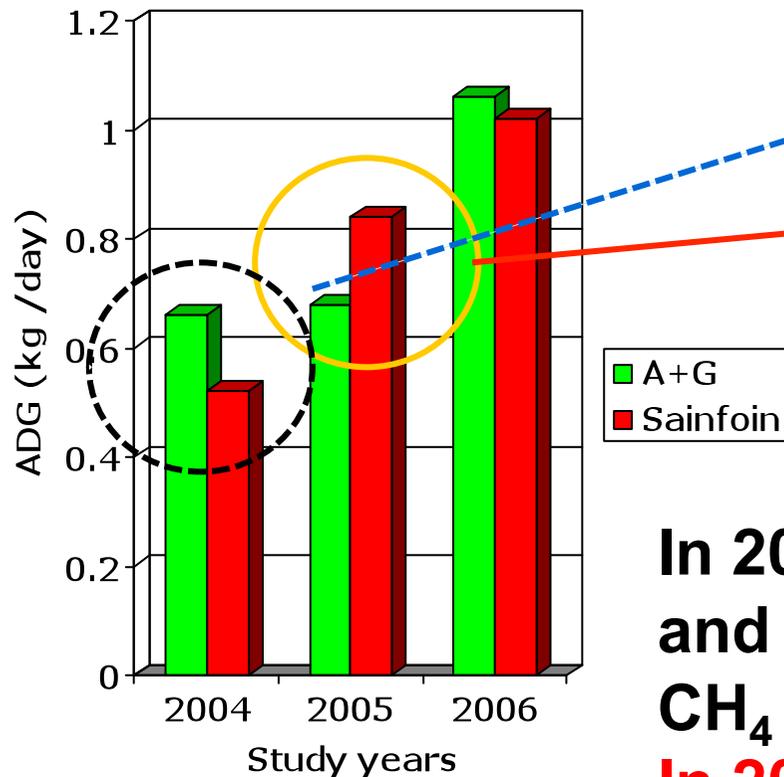
- Need to consider the **other potential benefits** of including a legume (alfalfa):
 - increase gains and total live production; higher digestibility and intake; N fixing ability and source of fertility, high forage production and **GHG reduction?**
- While the strategy has promise, producers are reluctant to replace grass with alfalfa because of bloat risk. Also higher management is needed. A Canadian study reported a 10% CH₄ reductions using alfalfa mix.

Forage Species and Pasture Management

- Condensed tannins (non bloating), in some legumes (sainfoin, etc.), have been associated with reductions in methane (CH_4) emissions.
- Sainfoin has high grazing preference, animals like it!



Sainfoin versus alfalfa + grass (A+G) pastures

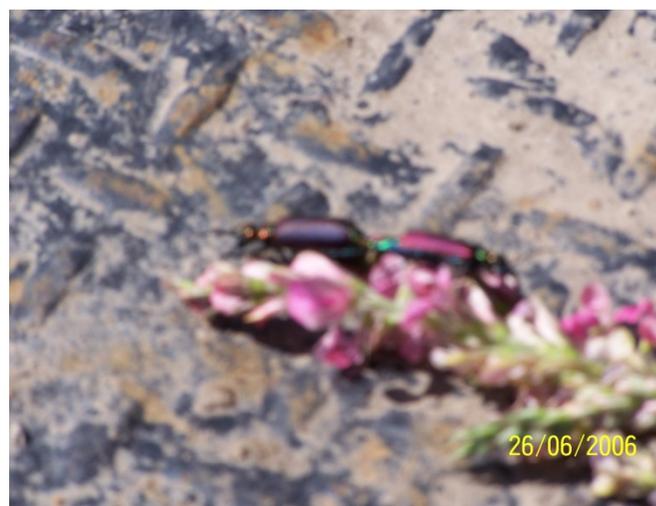


In 2004 the higher forage production and gains of the A+G resulted in lower CH₄ emissions from the A+G.

In 2005 the opposite happen with better S forage production and gains, resulted in lower CH₄ emissions > 10%.

Take Home Information

- Lots of things can affect whether the forage + grazing management is able to consistently result in reducing CH₄ emissions rates. Does this sound familiar?
- Environment, insect and management factors affecting plant growth.



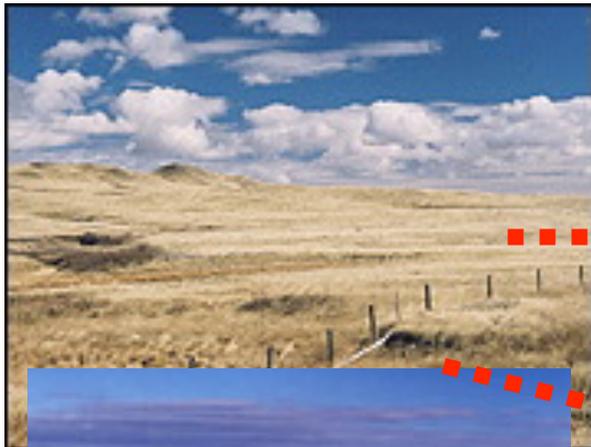
Take Home Information

- Things just happen!
 - 2004 herbicide treatment stunted S growth resulting in poor forage production and quality (A+G = 4705 vs. S = 2680 kg per ha) and insect problems.
- 2005 excellent forage production occurred and very good gains were observed for A+G (0.6 kgs d⁻¹ or 1.3 lbs d⁻¹) and S (0.8 kgs d⁻¹ or 1.8 lbs d⁻¹). Methane emissions per gain lower for S.
- 2006 forage production similar and animal gains were similar. Methane emissions were similar.

Take Home Information

- Need to consider the **other potential benefits** of including a legume (sainfoin):
 - Non-bloating; excellent grazing preference; similar to alfalfa nutritionally; improves N efficiency, maintains its forage quality as it matures, new sainfoin cultivar has similar forage production to alfalfa and regrowth potential and **GHG reduction?**
- While the strategy has promise, producers are unfamiliar with sainfoin and seed price is high. Studies have reported a 10 – 25% CH₄ reductions due to condensed tannins content and grazing preference.

Improved forage intake, digestibility, biomass production and forage quality



CH₄ ↓



**Carbon sequestration
methane reduction**



**Improved production
efficiencies!!!!
water quality,
minerals
supplementation etc.**



Alfalfa pasture

**Proper grazing management of
native and tame forages**



**Native legume +
grass pasture**

Saskatchewan, a Major Opportunity to Reducing GHGs



- Over 50% of Canada's potential agriculture carbon sinks.
- Over 30% of the beef livestock herd of Canada, therefore the development of potential BMPs to reduce GHGs would be beneficial.
- In order to consistently reduce certain GHGs (e.g., methane) good forage and grazing management is needed + RESEARCH!

**Thank you and Any
Questions**



Forage Quality and Maturity

- Managing your grazing system to maximize the use of good quality forages (rotational and complementary grazing etc.).
- CH₄ emissions are highest when only poor-quality forage is presented.



April grazing



Sept. grazing 2005



Nitrous Oxide Cycle

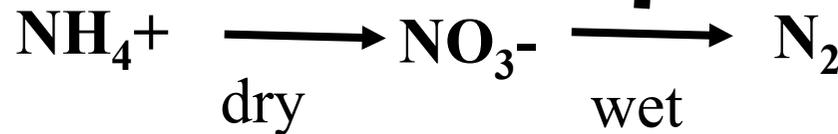
- has 310 times the GWP of carbon dioxide

26%

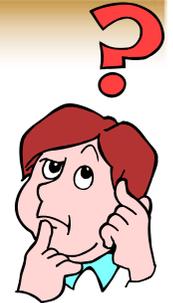


Crop
Residues
Legumes
Fertilizers

**Biological Transformations
of Mineral Nitrogen**



So why should beef producers be interested in ↓ GHG emissions



Interest by CCA

Good Management practices
Greenhouse Gases and the Canadian Beef Cattle Industry

GREENHOUSE GAS emissions

Based on methods developed by Agriculture and Agri-Food Canada (AAFC), Environment Canada has determined the agriculture sector is responsible for about 10 percent of total emissions of greenhouse gases (GHG) in Canada.

Nitrous oxide, methane and carbon dioxide are considered to be the main greenhouse gases. Carbon dioxide (CO₂) is the main greenhouse gas emitted by most industries. The primary gases emitted by agriculture are methane from livestock digestion and manure, and nitrous oxide from manure handling and storage and corn residual tillage.

Methane has 21 times the GWP as carbon dioxide, and nitrous oxide has 310 times the LWP of carbon dioxide.

Carbon is given off as carbon dioxide when plant material decomposes in the presence of oxygen, if oxygen is absent the decomposition process emits methane.

Microorganisms in the soil will convert methane to carbon dioxide and thus soils are able to absorb methane.

Breakdown of GHG Emissions (2001)

| Category | Percentage |
|-----------------|------------|
| Dairy | 23% |
| Beef | 42% |
| Other | 10% |
| CH ₄ | 10% |
| Crops | 12% |
| Fertiliser | 2% |

Carbon Dioxide Equivalent (CO₂e) is a measure used to compare the emissions from various greenhouse gases based on their global warming potentials (GWPs).

Sources and Sinks of Carbon Dioxide

When organic materials decompose in submerged or water-laden soils, the water reduces the oxygen supply causing the release of large amounts of methane. In the soil, organic matter is broken down into carbon dioxide and methane.

Government of Alberta, Agriculture and Agri-Food Canada
Agriculture and Agri-Food Canada
Reprinted from the Climate Change Action Fund Agriculture Awareness Partnership

Carbon Offset Solutions

CARBON OFFSET SOLUTIONS

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Alberta's GHG Reduction system

CARBON OFFSET SOLUTIONS

How do I measure my greenhouse gas offsets?
What should be in an emissions trading contract?
Do you want an update on provincial policy developments?
Where can you find out what events and consultations are taking place?

Welcome to Carbon Offset Solutions: your information resource for all things related to emissions trading and climate change policy in Canada. On this site you will find the answers to all your questions and more.

You can find an overview of both federal and Alberta policy and regulations on this site. This includes links to legislation and regulations in effect, guides to compliance, and outstanding policy issues.

A catalog of emissions trading resources will put the information in your hands to develop, sell, or buy emissions offsets. From market service providers to model contracts, this section will prepare you for entry into the emerging emissions trading market.

Fundamental to emissions trading is the quantification of offsets. One section is devoted entirely to offset quantification protocols. There is a list of draft and approved protocols, as well as the opportunity to suggest protocols for development.

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Welcome to our Website
the mission of this website is to let Alberta farmers and ranchers know of a safe reliable company that they can trust to aggregate their Carbon Offset Programs, who will aim to get the best possible price from the marketplace and will store their field data in the manner required by the Alberta Government.

Alberta Carbon Offset Program - This is an ALBERTA CANADA PROGRAM only

SUCCESSFUL SALE - THE FIRST EVER - APRIL 2008

Generates \$8.75/Tonne for Growers (this means an average sale price of \$12.50)
NET after all costs and 25% higher than our estimated amount of \$7.00/Tonne which was based on an average sales price of \$10

DARE TO COMPARE to any of our competitors!

Producers who choose to be cautious and guarded in their approach to our business may choose to re-assess the opportunity now that a business cycle is complete and we have demonstrable numbers to showcase. Our clients have committed to significantly more acreage immediately or as soon as we can supply.

BC has a carbon tax system which permits C offsets etc.