

Why is the Beef Industry Under Fire?

A Preliminary Comparison of the Greenhouse Gas Emissions from Canada's and India's Beef Industries



White Paper prepared for CAPI

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Introduction

Since 1981, the Canadian agricultural sector has reduced its emissions significantly and continues to work to reduce its carbon footprint. Canadian cattlemen today are focused on the raising of sustainable beef while prioritizing socially responsible and environmentally sound measures. While India's beef sector remains under scrutiny, both nationally and internationally, the country continues to be one of the largest exporters of beef in the world. Today, India remains in the top five exporters of beef and is beginning to make progress in decreasing its greenhouse gas (GHG) emissions. In comparison to India, Canada has been successful in mitigating its methane output from beef production and continues to work on better methods of reduction. Canada is a clear example of success in lowering GHG emissions with below average GHG emissions intensity in its beef sector.¹ However, both Canada and India have the potential to enhance their mitigation strategies in creating even more sustainable livestock production processes.

Climate change and GHG emissions currently polarize the media, with one side encouraging consumers to drastically reduce the intake of red meat and the other side arguing that the beef industry does not have any damaging effects. The beef industry continues to be under fire because of large GHG emissions caused by the methane output of cattle. Consumption patterns in beef around the world continue to increase.² Research shows that just over 50% of GHG emissions from agriculture are attributed to livestock production and manure management.³ There is potential to reduce GHG emissions from agriculture outputs attributed to livestock production by 30% through technological improvements and changes in farm management practices. According to the Food and Agriculture Organization of the United Nations (FAO), agriculture is responsible for 18% of the total GHG emissions worldwide.⁴ The beef sector in Canada and India each face their own environmental obstacles. The largest problem facing both countries is the outputs of GHG emissions. This paper exposes the facts behind the beef industry using case studies of Canada and India.

¹ Emissions intensity is measured as GHG emissions per unit of output.

² OCED, "Consumer Demand for Different Food." Accessed at: <https://www.oecd.org/env/consumption-innovation/1833503.pdf>.

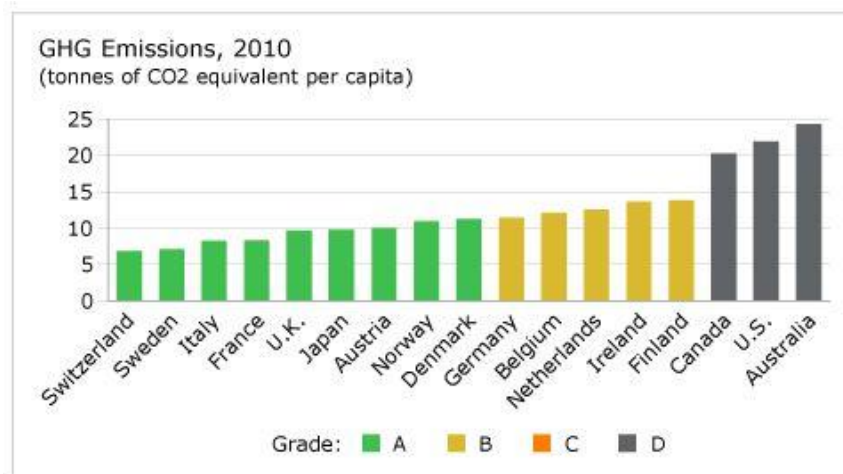
³ Canadian Agri-Food Policy Institute, "Clean Growth in Agriculture," March 2019, pg. 12. Accessed at: https://capi-icpa.ca/wp-content/uploads/2019/03/2019-03-22-CAPI-CEF-Final-Report_WEB-1.pdf.

⁴ FAO, Time for Change.

1.1 Beef Production in Canada

1.1.1 Canada's GHG Emissions

GHG emissions from agriculture account for 7% to 12% all of Canada's GHG emissions. In 2016, the agricultural sector in Canada produced 30% of the national CH₄ emissions, which accounted for just 14% of the total Canadian GHG emissions.⁵ However, Canada's total GHG emissions have been in decline since Canada reached its peak of GHG emissions in 2005. Canada lagged behind the rest of the world in 2010 if measured on a per capita basis.⁶ The Conference Board of Canada rated the 17 member countries of the Organisation for Economic Co-operation and Development (OECD). Canada as a member country received a failing grade of 'D' when measured in per capita terms (Figure 1).⁷ The average GHG emissions of the 17 OECD countries was 12.5 tonnes per capita. Meanwhile, Canada's GHG emissions per capita were 20.3 tonnes per capita.⁸ While Canada produced nearly three times more GHG emissions per capita than Switzerland in 2010, Canada has improved its trend, falling to 19.5 tonnes per capita in 2016. The Canadian agriculture sector, in particular, has reduced its GHG emission through feed, genetics, and other farm management practices, providing GHG metrics which are more fairly represented when emissions are measured per unit of output.



⁵ Environment and Climate Change Canada, "National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada," 2018, pg. 11. Accessed at: <https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/emissions-inventories-reporting/nir-executive-summary/National%20Inventory%20Report%20Executive%20Summary%202018.pdf>.

⁶ However international comparisons of GHG emissions based on a per capita basis distort the picture of how Canada is doing relative to other countries because Canada has a very small population yet produces and exports for the world. A more accurate international comparison would be GHG emissions intensity, measured as emissions per unit of output. On this basis, Canada performs well, as described in the CAPI publication listed here: <https://capi-icpa.ca/wp-content/uploads/2019/03/2019-05-15-CAPI-CEF-FINAL-Report-WEB.pdf> pg. 20.

⁷ The Conference Board of Canada, "Greenhouse Gas (GHG) Emissions." Accessed at: <https://www.conferenceboard.ca/hcp/Details/Environment/greenhouse-gas-emissions.aspx>.

⁸ Ibid.

Figure 1 - GHG Emissions, 2010, (tonnes of CO₂ equivalent per capita.)⁹

1.1.2 Canada's Agriculture Emissions

Canada has worked hard to reduce its GHG emissions in agriculture by 2 percentage points limiting its contribution of GHG emissions from 10% to 8% of Canada's national total. After the transportation sector and the oil and gas sector, the agriculture sector is the next largest emitter in Canada. Reductions can be seen through the improvement of mitigation strategies, carbon sequestration, and new innovative technologies of improved feed, genetics and herd health.¹⁰ Statistics for the emissions from this sector are from crop and livestock production and exclude the production of fertilizers and the use of fossil fuels (Figure 2).¹¹

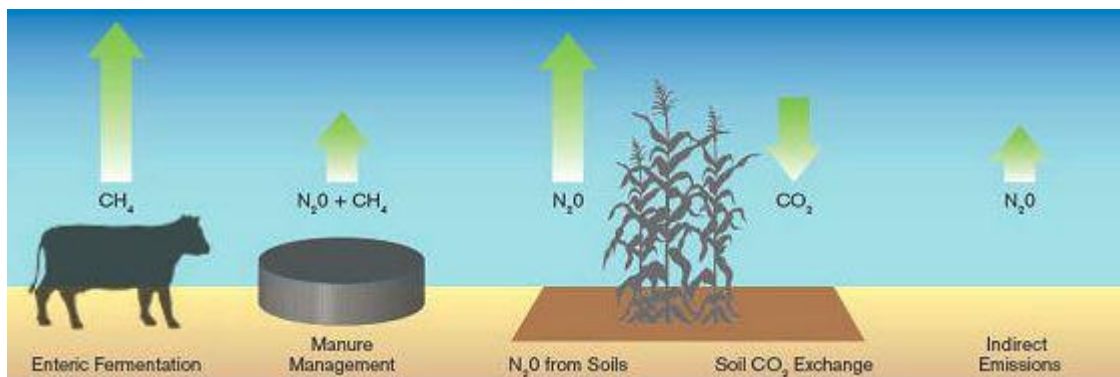


Figure 2 - Sources of Greenhouse gas emissions from Canadian agriculture excluding CO₂ emissions associated with energy use.¹²

Note: the size of the arrow indicates the relative magnitude of the emissions or amount sequestered.

1.1.3 Canadian Livestock Emissions

While the agriculture sector has seen an increase in GHG emissions from 60.0 CO₂e in 1981 to 74.8 CO₂e in 2015, the beef sector has continued to show reduction in its GHGs and taken proactive approaches to mitigating GHG emissions. Canadian beef producers have worked hard to improve the sustainability of their sector, resulting in more sustainable beef production. The Sustainable Beef Initiative is a verified beef production system that encourages “socially responsible, environmentally sound viable production that prioritizes planet, people, animals,

⁹ The Conference Board of Canada, “GHG Emissions, 2010.” Accessed at:

<https://www.conferenceboard.ca/hcp/Details/Environment/greenhouse-gas-emissions.aspx>.

¹⁰ Canadian Cattlemen's Association, “Beef Production 101.” Accessed at: <http://www.cattle.ca/cca-resources/animal-care/beef-production-101/>.

¹¹ Innovation.ca Canada Foundation for Innovation, “Mapping Investments to Impacts: Agriculture Research Greenhouse gases,” April 2018, pg. 3. Accessed at:

https://www.innovation.ca/sites/default/files/EOA/Reports/agriculture_casestudy_ghg_eng_final.pdf.

¹² Agriculture and Agri-Food Canada, “Greenhouse Gases.” Accessed at: <http://www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/climate-change-and-agriculture/greenhouse-gases/?id=1329321969842>.

and progress,” throughout the entire beef supply chain.¹³ Livestock production and manure management account for just over 50% of agriculture emissions, the largest output being methane.¹⁴ Canada’s agriculture sector accounts for 70% of all methane emissions nationwide, but methane emissions only account for 14% of total domestic GHG emissions.¹⁵ Globally, Canadian beef has one of the lowest GHG emissions per unit of production at 12.0kg CO₂ equivalent per kilogram of weight as of 2013. This is in comparison to 1981 when the live weight production of beef was 14.0kg CO₂e.¹⁶ In fact, 1kg of beef produced in Canada now creates 15% fewer GHG emissions than beef production in 1981.¹⁷ In 2011, the beef sector produced the same amount of beef as 1981 with less 29% less breeding stock, 27% fewer slaughter cattle, and 24% less land.¹⁸

1.2 Beef Production Contributions & Reductions to GHG Emissions in Canada

1.2.1 Raising, Housing and Feeding Cattle in Canada

Every year in Canada 10 million cattle are raised for beef.¹⁹ Cattle raised for beef are predominately from Alberta, where 70% of Canadian beef is raised.²⁰ Calves spend the first 6 to 12 months of their lives with their mothers, who graze while calves are nursed. These grazing pastures are rotational. Rotational grazing prevents overgrazing and allows for carbon sequestration. This helps reduce carbon emissions and hinders soil degradation. During the grazing period, the diet of calves consists of milk. Once they are weaned their diet consists of natural, high-fibre grasses.²¹ When calves reach a weight of about 300kg they are sent to feedlots for about 18 months before being slaughtered. While on the feedlot calves are initially fed special diets of corn and barley, and later fed high energy grains for finishing.²² Previously the finishing process included grass-feeding. Now grains have been introduced, resulting in reduced GHG

¹³ Canadian Roundtable for Sustainable Beef, “Defining Sustainability.” Accessed at: <https://crsb.ca/>.

¹⁴ Prairie Climate Centre, 2018. Accessed at: <http://prairieclimatecentre.ca/>

¹⁵ Canadian Agri-Food Policy Institute, “Clean Growth in Agriculture,” pg. 12.

¹⁶ Canadian Cattlemen’s Association, “Beef Industry Strategies for Reducing Greenhouse Gases and Building the Green Economy,” pg. 3. Accessed at: <http://www.cattle.ca/assets/0c1041cd87/Strategies-for-Reducing-Greenhouse-Gases-from-Beef-Production-in-Canada-26.07.16.pdf>.

¹⁷ Alberta Cattle Feeder’s Association, “What do you know about cows and GHG emissions?” Accessed at: <https://www.cattlefeeders.ca/what-do-you-know-about-cows-and-ghg-emissions/>.

¹⁸ Canadian Cattlemen Association, “Beef Industry Strategies for Reducing Greenhouse Gases and Building the Green Economy,” pg. 5.

¹⁹ BC SPCA, “Cattle farming in Canada.” Accessed at: <https://spca.bc.ca/programs-services/farm-animal-programs/farm-animal-production/beef-cattle/>.

²⁰ Canadian Roundtable for Sustainable Beef, “National Beef Sustainability Assessment and Strategy,” pg. 18. Accessed at: https://crsb.ca/assets/Uploads/About-Us/Our-Work/NBSA/290ae9c611/NBSA_and_Strategy_summary_report_web1.pdf.

²¹ BC SPCA, “Cattle farming in Canada.”

²² Canadian Cattlemen’s Association, “Beef Production 101.” Accessed at: <http://www.cattle.ca/cca-resources/animal-care/beef-production-101/>.

emissions by 40% because of better finishing times.²³ For instance, in Alberta cows are finished on a diet of 80% grain and 20% forages this diet is introduced over a two-week timeframe.²⁴

1.2.2 Processing Beef and Food Waste

Beef producers are often considered the sole source of increased GHG emissions. However, the processing of beef and consumer waste are also large contributors to GHG emissions in the beef industry (Figure 3).²⁵ In fact, the processing of beef and food waste are the highest emitters of GHG emissions in beef production. Currently, 19% of edible, bone-free, meat is wasted. If food waste was reduced by 50% it would mitigate 3kg CO₂ and 60L of water per kilogram of packed boneless beef. These reductions would also avoid the release of 1.6Mt CO₂e.²⁶ Mitigating this waste would provide the opportunity for full value chain sustainability.



Figure 3 - Meat Waste²⁷

Note: Meat waste occurring during secondary processing, retail and consumption

1.2.3 Carbon Sequestration²⁸

Globally, grasslands store 30% of soil carbon and in Canada grazing lands currently store 1.5 B tonnes of carbon.²⁹ A significant GHG emission mitigation strategy is carbon (C) sequestration. Untouched native grasslands represent important storage of carbon and may contain up to 200 tonnes of carbon per hectare.³⁰ On the Canadian prairie grasslands, the extensive plowing for crop production has left less than 20% of the ecosystem intact. Current carbon soil stores if

²³ Alberta Cattle Feeder's Association, "What do you know about cows and GHG emissions?" Accessed at: <https://www.cattlefeeders.ca/what-do-you-know-about-cows-and-ghg-emissions/>.

²⁴ Alberta Cattle Feeder's Association, "Feedlots 101." Accessed at: <https://www.cattlefeeders.ca/industry-overview/feedlots-101/>.

²⁵ Canadian Roundtable for Sustainable Beef, "National Beef Sustainability Assessment and Strategy," pg. 18.

²⁶ Ibid., pg. 18.

²⁷ Ibid., pg. 18.

²⁸ Land used for beef production in Canada is currently storing about 1.5 billion tonnes of carbon.

²⁹ Ontario Beef Council, "Worried about Greenhouse Gases?" Accessed at: [http://www.ontariobeef.com/uploads/userfiles/files/greenhouse%20gas%20infographics%20\(ontario%20beef-web\)\(1\).pdf](http://www.ontariobeef.com/uploads/userfiles/files/greenhouse%20gas%20infographics%20(ontario%20beef-web)(1).pdf).

³⁰ Beef Cattle Research Council, "Environmental Footprint of Beef Production." Accessed at: <http://www.beefresearch.ca/research-topic.cfm/environmental-footprint-of-beef-production-6>.

cultivated would release 59% of the carbon that has already been sequestered.³¹ Plowing is detrimental to the carbon stores as much of the carbon is stored in the roots of grass and shrubs. When the land is plowed the carbon released is comparable to the carbon released by natural fires. The amount of carbon stored in a single hectare of native grasslands is the equivalent to the number of emissions produced approximately by 150 cars in one year.³² Innovations in farm management practices such as plant and animal genetics are credited with gains in C sequestration.³³ C sequestration includes improved grazing practices, soil management, manure management, improved animal genetics, and feeding efficiency and increased crop yields. For example, in Saskatchewan 23 million acres have been reseeded which now have the capacity to store enough carbon to offset 30 million kilometers of driving annually.³⁴

1.3 Role of Exports in the Beef Industry in Canada

Canada continues to be one of the top beef exporters in the world. Canada annually produces 1.2 million tonnes of beef, making it the 6th largest exporter of boxed beef, and the 5th largest exporter of beef and cattle in the world.³⁵ The beef production sector contributes \$41 billion to the Canadian economy as well as 228,000 jobs.³⁶ Canada's beef industry plays an important role in its economy. Thus, the beef industry is a large contributor to the Canadian economy due to its large export value and nearly a quarter of million Canadians employed in this sector.

2.1 Beef Production in India

2.1.1 India's GHG Emissions

India is the third highest GHG emitter in the world, behind China and the United States.³⁷ Under the Narendra Modi government, India signed and committed to the Paris Climate Agreement. However, in 2016, India experienced the largest GHG emissions increase in decades.³⁸ Countries

³¹ Ontario Beef Council, "Worried about Greenhouse Gases?" Accessed at:

[http://www.ontariobeef.com/uploads/userfiles/files/greenhouse%20gas%20infographics%20\(ontario%20beef-web\)\(1\).pdf](http://www.ontariobeef.com/uploads/userfiles/files/greenhouse%20gas%20infographics%20(ontario%20beef-web)(1).pdf).

³² Beef Cattle Research Council, "Environmental Footprint of Beef Production." Accessed at:

<http://www.beefresearch.ca/research-topic.cfm/environmental-footprint-of-beef-production-6>.

³³ Canadian Agri-Food Policy Institute, "Clean Growth in Agriculture," pg. 12.

³⁴ Canola Digest, "A Saskatchewan Soil Sustainability Story," November 26, 2018. Accessed at:

<https://canoladigest.ca/science-edition-2018/a-saskatchewan-soil-sustainability-story/>.

³⁵ CRSB, "National Beef Sustainability Assessment and Strategy," pg.6. Accessed at:

https://crsb.ca/assets/Uploads/About-Us/Our-Work/NBSA/290ae9c611/NBSA_and_Strategy_summary_report_web1.pdf/.

³⁶ Ibid., pg. 6.

³⁷ World Resources Institute, "6 Graphs Explain the World's Top 10 Emitters," November 25, 2014. Accessed at:

<https://www.wri.org/blog/2014/11/6-graphs-explain-world-s-top-10-emitters>.

³⁸ PBL Netherland Environmental Assessment Agency, "Greenhouse gas emission levels continues to rise in 2016," September 26, 2017. Accessed at: <https://www.pbl.nl/en/news/newsitems/2017/greenhouse-gas-emission-levels-continued-to-rise-in-2016>.

such as China and the United States saw stable or decreased emissions, while GHG emissions in India increased by 4.7%.³⁹ In 2014, India's total GHG emissions were 3202 MtCO₂e, equal to 6.55% of the world's total GHG emissions.⁴⁰ Figure 4 breaks down India's GHG emissions by sector providing a better understanding of the GHG emissions output in India.

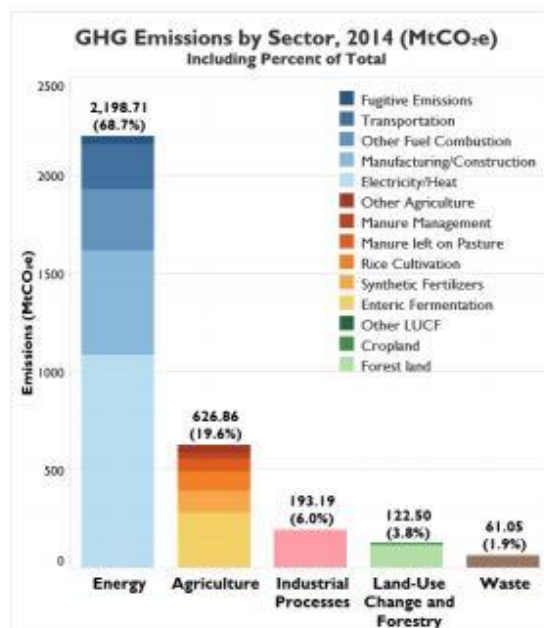


Figure 4 - GHG Emissions by Sector, 2014 (MtCO₂e)⁴¹

2.1.2 India's Agriculture Emissions

The agriculture sector contributes to one-fifth of the national GHG emissions. India must lower its GHG emissions, particularly in the agricultural sector. Since 1990, agriculture emissions in India have increased by 0.9% per year. This increase is minute in comparison to other sectors in India seeing at least 4.0% increase per year.⁴² The International Maize and Wheat Improvement Centre in the UK have found that India has the potential to reduce its emissions by 18%, equating to 85.5 Mt CO₂e per year.⁴³ The recommended improvements are all extremely low cost to the country such as efficient use of fertilizer, adoption of zero-tillage and the management of water.

³⁹ Ibid.

⁴⁰ US Aid from the American People, "India GHG Emissions Factsheet." Accessed at: <https://www.climatelinks.org/sites/default/files/asset/document/India%20GHG%20Emissions%20Factsheet%20FINAL.pdf>.

⁴¹ Ibid.

⁴² Ibid.

⁴³ Scroll.in, "Agriculture is a big contributor to greenhouse gas in India. A study finds a way to fix that." Accessed at: <https://scroll.in/article/914085/agriculture-is-a-big-contributor-to-greenhouse-gas-in-india-a-study-finds-a-way-to-fix-that> and CIMMYT & International Maize and Wheat Improvement, "New study: India could cut nearly 18% of

2.1.3 India's Livestock Emissions

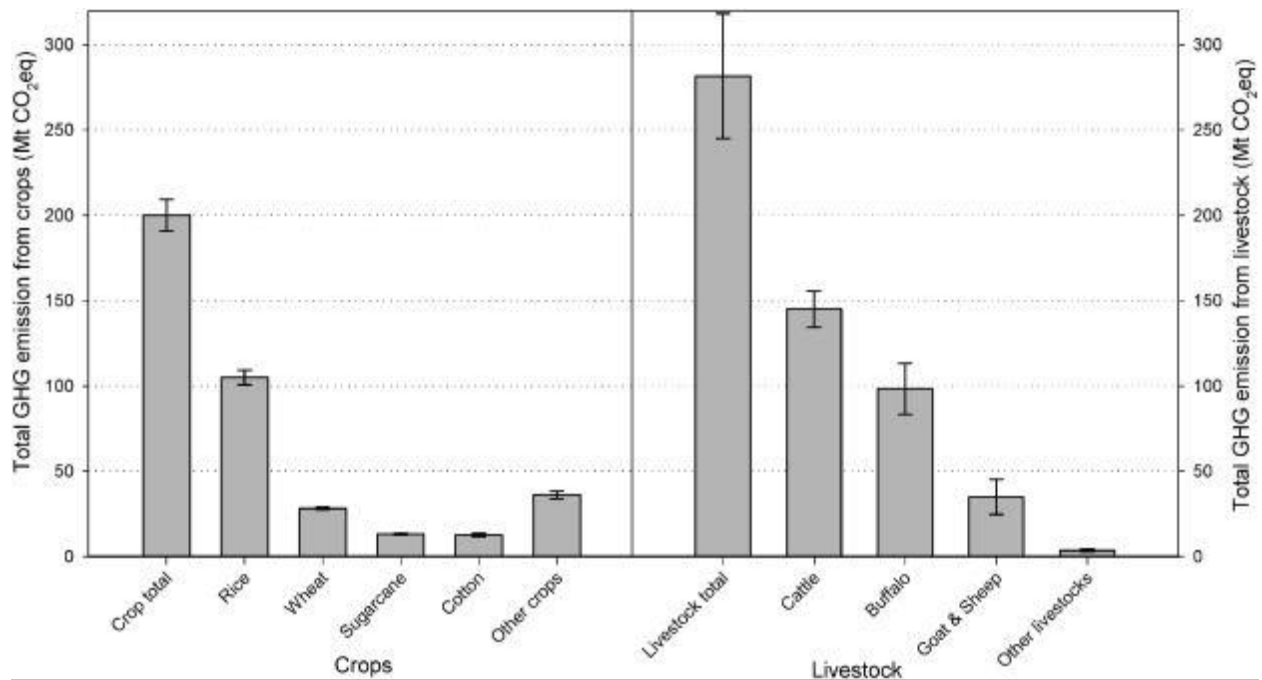


Figure 5 - Total national emissions from crops (left) and livestock (right). The error bars show 95% confidence interval.⁴⁴

According to the FAO, in 2012 India had the largest national herd in the world with 300 million cattle.⁴⁵ Carabeef is predominately raised in India. This specific type of beef is a lower quality beef that is marketed at a lower price, making it appealing to developing countries. Cattle production in India is the greatest emitters in the agriculture sector at about 150 MtCO₂e, drastically larger than any crop or another livestock production (Figure 5).

2.2 Beef Production Contributions & Reductions to GHG Emissions in India

2.2.1 Raising, Housing, and Feeding Cattle in India

India has limited agricultural land available and limited food available for grazing livestock. The high costs of feed supplementation and the scarcity of grasslands limit the feed options for cattle. Thus, cattle are fed crop residues, native herbage, and roughages.⁴⁶ Additionally, the low cost arising from non-intensive beef (carabeef) production helps to create more demand from South

agricultural greenhouse gas emissions through cost-saving farming practices," November 26, 2018. Accessed at: https://www.cimmyt.org/press_release/new-study-india-could-cut-nearly-18-of-agricultural-greenhouse-gas-emissions-through-cost-saving-farming-practices/.

⁴⁴ Tek B. Sapokta, et al, "Cost-effective opportunities for climate change mitigation in Indian agriculture," Science of The Total Environment, Vol. 655, March 10, 2019, pg. 1346. Accessed at: <https://www.sciencedirect.com/science/article/pii/S0048969718345819?via%3Dihub>.

⁴⁵ FAO, "Beef Cattle Production and Trade," pg. 70. Accessed at: www.fao.org/wairdocs/ilri/x5535e/x5535e03.htm.

⁴⁶ FAO, "Beef Cattle Production and Trade," pg. 70. Accessed at: www.fao.org/wairdocs/ilri/x5535e/x5535e03.htm.

East Asia for cheap beef.⁴⁷ Unlike Canada, India does not have large scale farms with the purpose of raising beef for market. The majority of the producers are in rural areas with few cattle, raising the animal primarily for the products it provides.⁴⁸ For example, in rural areas cattle is used for products such as milk, cheese, butter and less commonly for beef. However, some Muslim cattlemen raise cattle solely for beef despite the national views on beef. Beef production provides income for 58% of India's population.⁴⁹

2.2.2 Processing Beef and Food Waste

The Hindu faith is practiced by 79.8% of the Indian population.⁵⁰ Hindus believe that cows are sacred animals. According to their religion, they do not eat beef. Because of this religious belief, slaughterhouses in India must abide by strict guidelines.⁵¹ It is not surprising for people to be killed while bringing beef to slaughter due to these religious perspectives. Religious tensions within the nation have caused the government, The Hindu Nationalist Party, led by Narendra Modi, to tighten 'cow protection laws.' This disrupts the country's traditional livestock economy and left many without work.⁵² The protection laws have led to a 15% decrease in India's \$4 billion beef export industry.

2.3 Role of Exports in the Beef Industry in India

India's exports continue to increase, due to regional demand for cheaper beef from developing markets in South East Asia, and Africa.⁵³ India's herd of 300 million cattle provides excellent supply to respond to the high export demand. Beef exports from India account for nearly 20% of the world's beef exports, due to the limited in-country consumption.⁵⁴ Since 2009, India's beef exports have continued to climb steeply (Figure 6). The beef exported, both chilled and frozen,

⁴⁷ Ibid., pg. 65.

⁴⁸ Ibid., pg. 70.

⁴⁹ India Brand Equity Foundation, "Agriculture in India: Information about Indian Agriculture & It's Importance," Accessed at: <https://www.ibef.org/industry/agriculture-india.aspx>.

⁵⁰ Aljazeera, "Hindus drop below 80 percent of India's population," August 26, 2015. Accessed at: <https://www.aljazeera.com/news/2015/08/hindus-drop-80-percent-india-population-muslims-census-150826052655585.html>.

⁵¹ Annie Gowen, "Cows are sacred to India's Hindu majority. For Muslims who trade cattle, that means growing trouble," July 16, 2018. Accessed at: https://www.washingtonpost.com/world/asia_pacific/cows-are-sacred-to-indias-hindu-majority-for-muslims-who-trade-cattle-that-means-growing-trouble/2018/07/15/9e4d7a50-591a-11e8-9889-07bcc1327f4b_story.html?utm_term=.624e187f3b92.

⁵² Ibid.

⁵³ "Beef Cattle Production and Trade," pg. 71.

⁵⁴ World Atlas, "The World's Largest Exporters Of Beef." Accessed at: <https://www.worldatlas.com/articles/the-world-s-largest-exporters-of-beef.html>.

is delivered to more than 60 countries. Most of the beef is deboned, and frozen meat accounts for 97% of the meat exports from India.⁵⁵

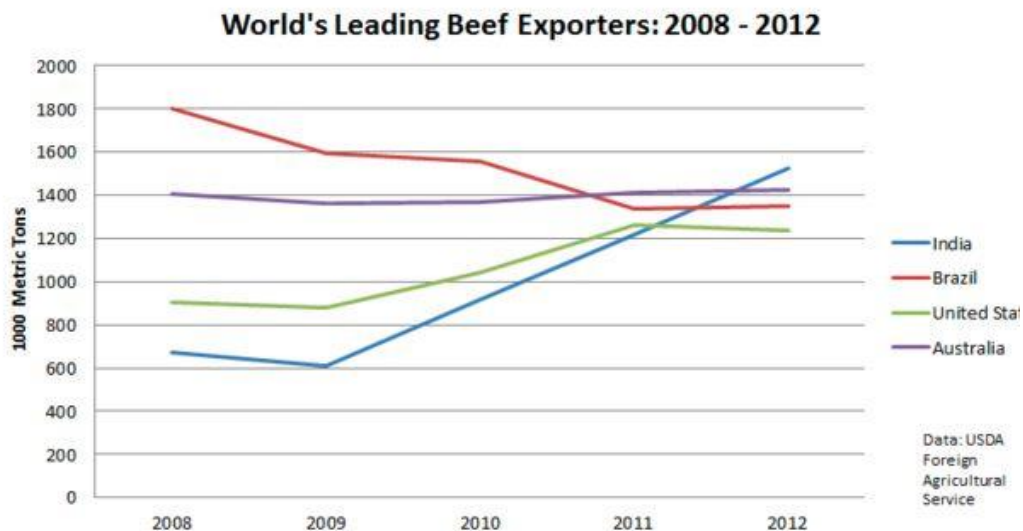


Figure 6 - World's Leading Beef Exports: 2008-2012⁵⁶

Conclusion

The message that beef production is detrimental to the environment because of its production of GHGs continues to reverberate across various media. Measures to eliminate beef production are demanded by bloggers, consumers, and even some academics. But the beef sector is already reducing GHG emissions. Environmental progress continues to be made in the beef sector, through the adoption of new mitigation strategies.

Through continual improvements, innovation and commitment of Canadian beef producers, Canadian beef is one of the lowest GHG emitters per unit of production in the world (12.0 kg CO₂ equivalent per kilogram of live weight, 2013).⁵⁷ Canada has continued to see progress since 1981 when the production of beef emitted 14.0 kg CO₂e per kilogram of live weight. Today, Canada's mitigation strategies such as reducing food processing waste, improved animal genetics, and

⁵⁵ Rajesh Kumar, Sushil Prasad, and Sanjit Kumar, "Present Status of Indian meat Industry – A Review," *International Journal of Current Microbiology and Applied Sciences*, Special Issue 7, pg. 4632. Accessed at: <https://www.ijcmas.com/special/7/Rajesh%20Kumar3,%20et%20al.pdf>.

⁵⁶ USDA, "Livestock and Poultry: World Markets and Trade, October 11, 2018. Accessed at: https://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf.

⁵⁷ "Beef Industry Strategies for Reducing Greenhouse Gases and Building the Green Economy," pg. 3..

various producer-based initiatives have led the way in reducing GHG emissions resulting from beef production.

India, in comparison, is one of the largest beef exporters and has yet to start making significant reductions in GHG emissions. India continues to lag behind Canada, although India has the potential to be successful in mitigating its GHG emissions in beef production as well. While it is difficult to obtain metrics on current or historical GHG emissions from India's beef production, in 1990 the total agricultural emissions were 364461.6 gigagrams CO₂e. In 2014 GHG emissions had risen to 406622.4 gigagrams CO₂e. The drastic increase in GHG emissions can be attributed to India's growth in production from 2.6 million tonnes in 1980 to 3.643 million tonnes in 2012. While production is increasing, efficiency is not, and no notable reduction of GHG emissions have been made.

India might look to Canada for guidance to encourage its beef producers to adopt new technologies and practices to reduce GHG emissions. Better land management practices such as improved water management and rotational grazing would reduce India's GHG emissions.⁵⁸ The decision to reduce GHG emissions needs commitment not only from the farmers but government and stakeholders. Canada exemplifies success in mitigating GHG emissions and engagement for continual progress.

⁵⁸ Climate Change, Agriculture and Food Security, "Climate change is affecting grazing lands," February 22, 2018. Accessed at: <https://ccafs.cgiar.org/news/climate-change-affecting-grazing-lands#.XJou0ZhKjIU>.