

NATIONAL BEEF SUSTAINABILITY Assessment & Strategy 2014 – 2021







Advancing, measuring and communicating continuous improvement in the sustainability of the Canadian beef value chain.

Recommended citations:

Canadian Roundtable for Sustainable Beef (CRSB). (2024). National Beef Sustainability Assessment and Strategy summary report. Calgary, AB.: CRSB.

Abbreviation: (CRSB NBSA, 2024)

Note: The National Beef Sustainability Assessment is not intended to compare or rank beef production practices or systems. Rather, its sole intention is to provide a benchmark of the social, economic and environmental performance of the entire Canadian beef industry, and should be considered in its entirety:

- Canadian Roundtable for Sustainable Beef. (2024a). *National Beef Sustainability Assessment: Environmental and Social Assessments*. Calgary, AB: Groupe AGECO. (CRSB NBSA, 2024a).
- Canadian Roundtable for Sustainable Beef. (2024b). *National Beef Sustainability Assessment: Economic Assessment*. Calgary, AB: Canfax Research Services. (CRSB NBSA, 2024b).

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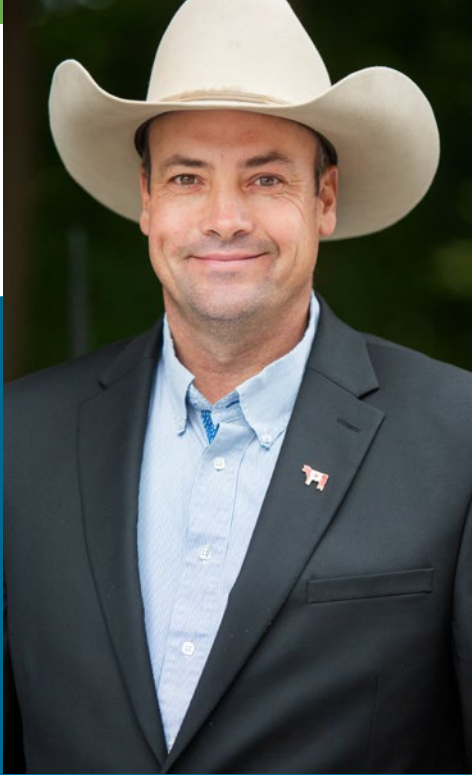
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MESSAGE FROM THE CHAIR

Canada's agri-food system is respected world-wide, and I am proud of the outstanding leadership the Canadian beef industry has demonstrated in advancing sustainability - regionally, nationally and on the international stage. As a beef producer, I know that we raise our beef in a responsible, sustainable way in Canada, and I am immensely proud of the improvements the industry has accomplished by working together. The CRSB's National Beef Sustainability Assessment is a key tool in demonstrating performance and progress on our sustainability journey.

The sustainability of the agri-food system continues to be of growing importance, and we know that Canadian consumers are looking for safe, affordable, nutritious, high-quality food that is raised in an environmentally sound and socially responsible way, based on sound science. At the same time, we also need to support the economic viability and resilience of the farmers, ranchers, workers, value chain actors and all those involved in bringing food to the table.

The Canadian Roundtable for Sustainable Beef published its first National Beef Sustainability Assessment in 2016, which provided a baseline from which to measure progress. The sustainability performance baseline and outcomes from that study have been incredibly valuable for the whole Canadian beef industry to build trust, inform policy, and communicate our sustainability stories from across Canada. A Sustainability Strategy accompanied the assessment, and identified areas for the Canadian beef value chain to make improvements. This second assessment highlights many areas where significant progress has been made, and key areas where there is more work to do.

“

I am proud of the Canadian beef industry’s commitment to continuous improvement, and the progress made already on our sustainability journey. The 15% reduction in greenhouse gas emissions to produce 1kg of beef since 2014, and the important role of Canadian beef producers in storing 1.9 billion tonnes of carbon in Canada are just two of the results that excite me about what we have accomplished together. ”



The CRSB’s first Sustainability Strategy set 10 key goals, which formed a strong basis from which the industry came together to establish a suite of robust, ambitious 2030 goals across diverse priority areas of focus. These goals highlight the role of the Canadian beef sector as integral for climate change mitigation, conserving biodiversity and our natural ecosystems, supporting people and communities, embracing innovation, and our contribution to a sustainable food system. This assessment marks the mid-way point towards these goals, and the urgency to work together is more important than ever.

We see sustainability as a continuous journey - not a destination. Our strategy’s key priorities and actions identified and highlighted throughout this report are intricately linked with the Canadian beef industry’s 2030 goals and outline the path on our journey of improvement. We are lucky to have such a dedicated and diverse group of members and partners working with us on this journey, and I look forward to working together and achieving these goals in the years to come.

Sincerely,

Ryan Beierbach
Chair, CRSB



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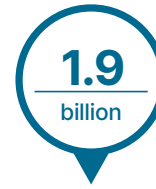
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in GHG emissions intensity since 2014 (on track for 33% reduction by 2030)



Tonnes total soil organic carbon in land used for beef production



Increased habitat capacity attributed to land used for beef production

EXECUTIVE SUMMARY

The Canadian Roundtable for Sustainable Beef (CRSB)'s National Beef Sustainability Assessment (NBSA) measures the Canadian beef value chain's environmental, social and economic sustainability performance and progress against an initial baseline of indicators and metrics approximately every seven years.

The first NBSA was published in 2016 utilizing data from 2014, which provided a baseline for evaluating progress and improvements over time. This second study is the first to measure changes against that baseline, utilizing data from 2021, and serves as a benchmark and a half-way point as the industry works towards its 2030 goals.

In the interval of 2014 to 2021, there have been improvements in the majority of environmental indicators (carbon footprint, fossil fuel depletion, water consumption, agriculture land occupation and freshwater eutrophication). These improvements are driven by increased efficiency in beef production signaled by higher cattle end-weights and shorter production periods. This ultimately means that more beef is now being produced from the same number of animals, while requiring fewer resources. Greenhouse gas (GHG) emissions intensity reduced by 15% (per kg boneless beef, consumed) since 2014, and with the 2030 beef industry goal of a 33% reduction in GHG emissions intensity, we are on track towards achieving that goal. The total soil organic carbon (SOC) is estimated at 1.9 billion tonnes in land used for beef production in Canada, with a large proportion (84%) attributed to pastureland. This showcases the importance of preserving that land as it has the highest capacity to store carbon and promote biodiversity in agricultural areas. While the overall habitat capacity on cropland and pastureland has decreased due to land use change (LUC), the contribution of habitat capacity attributed to land used for beef production increased since 2016. Maintaining agriculture land occupied by beef cattle on native grasslands and pasture is vital to supporting biodiversity and storing SOC.



..More beef is now being produced from the same number of animals, while requiring fewer resources.

Within each region, eastern and western beef production both decreased their [blue] water consumption since 2014. The proportion of national beef production has grown in western Canada. When accounting for this shift, the national [blue] water consumption value has increased slightly (+ 0.4%), as more irrigation is used in this region.

The social assessment made key observations in the life cycle of Canadian beef production, identifying strengths and how to manage the risks and challenges regarding labour management, people's health and safety, animal care and antimicrobial use (AMU). The assessment indicated that labour availability, recruitment and retention are increasing workload levels with potential negative repercussions on people working in the industry. However, it is recognized that there is broad awareness and efforts being made across sectors to address workload levels and integrate innovative approaches to reduce risk. Health and safety are also identified as an area that can be overlooked and where more dedicated efforts are needed. Producers are experiencing high levels of physical and mental stress; on a positive note, awareness and the stigma around mental health are improving.

Animal care is a success story in Canada, and many federal regulations and industry standards (e.g. Code of Practice for the Care and Handling of Beef Cattle) play a role; increased coordination and communication across areas within the beef supply chain are areas for improvement to fully secure animal care throughout the cattle life cycle. Antimicrobial use is important to the industry and its stakeholders. There are good practices currently being utilized by producers to ensure responsible use. Further training would be



84% of land used for beef production is pastureland



Animal Care is a success story in Canada



Broad awareness and efforts being made to address workload levels



Consumer demand in Canada and globally has remained strong

beneficial to drive continuous improvement. Room for improvement also exists with respect to the adoption of management practices associated with AMU, including further reduction of stressors and increased access to veterinarians in some regions.

The economic sustainability of the Canadian beef industry has undergone many supply and demand shocks including the COVID-19 pandemic and widespread severe drought in 2021. The resilience and ability to shift according to market conditions resulted in increased off-farm income and a growing feedlot sector despite high feed prices. Inflationary pressures have increased the cost of inputs faster than cost of outputs, but consumer demand here in Canada and globally for protein remains strong with a preference for high-quality beef.

The National Beef Sustainability Strategy is aligned with, and supports achievement of, the beef industry 2030 goals. The applicable goals are re-iterated, and the key performance indicators (KPIs) and action items are dispersed throughout this report labelled Strategy. The strategy includes an overarching goal of continuing to build on the CRSB's collaborative, engaged beef sustainability community.

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ABOUT THE CANADIAN ROUNDTABLE FOR SUSTAINABLE BEEF



Formed in 2014, the Canadian Roundtable for Sustainable Beef (CRSB) has created a collaborative community to make continual progress in the sustainability of the Canadian beef value chain.

The CRSB is a member of the Global Roundtable for Sustainable Beef (GRSB). The CRSB has adopted the same definition and guiding principles of beef sustainability as developed by the GRSB, and is an active member of its committees and working groups.

Figure 1 • Guiding Principles of Beef Sustainability



While economic viability is not identified as a specific guiding principle, it is rather a triple bottom line approach, underpinned within all of these areas, necessary to achieve true sustainability in the Canadian beef system.



OUR MISSION To advance, measure and communicate continuous improvement in sustainability of the Canadian beef value chain.

OUR VISION That the Canadian beef value chain is a global leader in environmental, social and economic sustainability and part of a trusted and thriving food system.

WHAT IS SUSTAINABLE BEEF?

A socially responsible, environmentally sound and economically viable product that prioritizes the *planet, people, animals and progress.*

Figure 2 • The four pillars of CRSB's mission



The CRSB is a membership based, not-for-profit organization. With over 100 members, the CRSB delivers on its mission through its four pillars of work (Figure 2):

- ✓ Measuring and benchmarking the Canadian beef industry's sustainability performance.
- ✓ Collaborating with members, stakeholders and partners on key projects and initiatives.
- ✓ Developing a world class 3rd party audited Certification program – first of its kind for beef sustainability in world.
- ✓ Communicating our continual progress encompassing all five guiding principles of beef sustainability - with industry stakeholders and to the Canadian public. Central to that message is that cattle are a key tool and integral as a climate solution.

CRSB membership is diverse and spans the Canadian beef value chain from farm to fork, and beyond. Voting members represent Beef Producer Associations, Beef Processors and Associations, Retail and Food Service companies, Non-Governmental Organizations (NGOs) such as conservation, forage, environmental and animal care groups, and agriculture and food businesses that work with, and support the Canadian beef industry. Non-voting members and observers include academic institutions, individual beef producers, non-livestock producer associations, and others who support our mission, vision and principles. Scientific researchers provide subject matter expertise, and youth, government representatives and others also engage in and support the work of the CRSB.

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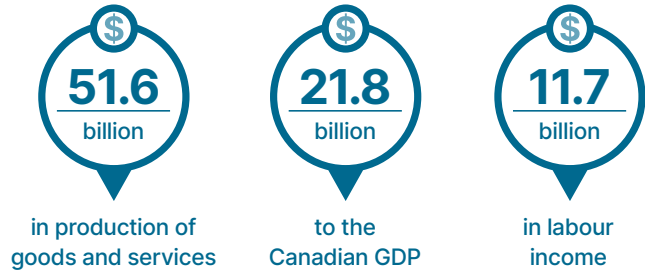
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The Canadian cattle industry contributes



SNAPSHOT OF THE CANADIAN BEEF INDUSTRY

The Canadian beef industry contributes to the Canadian agricultural and food landscape. Integrated across the country, beef producers raise cattle in every province on 60,000 beef farms and ranches, including cow-calf, background and feedlot operations.¹

Cow-calf operations, that sell cattle into background and feedlot operations, tend to have smaller herd numbers as they utilize extensive rangelands across the country. The average cow-calf herd is 69 mother cows.¹

Feedlots, where cattle are finished on a high-grain diet, are larger operations, typically ranging from 500-20,000 head. While beef cattle herds are spread across Canada, feedlot production is predominantly focused in western Canada. Canada had a total of 10.8 million beef cattle on July 1st, 2021. The national beef herd spans every province across Canada: British Columbia (4%), Alberta (49%), Saskatchewan (24%), Manitoba (9%), Ontario (9%), Quebec (4%), and in the Atlantic (1%).¹

Canada produces high-quality, predominately grain-finished beef from a base herd mainly of *Bos taurus* breeds (i.e., Angus, Hereford, Shorthorn, Galloway, Charolais, and Simmental), originating from Europe. These two main contributing factors support the production of high-quality products and enable Canadian producers to sell into 53 markets around the world², making Canada the 8th largest exporter of boxed beef.³ The Canadian cattle industry contributes \$51.6 billion in production of goods and services, \$21.8 billion to the Canadian Gross Domestic Product (GDP) and \$11.7 billion in labour income annually.^{4,5}

1. *Statistics Canada, Census of Agriculture (2021).*
2. *Statistics Canada, International Trade Data (2022b).*
3. *United States Department of Agriculture, Production, Supply and Distribution (Online).*
4. *Kulshreshtha, S., & Nagy, C. (2021). Economic Impacts of Cattle in Canada – A Regional Multiplier Analysis*
5. *Canadian Cattle Association (2023).*

Figure 3 • The distribution of beef [mother] cows across Canada by census division
 (Adapted from Statistics Canada, Census of Agriculture, 2021)

1 dot = 2500 animals

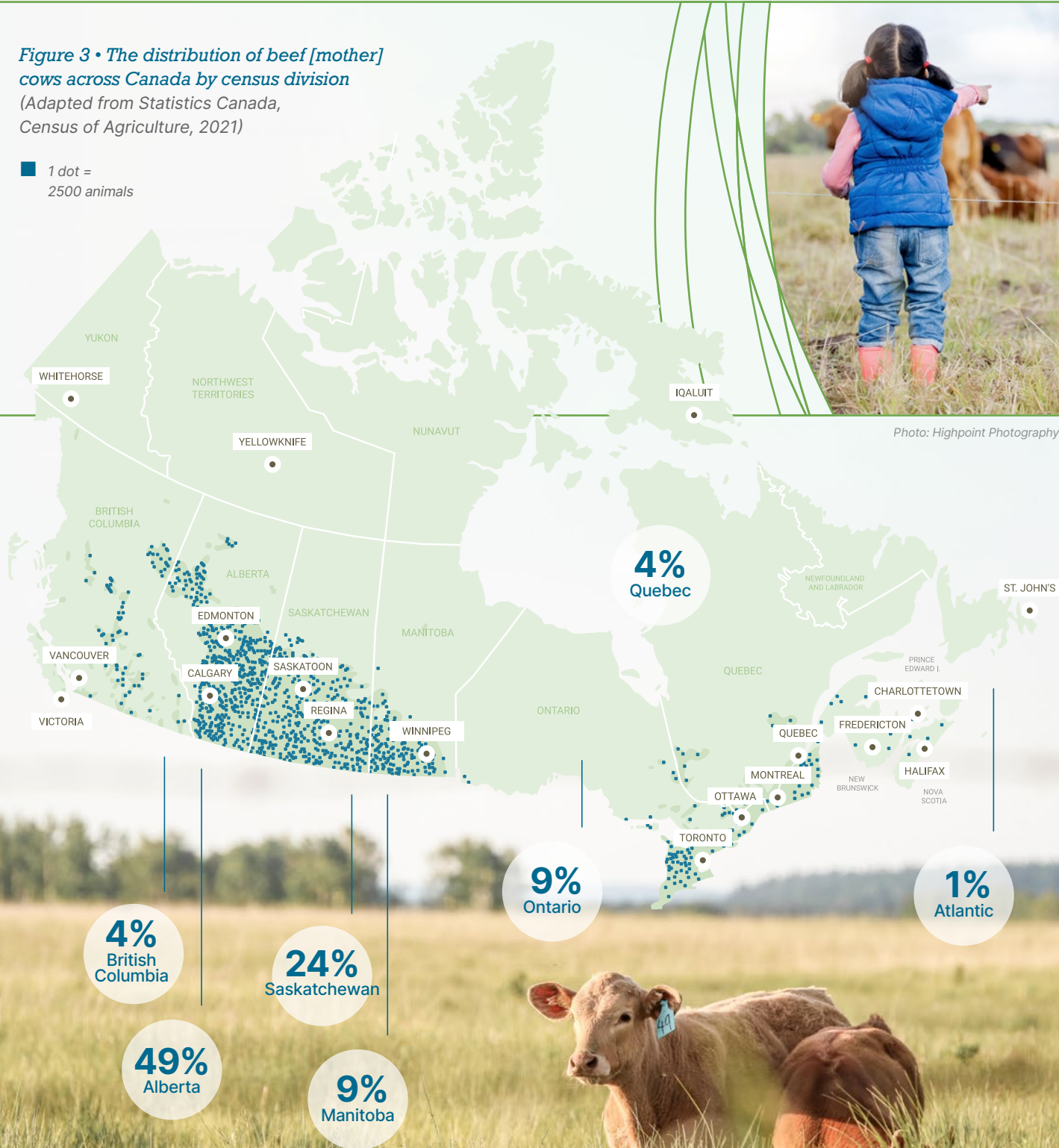


Photo: Highpoint Photography

Percentages of cattle distribution across Canada includes cattle from all beef operations (July 1st, 2021)

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2030 BEEF INDUSTRY GOALS

These goals highlight the role of the Canadian beef sector as integral for climate change mitigation, conserving biodiversity and our natural ecosystems, supporting people and communities, embracing innovation, and our contribution to a sustainable food system.

In 2015, the Canadian beef industry released its first five-year National Beef Strategy, with a mission to be the most trusted and competitive high-quality beef cattle producer in the world recognized for our superior quality, safety, value, innovation and sustainable production methods. A National Beef Strategic Plan was developed with the aim to achieve targeted industry goals that are aligned with the industry's vision and mission under four key pillars: connectivity, productivity, competitiveness and demand. The pillars identified key areas of focus where industry stakeholders will work together to collectively achieve the outcomes identified, with various facets of sustainability embedded throughout. This strategy was updated for 2020-2024, and the need for longer term goals with key actions, key performance indicators and plans to achieve them was identified as a priority. Coupled with the 2016 National Beef Sustainability Assessment and Strategy, the industry was well-positioned to work together to develop a suite of long term (10-year) goals looking towards 2030.

Through an iterative process the industry has now identified a suite of ambitious ten-year goals that will provide positive and clear messaging about the process to continually improve practices, product quality, enhance natural environments and utilize technologies to benefit people health, safety and profitability. The process included a literature review, stakeholder interviews with researchers, subject matter experts, veterinarians and producers, and engagement across the beef value chain and CRSB membership that provided feedback on what was feasible for industry to accomplish. This process evaluated past performance and recognized that progress came from multiple small incremental improvements across the system as a whole, and acceleration due to technology, adoption and new opportunities. Where feasible, scenarios were provided that included a continuation of historical trends and potential breakthroughs.





The result was a robust suite of ambitious, long-term goals addressing a diverse range of key topic areas and demonstrates how we are collaborating to address continual improvement.

The Canadian beef industry has committed to the following goals:

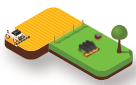
1

Greenhouse Gas Emissions and Carbon Sequestration

Reduce the primary production GHG emissions intensity by 33% by 2030.

Safeguard the existing 1.5 billion tonnes of carbon stored on lands managed with beef cattle, and sequester an additional 3.4 million tonnes of carbon every year.

Reduce food loss and waste (from second processing to consumer) by 50% by 2030.



2

Land Use & Biodiversity

Maintain the 35 million acres of native grassland in the care of beef producers by focusing on economic viability of producers and supporting programs that incentivize conservation.

Maintain a network of natural landscapes and healthy functioning ecosystems through well-managed grazing systems that maintain sustainable plant communities and healthy rangelands:

- Maintain and enhance the 68% of wildlife habitat capacity
- Enhance the ecosystem services
- Encourage practices that build soil organic matter and enhance soil biodiversity

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Water and Soil Quality

Promote practices that maximize water quality and retention, to deliver healthier landscapes, resilience to drought and flood events, and groundwater recharge as appropriate to the region's precipitation.

Improve water use efficiency in the beef value chain.

Build recognition by the public and policy-makers of the benefits provided by grassland ecosystems, including:

- *Protection of wetlands*
- *The role of wetlands as important carbon sinks*
- *Filtration of nutrients that protect water quality and reduce non-point source pollution*
- *Resilience to drought and flood events*
- *Support groundwater recharge and future water supplies*

People's Health & Safety

Create a culture of safety across the beef industry supply chain.

Reduce serious, fatal, and fatigue-related incidents by 1.5% per year up to 2030, by supporting education, awareness and improvements in farm and ranch safety.



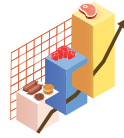
5

Animal Health and Welfare

Ensure the five freedoms of animal wellbeing by increasing adoption of on-farm management practices.

Ensure the effectiveness of existing and future antimicrobials is preserved to support human and animal health and welfare.

6



Beef Quality and Food Safety

Establish the inherent quality and value of Canadian Beef in domestic and export markets which supports comparative equivalency or superiority to alternatives.

Increase the value of AAA and Prime carcasses, to be equivalent with the US, by building demand for all cuts on the carcass.

Remove internal regulatory impediments to innovation, export and commercial trade and the competitiveness of Canadian beef in domestic and international markets.

Support the development, regulatory approval and adoption of improved food safety interventions and technologies throughout the supply chain.



7

Technology and Innovation

Improvements in speed, reliability, accuracy, and cost-effectiveness of traceability solutions that advance both business and regulatory objectives.

Supporting functional information flow solutions to producers derived from a competitive service sector.

Invest in technological solutions that reduce costs, improve competitiveness and enable regulatory approvals and business functions that support trade and commerce.

Support innovation, research, refinement and commercialization of technologies throughout the supply chain that support economic viability and worker conditions.

Promote the acceptance of sustainable and safe beef production technologies by customers and regulators, in both domestic and international markets.

These Canadian beef industry's 2030 goals form the basis of the CRSB Sustainability Strategy, and you will see them embedded throughout this report.

The 2030 goals also inform the Beef Cattle Research Council's National Beef Research and Extension Strategy for 2023-28.

The National Beef Strategy and the 2030 Canadian Beef Goals process are overseen by the Canadian Beef Advisors, comprised of the seven National Beef Organizations (Figure 4) supporting the beef industry in Canada.

Learn more about the industry's 2030 goals at <https://beefstrategy.com/2030-goals.php>

Figure 4 • Seven National Beef Organizations Comprising the National Beef Advisors.



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UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs) are a call for action by all countries to work together to promote prosperity, well-being, and economic growth, while protecting the planet. They recognize that a balance of strategies are needed in a sustainable world, and the global food system plays an important role.

The United Nations (UN) 17 SDGs were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development which set out a 15-year plan to achieve the Goals.

By considering how the SDGs align with the work of the CRSB and our members, we can better demonstrate how our contributions to all aspects of sustainability – from environmental, social and economic perspectives – are contributing to progress on a global level.

The CRSB's National Beef Sustainability Assessment (NBSA) and Strategy, in conjunction with the Canadian beef industry's 2030 goals, align with a number of the UN's SDGs (Figure 5). To provide context, you will find them highlighted using the icons on the following page, throughout this report, where they align with the NBSA's metrics and strategy actions. For more information on the SDGs, visit <https://www.un.org/sustainabledevelopment/>.

Figure 5 • Overview of the Sustainable Development Goals of the United Nations



**GLOBAL
ROUNDTABLE FOR
SUSTAINABLE
BEEF**

The CRSB is an active member and regional roundtable of the Global Roundtable for Sustainable Beef (GRSB)'s network, and supports its vision of a world where beef is a trusted part of a thriving food system in which the beef value chain is environmentally sound, socially responsible and economically viable. The Canadian beef industry's 2030 goals are closely aligned with the GRSB's global goals, and CRSB is an active member of many of the working groups and initiatives around achieving those goals.



CLIMATE

Reduce the net global warming impact of beef by 30%



NATURE POSITIVE PRODUCTION

Ensure the beef value chain is a net positive contributor to nature



ANIMAL HEALTH & WELFARE

Provide cattle with an environment in which they can thrive through best practices

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ABBREVIATIONS, UNITS, AND DEFINITIONS



Abbreviations

AAFC	Agriculture and Agri-Food Canada
AM	Antimicrobial
AMU	Antimicrobial Use
CRSB	Canadian Roundtable for Sustainable Beef
E-LCA	Environmental Life Cycle Assessment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GRSB	Global Roundtable for Sustainable Beef
ISO	International Organization for Standardization
KPI	Key Performance Indicator
LMC	Land Management Change
LUA	Land Use Assessment
LUC	Land Use Change
NBSA	National Beef Sustainability Assessment
PPE	Personal Protective Equipment
SAC	Scientific Advisory Committee
SDGs	Sustainable Development Goals
S-LCA	Social Life Cycle Assessment
SOC	Soil Organic Carbon
UN	United Nations
UNEP	United Nations Environment Programme
VCPR	Veterinary Client-Patient Relationship
WHCI	Wildlife Habitat Capacity Index

Units

CH₄	Methane
CO₂	Carbon dioxide
CO₂ eq.	Carbon dioxide equivalent
eq.	Equivalent
g	Gram
kg	Kilogram
L	Litres
m²	Square metres
Ma	Million acres
Mt CO₂ eq.	Mega tonnes of carbon dioxide equivalent
N	Nitrogen
NH₃	Ammonia
NOx	Nitrogen oxides
Oil eq.	Oil equivalent
P	Phosphorus
P eq.	Phosphorus equivalent
SO₂ eq.	Sulfuric dioxide equivalent

Definitions

Agriculture land occupation Quantity of land used disturbing soil or habitat (m² annual crop eq.).

Animal care Physical and mental well-being of animals.

Antimicrobial use Use of antimicrobials for animal health in livestock agriculture.

Biodiversity Variety of life in a habitat or ecosystem.

Bunk capacity Maximum number of animals that can be housed in the feedlot at any given point in time.

Carbon footprint Greenhouse gas intensity (kg CO₂ eq.).

Carbon stock Quantity of carbon contained in a reservoir (soil).

Cover type classification of wildlife habitat:

Primary always used, critical or strongly preferred habitat;

Secondary often used, important habitat;

Tertiary occasionally used, low value habitat

Eutrophication Enrichment of aquatic ecosystems due to the release of nutrients leading to algae growth, depleting dissolved oxygen in water (g P eq.).

Food loss Food that is unfit for human consumption, occurring during post-harvest, transport, processing and packaging.

Food waste The waste of consumable food at the end of the supply chain (retail and the consumer).

Fossil fuel depletion Resources subject to extinction if extraction from the Earth's crust is greater than natural renewal (kg oil eq.).

Labour management Working conditions of employees and how they contribute to human health, sustainable workplaces and communities.

Live weight Weight of an animal before it has been slaughtered.

People's health and safety The promotion and maintenance of physical, mental, and social well-being and capabilities of all the individuals.

Photochemical oxidant formation Substances released that affect humans through acute toxicity, cancer-based toxicity, respiratory effects, increases in UV radiation or ecosystem quality causing damage to wildlife (g NOx eq.).

Terrestrial acidification Increasing acidity in soil (NH₃, NOx, SO₂ emissions) leading to degradation of aquatic ecosystems, and endangering species (g SO₂ eq.).

Terrestrial ecosystem Ecosystems found on land.

Water consumption Water used that is not returned to the same water body (L).

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Figure 6 •
The NBSA is within the Benchmarking and Goals Pillar of CRSB's mission



METHODOLOGY

WHAT IS THE NATIONAL BEEF SUSTAINABILITY ASSESSMENT?

The National Beef Sustainability Assessment (NBSA) represents CRSB's first core area of work: **Benchmarking and Goals** (Figure 6). The assessment is a comprehensive scientific study analyzing the sustainability performance of the Canadian beef industry encompassing the whole supply chain from three distinct perspectives: 1) environmental 2) social and 3) economic (Figure 7).

Two NBSAs have been completed by CRSB to-date. The first, published in 2016, utilizes data collected from 2013 and 2014 as its base year, but will be referred to as 2014 throughout this report for simplicity. The second, current assessment, published in 2024 utilizes data collected from 2021 as its base year. In order to compare metrics, the second assessment included a re-analysis of the 2014 base year as the methodology has been updated and improved. In this summary report, the 2021 and re-analyzed 2014 numbers are used for comparison purposes. This summary report contains data from the combined NBSA Environmental and Social Assessments⁶ along with data from the Economic Assessment.⁷

The entire project was guided by the CRSB's Scientific Advisory Committee (SAC) consisting of CRSB member representatives and subject matter experts (see Acknowledgements, [page 65](#)) and was reviewed by an external third-party panel of experts. A peer-reviewed scientific paper has also been published that complements this report.⁸

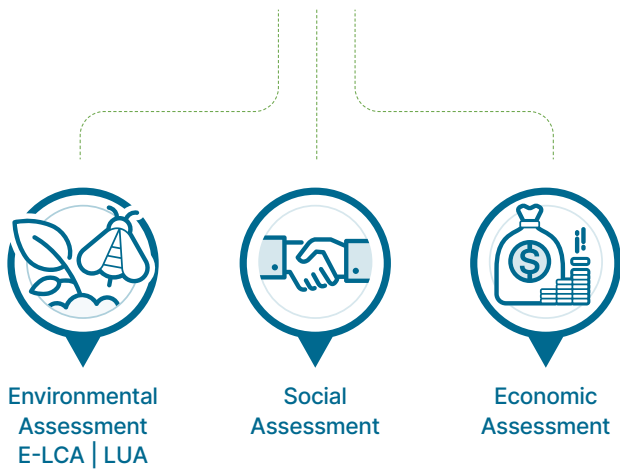
6. (CRSB NBSA, 2024a).

7. (CRSB NBSA, 2024b).

8. Aboagye et al., (2024). An Assessment of the Environmental Sustainability of Beef Production in Canada. *Canadian Journal of Animal Science*. (doi.org/10.1139/CJAS-2023-0077)

Figure 7 • The three main components of the NBSA

NATIONAL BEEF SUSTAINABILITY ASSESSMENT



Environmental Assessment

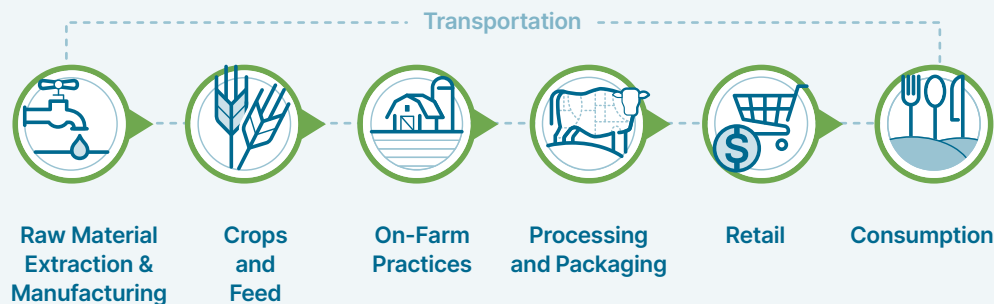


To measure environmental performance, an Environmental Life Cycle Assessment (E-LCA) and a Land Use Assessment (LUA) were performed.

The objective of the E-LCA is to provide a comprehensive update of the environmental indicators related to the beef industry while the LUA is to assess the ecosystem services provided through Canadian beef cattle production.

An **Environmental Life Cycle Assessment** is a tool used to assess the environmental performance of products, processes and services. It provides a comprehensive approach to understanding relationships and trade-offs between environmental and social impacts.

Figure 8 • Parameters used for analysis of the E-LCA
Emissions to air, land, and water (Reference Year: 2021)



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An E-LCA is widely recognized by industries, governments, and the scientific community. It is an internationally recognized method regulated by the International Organization for Standardization (ISO) to gauge environmental impacts (ISO 14040:2006/14044:2006). In this assessment, data sources included primary and secondary data. The primary data consisted of survey information from Canadian beef producers or from the previous CRSB assessment (CRSB, 2016). When primary data were not available, secondary data were obtained from the literature, expert opinion, life cycle inventory tools (i.e., Ecoinvent v3.7; Agri-footprint 5.0), and Canadian government databases (i.e., Statistics Canada).

E-LCA's major strength lies in its **holistic** approach, which includes all relevant environmental aspects of a product's life cycle, from birth through farm-gate to the plate (Figure 8) and is reflected within functional units used (Figure 9). An E-LCA therefore ensures that major environmental hotspots are considered, and relevant trade-offs are not omitted. This E-LCA examined Canadian beef production in the west (British Columbia, Alberta, Saskatchewan and Manitoba) and east (Ontario, Québec and Atlantic) and its impact on carbon footprint, fossil fuel depletion, [blue] water consumption, agricultural land use, freshwater eutrophication, terrestrial acidification, and photochemical oxidant formation potentials. More details regarding the parameters included in the E-LCA can be found in the associated peer-reviewed paper (Aboagye et al. 2024) as well as in [Appendix A](#).

Figure 9 • Functional units used in the E-LCA



FARM

1 kg
Live weight at the farm gate



PROCESSING PLANT

1 kg
Carcass weight

1 kg
Boneless meat



CONSUMER

1 kg
Boneless beef, consumed

100 g
1 serving of beef



Animal Care



Antimicrobial Use



Producer Viability



Consumer Resilience

The **Land Use Assessment** included impacts on biodiversity using the Agriculture and Agri-Food Canada (AAFC) Wildlife Habitat Capacity Index (WHCI) on Agricultural Land in Canada Agri-Environmental Indicator, potential water risks in cattle production regions based on the Aqueduct tool, an evaluation of carbon sequestration based on land management change (LMC) and land use change (LUC), and a qualitative evaluation of antimicrobial use (AMU) by cattle farmers.

The E-LCA was conducted by Groupe AGÉCO, consultants in agri-food analysis and strategy, and social and environmental responsibility. Improvements to the E-LCA model include feed/irrigation based on including the most representative Canadian datasets available, updated mortality and cattle culling rates, and irrigation on tame pasture – and a scenario including dairy. The LUA was conducted by Groupe AGÉCO in conjunction with AAFC.

Social Assessment



The social assessment evaluated the socioeconomic performance of Canadian beef production at different stages in its life cycle by assessing the social performance of organizations across the value chain to establish socioeconomic impacts with respect to main stakeholders and to different social issues. It provides an evidence-based assessment of the positive contributions as well as of the potential risks associated with the industry's activities with respect to four priority social issues: **Labour Management, People's Health and Safety, Animal Care, and Antimicrobial Use.**

The study used mixed methods in a stepwise approach informed by Social Life Cycle Assessment (S-LCA) guidance (United Nations Environment Programme; UNEP 2020). First, a **goal and scoping phase** was performed to identify priority issues; beef industry stakeholders (n = 39) were purposefully sampled to participate in a Q-sort method exercise. Second, a

social responsibility framework was developed to evaluate the degree of commitment of Canadian beef producers based on interviews (n = 15), on-farm (n = 333) and packer (n = 5) surveys and secondary data. Finally, 4 **deep-dives** were performed to provide an evidence-based assessment of how social issues of high priority are managed in a way that positively or negatively impact people and animals. This top-down, bottom-up iterative approach was used to best manage data availability and to provide an accurate picture of the sustainability performance of the Canadian beef industry. Together, the three phases provide an evidence-based assessment of the positive contributions and potential risks associated with beef production in Canada, as well as informing practical and action-oriented recommendations to improve the industry's performance over time.

The social assessment was conducted by CanFax Research Services and Groupe AGÉCO.

Economic Assessment



The 2021 economic assessment utilized the same framework as the 2014 assessment, with a focus on **resilience**. The framework to evaluate economic performance of the Canadian beef industry considers both **Producer Viability** and **Consumer Resilience**.

Four indicators are used as benchmarks: **Long-term profitability, long-term per unit cost of production, domestic consumer demand and international consumer demand.**

The economic assessment was conducted by CanFax Research Services, a team of expert analysts providing market and trend insights for the Canadian beef industry.

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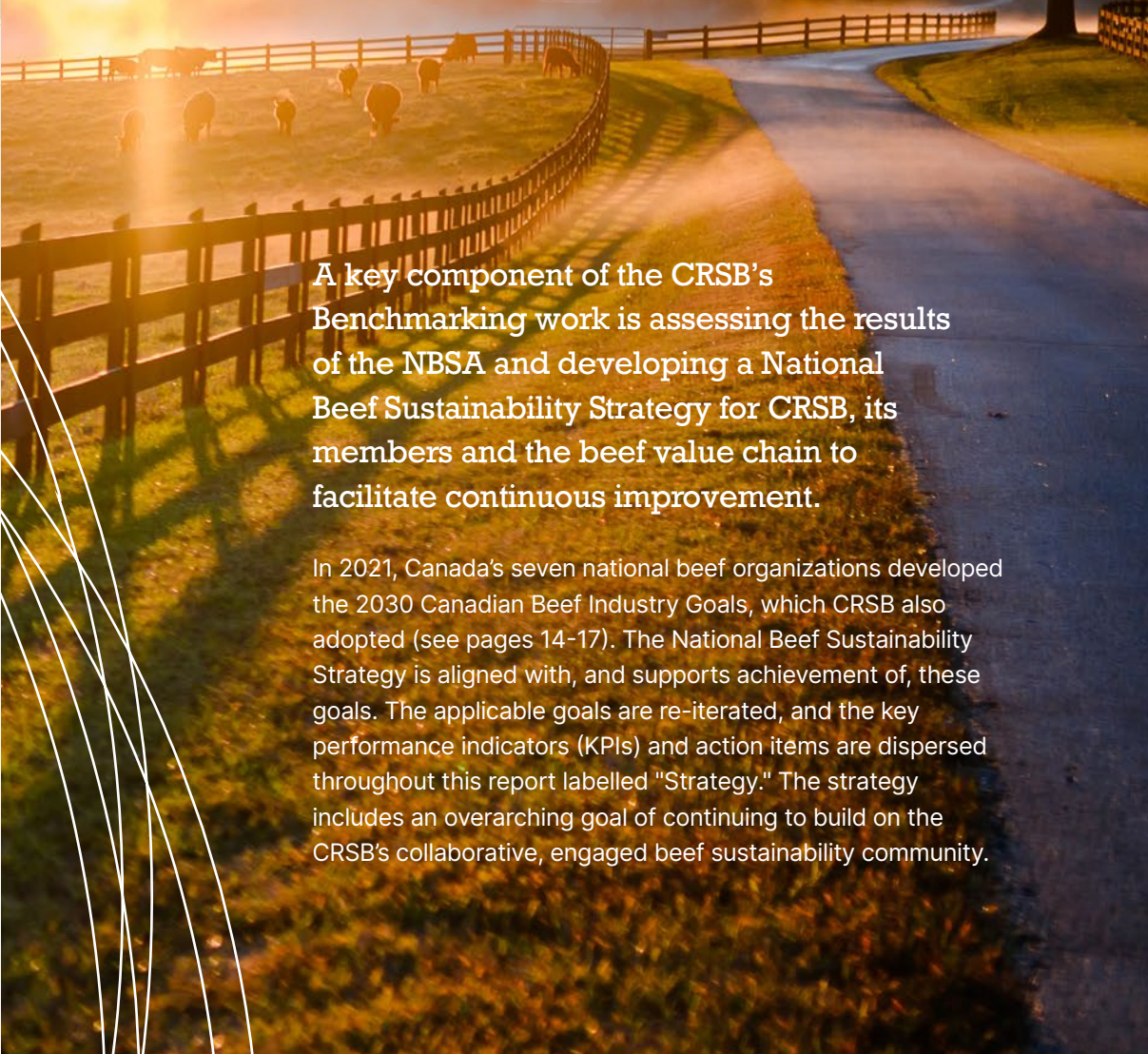
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NATIONAL BEEF SUSTAINABILITY STRATEGY



A key component of the CRSB's Benchmarking work is assessing the results of the NBSA and developing a National Beef Sustainability Strategy for CRSB, its members and the beef value chain to facilitate continuous improvement.

In 2021, Canada's seven national beef organizations developed the 2030 Canadian Beef Industry Goals, which CRSB also adopted (see pages 14-17). The National Beef Sustainability Strategy is aligned with, and supports achievement of, these goals. The applicable goals are re-iterated, and the key performance indicators (KPIs) and action items are dispersed throughout this report labelled "Strategy." The strategy includes an overarching goal of continuing to build on the CRSB's collaborative, engaged beef sustainability community.



STRATEGY Sustainability Community

GOAL Build on a collaborative, credible and aligned sustainability community in Canada.

KEY PERFORMANCE INDICATORS

- Number of CRSB Members [and Observers]
- Diversity of membership representation on CRSB Committees

PERFORMANCE

- ✓ As of June 30, 2023, the CRSB has 69 voting members, and many other observers and subject matter experts engaged in our work.
- ✓ Over 50% of our member organizations serve on CRSB Council and committees.

STRATEGIC ACTION ITEMS

1. Strengthen CRSB's reputation as the trusted organization for beef sustainability in Canada.
2. Build shared understanding of the balanced health of people, animals and the environment.
3. Establish and maintain strong relationships, partnerships and communication with the scientific community.
4. Further engage youth leaders in CRSB's work.
5. Inform and support information-sharing that advances the sustainability of the Canadian beef value chain.



Beef Producer Associations



Beef Processors and Associations



Retail and Food Service Sector



Non-Governmental Organizations



Agriculture and Food Businesses



Non-Voting Members

Academic Institutions • Individual Beef Producers • Other Supporters



30% increase in voting membership since 2016



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*Carbon Soil
Sequestration*

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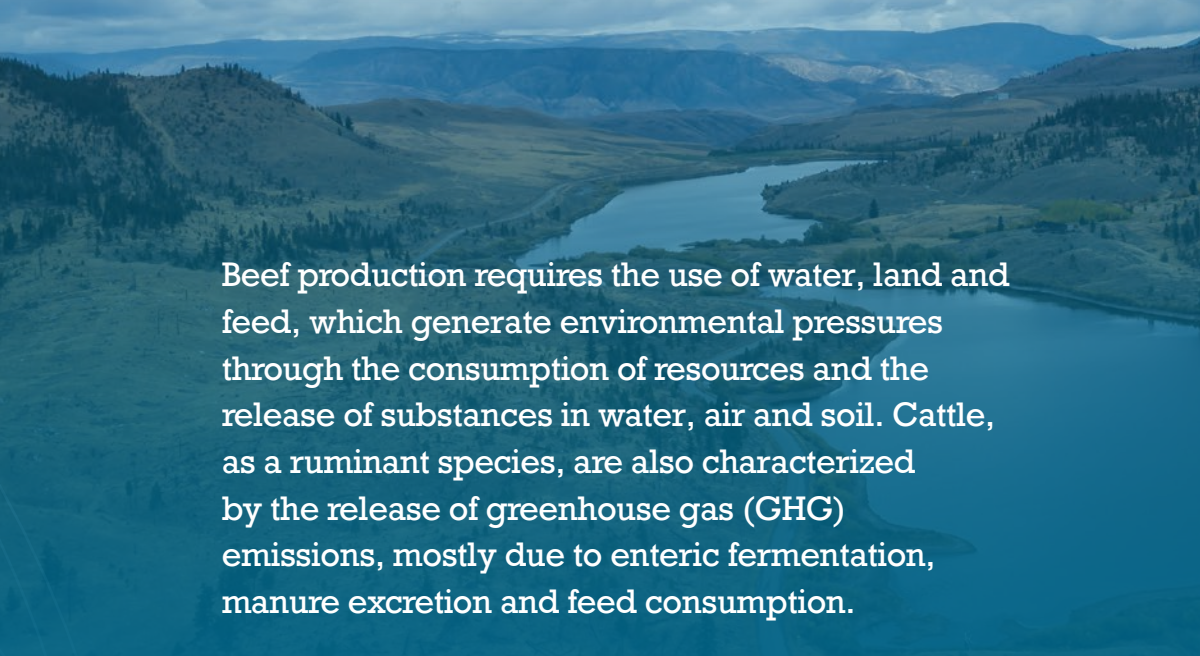
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ENVIRONMENTAL ASSESSMENT RESULTS



Beef production requires the use of water, land and feed, which generate environmental pressures through the consumption of resources and the release of substances in water, air and soil. Cattle, as a ruminant species, are also characterized by the release of greenhouse gas (GHG) emissions, mostly due to enteric fermentation, manure excretion and feed consumption.

The beef industry also supplies many ecosystem services such as sequestering carbon in the soil, providing natural habitat that supports biodiversity and maintaining wetlands on the landscape.

Beef producers are important stewards to maintaining and conserving these spaces and resources, which provide overall societal benefits for the environment.



Improvements in Farm Gate Indicators from 2014 to 2021

Compared to 2014, the Canadian beef industry improved its carbon footprint, fossil fuel depletion, freshwater eutrophication and photochemical oxidant formation.

Within each region, eastern and western beef production both decreased their [blue] water consumption since 2014. The proportion of national beef production has grown in western Canada. When accounting for this shift, the national [blue] water consumption value has increased slightly (0.4% or 7L), as more irrigation is used in this region.

These improvements were driven by increased efficiency in production signaled by higher end-weights and shorter production periods. Animals achieved higher end-weights, which allowed for a better feed to gain ratio.

More beef is now produced from the same number of animals and fewer resources are needed.

Additionally, a scenario modelled using data input from dairy animals contributing to beef product can be found in [Appendix B](#). The contributions of all areas across the supply chain can be seen in [Appendix C](#) for both Western and Eastern Canadian beef production. Results of all environmental indicators in all functional units can be found in [Appendix D](#).

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The initiatives in this section align with the following UN SDGs:



Carbon Footprint

The carbon footprint is determined by measuring the GHG intensity (kg CO₂ eq.) of the three main GHGs. These include methane (CH₄) from enteric fermentation and manure on pasture or during storage (manure management system); nitrous oxide (N₂O) from direct and indirect sources [nitrogen (N) leaching, runoff and volatilization], and carbon dioxide (CO₂) from energy use. The Canadian beef industry has made great strides in increasing its production efficiency to reduce its carbon footprint, which encompasses contributions from enteric methane, manure management and feed production, and from smaller contributors including transport, bedding, water, energy and grazing (Figure 10).

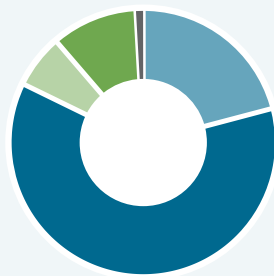


Figure 10 • Composition of factors contributing to the on-farm national carbon footprint of beef (live weight)

- Enteric Methane (61%)
- Feed (21%)
- Manure, Pasture (10%)
- Manure, Confined (7%)
- Transport (1%)

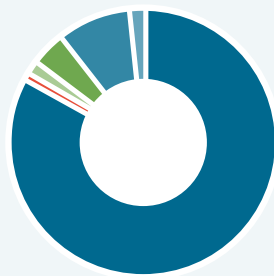


Figure 11 • Contribution of areas within the supply chain to the national carbon footprint (CO₂ eq./kg boneless beef, consumed) examined in the E-LCA

- Farming (83%)
- Retail (9%)
- Packaging (4%)
- Processing (2%)
- Consumption (1%)
- Transport (0%)

(Note: individual items may not add to the total due to rounding)

Since 2014 in Canada, producing 1 kg of beef (boneless and consumed), now creates 15% less greenhouse gases.

This 15% reduction in the carbon footprint (38.6 to 32.8 kg CO₂ eq./kg boneless beef, consumed) is attributed to increased beef cattle feed intake (dry matter basis) and efficiency, leading to faster growth and reducing the time needed for production of an individual animal – leading to a smaller carbon footprint.

The largest proportion of the carbon footprint occurs on-farm; however, all areas of the supply chain contribute to the total carbon footprint (CO₂ eq./kg of boneless beef, consumed; Figure 11), presenting various areas for mitigation opportunities.

Carbon Soil Sequestration

Estimations of carbon sequestration are complex and include many factors such as soil type, geography, land use history and weather. Agricultural and grazing management practices to sequester carbon can improve soil health, including stocking rate management, rotational, planned, or adaptive grazing, and when needed enclosure of grassland from livestock grazing.

LUC and LMC practices can further enhance soil carbon storage, offsetting emissions of beef production. If offsets are taken into consideration, the net carbon footprint of beef production in western Canada is estimated to decrease by 6% (10.5 to 9.9 kg CO₂ eq./kg live weight).

The total SOC (Mt) is estimated at 1.9 billion tonnes in land used for beef production. Land used for beef production is primarily pasture, followed by hay, barley production and other feed crops (see page 38). Of the land used for beef production, native grasslands contain over 40% and 66% more total soil carbon (Mt) at 30 cm depth than cropland and tame pastures, respectively, as there are more acres. Improved grassland management practices (such as rotational grazing) that increase net accumulation of carbon in grasslands are needed for their potential to minimize the rising concentration of atmospheric carbon dioxide.



Land used for beef production is estimated to **store nearly 40% of the total soil organic carbon (SOC)** stock on Canada's agricultural land.

Beef cattle production helps preserve **1.9 billion tonnes of carbon** in Canada.

Native rangelands and unimproved pasture are important in providing the highest capacity to sustain both carbon and biodiversity in agricultural areas.



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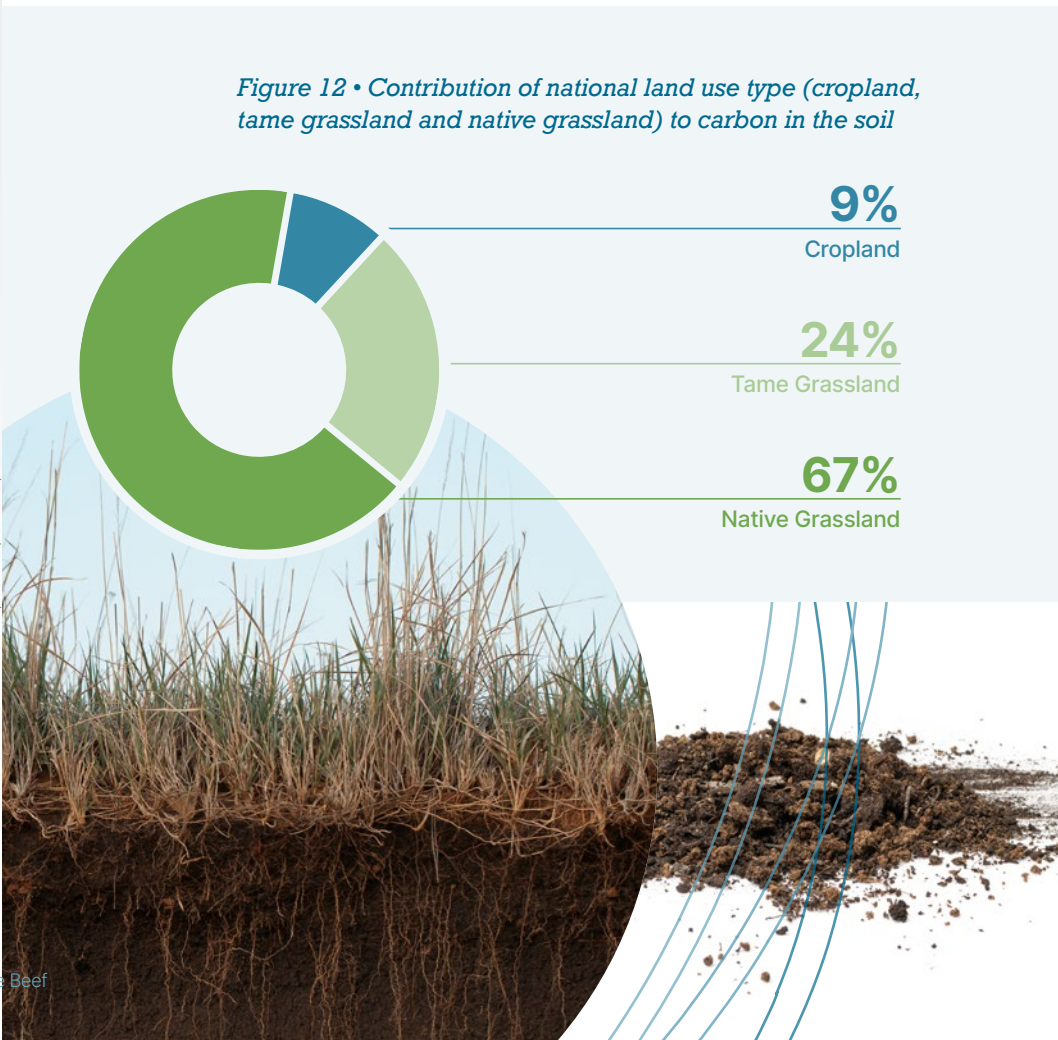
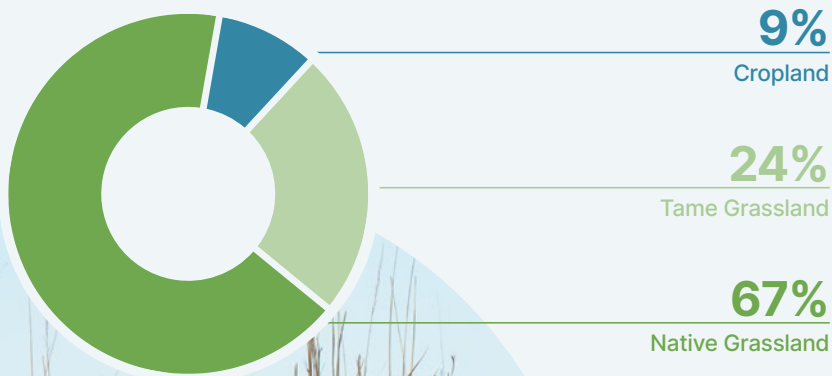
Appendix

Grasslands are a significant land resource in Canada and around the world. They have the ability to act as a carbon sink (Figure 12).

The carbon soil sequestration approach evaluated carbon emissions or storage due to LMC and LUC associated with Canadian beef production. Beef cattle production uses 40% (63.1 million acres or 25.6 million hectares) of the total agricultural land and represents 39% of the total carbon stock across the Canadian agricultural landscape. As the majority of land beef cattle use is pasture (see page 38), a nearly equal percentage of land (40%) to carbon stock (39%) highlights that the average carbon stock intensity is relatively similar in pasture and other agricultural land (cropland). However, as cropland uses higher quality soils, the initial carbon levels are much higher than that in native pasture making grazing cattle an important tool in improving carbon levels in the soil.

Grassland management can sustain and improve the health of grasslands and maintain SOC. Keeping native grasslands intact is vital in maintaining its carbon stock.

Figure 12 • Contribution of national land use type (cropland, tame grassland and native grassland) to carbon in the soil





STRATEGY Carbon Footprint and Sequestration

GOAL 1 Reduce primary production GHG emissions intensity 33% by 2030.

GOAL 2 Safeguard 1.5 billion* tonnes of carbon on land managed by beef producers.

GOAL 3 Sequester an additional 3.4 million tonnes of carbon every year.

KEY PERFORMANCE INDICATORS

- Carbon footprint intensity of Canadian beef (CO₂ eq./kg).
- Soil organic carbon (Mt) on land used for Canadian beef production.

2021 PERFORMANCE

- ✓ 32.8 kg of CO₂ eq./kg boneless beef, consumed
- ✓ 1.9 billion tonnes soil organic carbon stored on land used for beef production.

STRATEGIC ACTION ITEMS

1. Encourage research and collaboration to optimize cattle diets.
2. Promote implementation of practices to enhance manure management.
3. Collaborate with initiatives that work to safeguard carbon storage and increase carbon sequestration.
4. Collaborate with initiatives that support Improvements in feed and forage production.
5. Collaborate with initiatives that develop genetic selection tools that reduce GHG emissions.
6. Measure and disseminate the Canadian beef industry's GHG footprint and carbon stock.
7. Promote communication and knowledge transfer between the research community and producers to increase uptake of practices that reduce GHG emissions and improve carbon sequestration.

**Goal established in 2020, based on 2014 assessment value of 1.5 billion tonnes.*



↓ Producing 1 kg of beef (boneless and consumed) now creates **15% less** greenhouse gases than in 2014.



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The initiatives in this section align with the following UN SDGs:

Water

The beef industry's interaction with water was assessed in three different ways: [blue] water consumption, water quality and water risk.



The proportion of national beef production has grown in western Canada since 2014. When accounting for this shift, the national [blue] water consumption value has increased slightly (0.4% or 7L), as more irrigation is used in this region.

Within each region, eastern and western beef production both decreased their [blue] water consumption since 2014.

Reduced impact on water quality (Freshwater eutrophication) due to changes in feed rations.

Water consumption

Water consumption is measured by evaluating the volume of water (L) that is used but not returned to the same water body. The assessment indicated a blue water [irrigation, direct consumption by cattle and cleaning] reduction of **177 L/kg boneless beef, consumed in both eastern and western Canada**, mostly due to **increased feed efficiency** and **less feed needed** as irrigation and drinking levels remained stable.

Although reductions in water consumption were observed in both eastern and western Canada, the overall water consumption increased on a national scale (increase of 7 L/kg boneless beef, consumed). As the largest proportion of water consumption is on-farm (Figure 13) the major contributing factor was a 10% increase in beef production in the west in 2021 compared to 2014. Due to the drier climate, drought prevalence and severity in much of western Canada over this time period, more irrigated feed and land is needed resulting in a slightly higher overall blue water footprint.

The vast majority of water consumption in the beef value chain is from farming due to the ratio between live weight and processed beef. With a slight increase in water consumption at the processing stage in 2021, to reduce water consumption beyond the farm-gate, reduction of meat waste throughout the supply chain is also required.

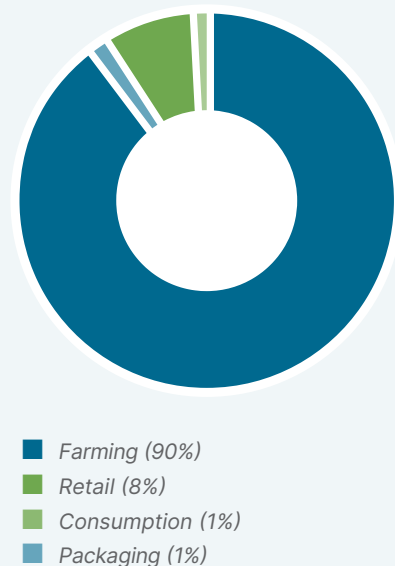


Irrigation is attributed to at least 99% of [blue] water consumption, and 90% of all irrigation is in western Canada, totalling 860,000 hectares according to the 2020 Agricultural Water Survey⁹. E-LCAs do not account for green water (rainfall or naturally occurring water); therefore, the context for the water consumption metric accounts for the lower precipitation levels, as beef cattle production typically occurs on drier lands, where growing crops is not as feasible. **As a result, it is expected that areas of high beef cattle production coincide with risks of drought and competition between users.**

The water risk assessment revealed that the highest drought risks coincided with areas of high cattle density in the Prairies. Saskatchewan, parts of Alberta, and southern Manitoba are especially at risk. Southern Saskatchewan had the majority of drought risk in 2021, increasing water competition in this area. A significant risk of variability year to year is present across the country; however, most of it does not coincide with areas of high cattle concentration. **When considering baseline water depletion, drought risk and interannual variability, most cattle production in Canada does not coincide with areas of high risk and this is truer in 2021 than it was in 2014.**

Furthermore, water consumption values in Canada are extremely efficient compared to the global scale and are less than values reported in other beef producing countries, largely due to efficient irrigation practices here in Canada. Although Canada has highly efficient water consumption values, promoting further improvement in irrigation practices remains important.

Figure 13 • Contribution of areas within the supply chain to national water consumption (L per kg boneless beef, consumed) examined in the E-LCA



Water quality:

Freshwater Eutrophication

The eutrophication potential (g P eq.) measures the increase of nutrients in an aquatic ecosystem resulting from natural or human activity, leading to excessive algae growth, which then depletes oxygen levels in the water. Freshwater eutrophication reduced by 3.9 g P eq./kg boneless beef, consumed: 25%, due to changes in feed rations.

9. Agricultural Water Survey (2020).

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STRATEGY Water

- GOAL 1** Promote practices that maximize water quality and retention, to deliver healthier landscapes, resilience to drought and flood events, and groundwater recharge appropriate to the region's precipitation.
- GOAL 2** Improve water use efficiency in the beef value chain.
- GOAL 3** Build recognition by the public and policymakers of the benefits provided by grassland ecosystems.

KEY PERFORMANCE INDICATORS

→ Blue water footprint intensity.

2021 PERFORMANCE

Water footprint:

- ✓ 1912 L blue water / kg boneless beef, consumed
- ✓ 657 L blue water / kg (live weight)

Water quality:

- ✓ 3.9 g P eq. / kg boneless beef, consumed

STRATEGIC ACTION ITEMS

1. Build further beef producer understanding, awareness and use of riparian health assessments by supporting organizations that are enhancing awareness and promoting adoption of tools.
2. Collaborate with stakeholders to further measure the relationship between beef production and wetland conservation, and the associated ecosystem services being provided.
3. Partner with organizations that deliver producer extension to encourage uptake of practices to preserve wetlands.
4. Build awareness about the limitations in water risk assessments and the importance of local context when interpreting the results, both nationally and internationally.
5. Support innovation that increases water use efficiency within the processing and packaging sectors.
6. Support improvement in feed yields/productivity, drought resistance and irrigation practices to reduce the blue water footprint of feed.



Producing 1 kg of Canadian beef (boneless and consumed) **uses 177 L less blue water** in both eastern and western Canada than in 2014.



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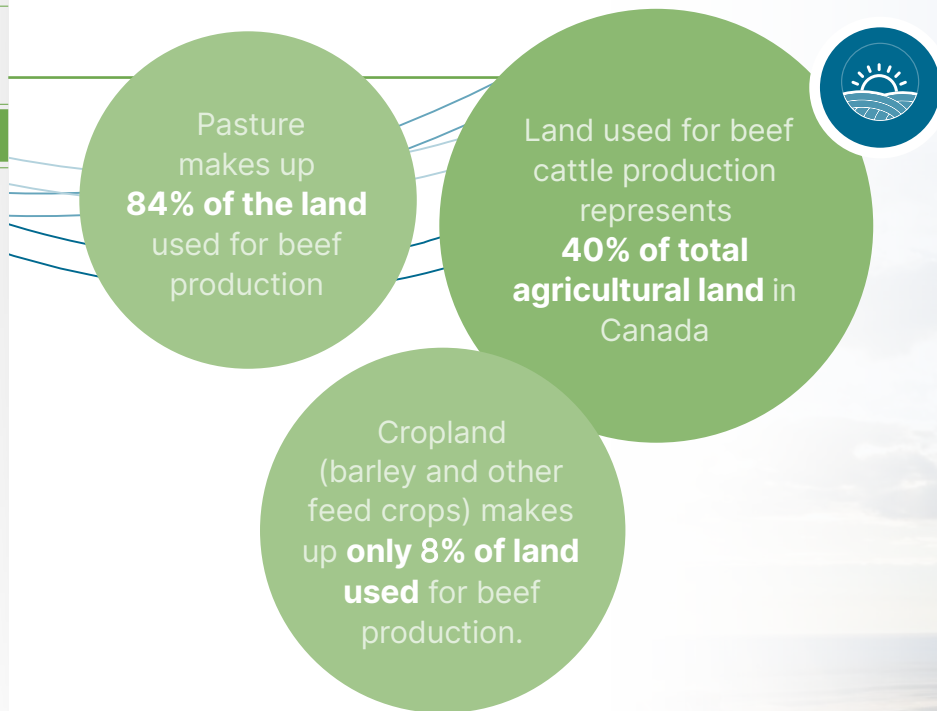


The initiatives in this section align with the following UN SDGs:

Agricultural Land Occupation

Agriculture land occupation is determined by quantifying land used disturbing soil or habitat (m² annual crop eq.). Beef production utilized 40% of agricultural land, of which **84% is pasture** (Figure 14). A decrease in annual land occupation was observed in the west (11.8%) and the east (11.5%) per kg boneless beef, consumed.

Land use is calculated based on the lifetime of the animal for grazing and feed requirements, of which cropland makes up only 8% of land used for beef production. A slight reduction in overall land use can be attributed to faster growth and lower mortality (lowering the ratio of grazing animals to non-grazing animals).



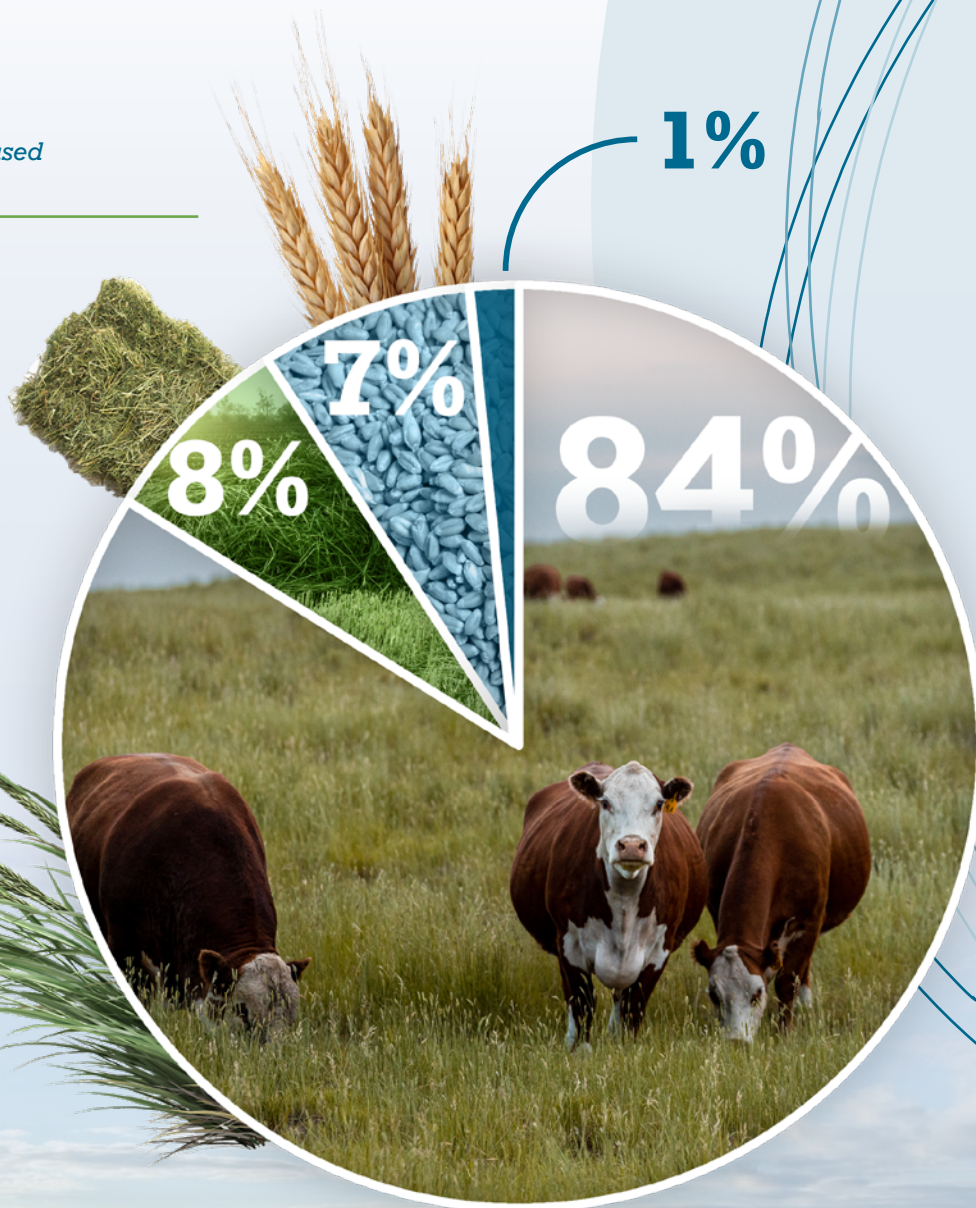
Land used for grazing (i.e. pasture) is much higher than that used for feed production (Figure 14); therefore, land use is higher in the west due to increased use of grazing practices. Furthermore, the west feeds predominantly a barley-based diet due to growing conditions such as drought tolerance. Barley obtains a lower yield in comparison to corn-based feed rations in the east, increasing use of land.

Figure 14 • Proportion of land used for beef production in Canada

Beef production overall

63.1 Ma / 25.5 Mha

- Pasture 84%
(52.8 Ma / 21.4 Mha)
- Hay 8%
(5.0 Ma / 2 Mha)
- Barley 7%
(4.5 Ma / 1.8 Mha)
- Other feed crops 1%
(0.8 Ma / 0.3 Mha)



Ma = million acres

MHa = million Hectares

*For reference, 1 acre is approximately the same size as 2.5 NHL Hockey rinks. One acre is equal to 0.4 Hectares.

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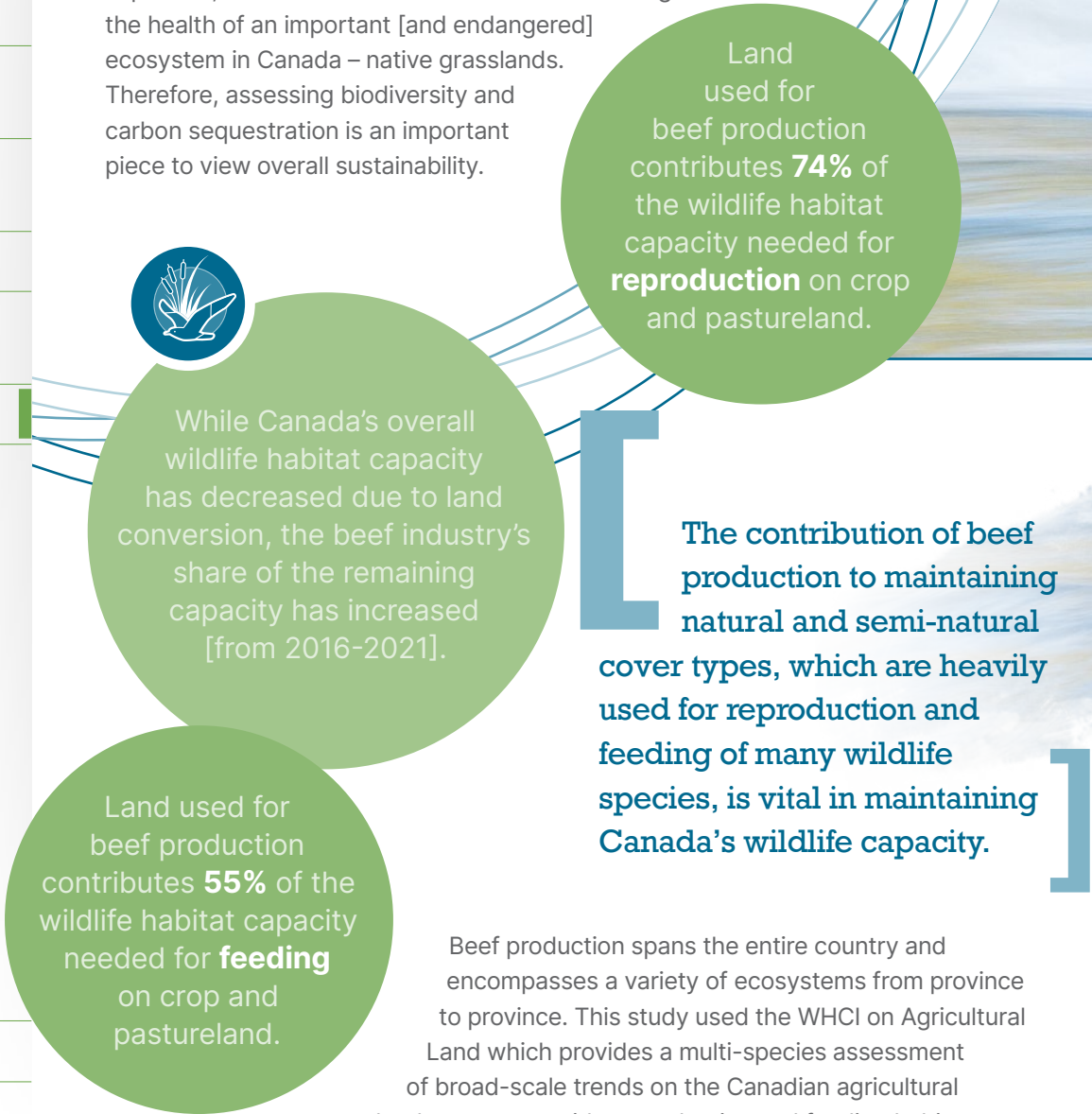
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The initiatives in this section align with the following UN SDGs:

Biodiversity

An understanding of the amount of land used is important, but it does not account for maintaining the health of an important [and endangered] ecosystem in Canada – native grasslands. Therefore, assessing biodiversity and carbon sequestration is an important piece to view overall sustainability.



Beef production spans the entire country and encompasses a variety of ecosystems from province to province. This study used the WHCI on Agricultural Land which provides a multi-species assessment of broad-scale trends on the Canadian agricultural landscape to provide reproductive and feeding habitat for populations of land animals on various cover types.

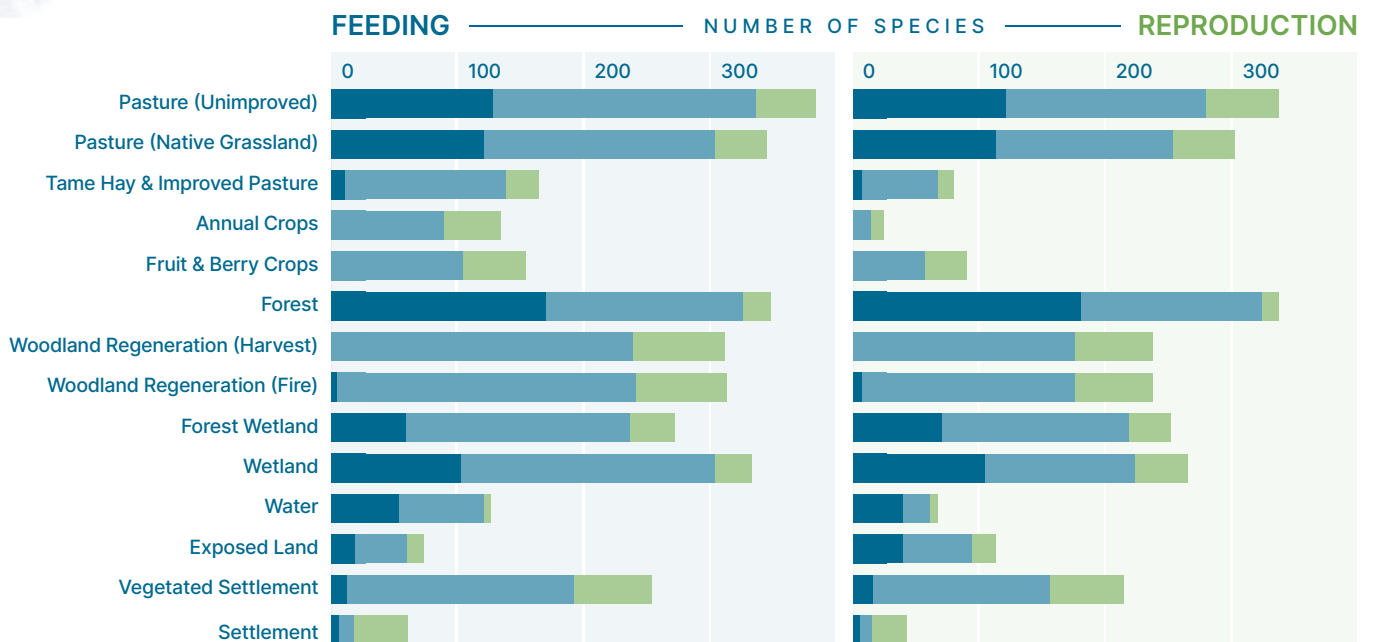
In Canada, there are 545 wildlife species (332 birds, 134 mammals, 41 amphibians and 38 reptiles) that use agricultural land for feeding and reproduction. Each land cover type used by wildlife species was classified as **Primary** (always used, critical or strongly preferred habitat), **Secondary** (often used, important habitat) or **Tertiary** (occasionally used, low value habitat; Figure 15).



Figure 15 • The number of wildlife species using cover types for primary, secondary and tertiary feeding and reproductive habitat

(Note: The data shown is representative of the year 2016 as part of the underlying WHCI dataset)

■ Primary ■ Secondary ■ Tertiary



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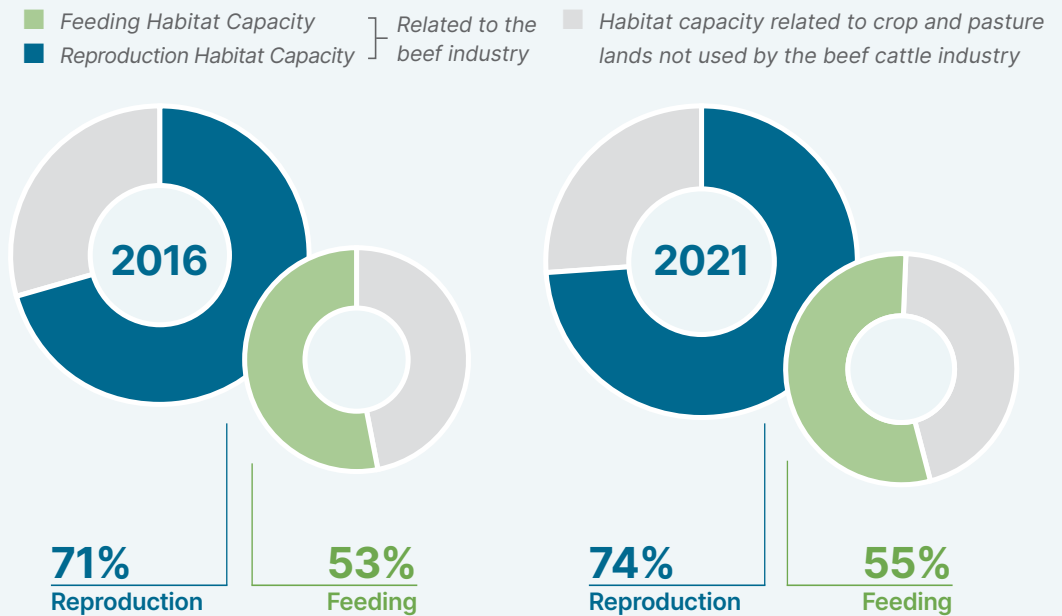


The inability of cropland alone to fulfill habitat requirements for most wildlife species highlights the importance of unimproved pasture, native grassland, forest, forest wetland, wetland, and water in Canadian agricultural landscapes. In Canada, most of the remaining native grasslands and pasture are under the care of beef producers.

National reproductive habitat capacity decreased by 2% over the last 5 years (Figure 16) while the Canadian beef industry has increased their share from 71% to 74% of total WHCI on agricultural land.

This implies that there is a strong link between biodiversity and land used by cattle - maintained by beef producers - through proper grazing practices. Grazing cattle is critical to preserving habitat and supporting biodiversity.

Figure 16 • Habitat Capacity Index values for Canada and land associated with the beef industry for wildlife reproduction and feeding habitat.



(Note that for the benchmarking year of 2016, the underlying biodiversity data is representative of the year 2016, while the feed rations applied to determine land over types is representative of the years 2014.)

Total wildlife habitat capacity has shrunk due to land use change – specifically native pasture being converted to cropland – and urban sprawl. As the wildlife move off these converted areas the **proportion of habitat capacity attributed to beef land has increased**. This showcases the contribution of beef production to maintaining natural and semi-natural cover types - heavily used for reproduction and feeding of many species – which is vital in maintaining Canada’s wildlife capacity.



Opportunity



STRATEGY Land Use and Biodiversity

GOAL 1 Maintain the 35 million acres of native grassland in the care of beef producers.

GOAL 2 Maintain a network of natural landscapes and healthy functioning ecosystems through well-managed grazing systems:

- ✓ Maintain and enhance the 68% of wildlife habitat capacity.
- ✓ Enhance ecosystem services.
- ✓ Encourage practices that build soil organic matter and enhance soil biodiversity.

KEY PERFORMANCE INDICATORS

- Agricultural land area used by the beef industry.
- Soil carbon stock on land used for beef production.
- Wildlife Habitat Capacity Index (WHCI).

STRATEGIC ACTION ITEMS

1. Support the creation and adoption of ecosystem services payments, markets and producer incentives.
2. Facilitate collaboration across stakeholder groups to develop a shared understanding of the challenges and potential solutions to promote biodiversity.
3. Support work that builds understanding and enhances or restores habitat quality and quantity on beef [production] operations.
4. Build further awareness and use of range health assessments by producers.

2021 PERFORMANCE

Land used for beef cattle production:

- ✓ represents 40% of total agricultural land in Canada, of which 84% is pasture.
- ✓ stores approximately 1.9 billion tonnes of carbon
- ✓ provides 74% of the wildlife habitat capacity needed for reproduction and 55% needed for feeding on crop and pastureland.

Despite a 2% decrease in overall habitat capacity on cropland and pastureland in Canada, **beef’s share (reproduction) of that capacity increased approximately 3%** [from 2016 to 2021].



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Meat Waste and Packaging

Approximately one-third of all food produced for human consumption in the world is lost or wasted each year.¹⁰ Food loss and waste were considered in this study as it represents a considerable opportunity for the sustainability of the entire beef supply chain.



Food loss occurs during packaging due to trimming - representing approximately 5% of the boneless, consumed beef product. Most impacts associated with the secondary processing stage come from the packaging materials themselves, where packaging accounts for 1% – 20% of impacts.

Food waste occurs at the retail stage, typically due to unsold products sent to the landfill after expiration, increasing impacts as it will be allocated to the meat. Finally, the consumption stage includes disposal of packaging materials and any meat waste that occurs at the consumer. This stage represents only up to 1% of impacts across all impact categories, except for freshwater eutrophication, where consumption contributes to 9-13% of impacts depending on region.

10. Food and Agriculture Organization of the United Nations (FAO). *Food loss and food waste* (2016).



STRATEGY Food Waste & Carcass Utilization

- GOAL 1** Reduce food loss and waste (from secondary processing to consumer) by 50% by 2030.
- GOAL 2** Increase the value of AAA and Prime carcasses, to be equivalent with the US, by building demand for all cuts on the carcass.
- GOAL 3** Support the development, regulatory approval and adoption of improved food safety interventions and technologies throughout the supply chain.

KEY PERFORMANCE INDICATORS

→ Overall loss and waste (% of edible bone-free meat)

2021 PERFORMANCE

Post-harvest losses:

- ✓ Approx. 5% loss of boneless beef, consumed during trimming
- ✓ Between 1 and 20% loss in packaging materials

Retail / Consumer Waste:

- ✓ Up to 1% across all impact categories, except freshwater eutrophication:
 - 9-13%, depending on region

STRATEGIC ACTION ITEMS

1. Encourage programs and projects that help food diversion efforts and reduce barriers to implementation.
2. Further enhance understanding of food loss and waste in the Canadian beef value chain.
3. Encourage research and adoption of packaging that enhances product life, and reduces waste and environmental impact, while aligning with on-going national and global initiatives.
4. Support initiatives to improve carcass quality and utilization.



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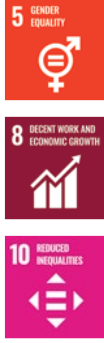
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SOCIAL ASSESSMENT RESULTS



In addition to environmental and economic metrics, social indicators are critical to a product's overall sustainability. The goal of this social sustainability assessment was to review the processes and practices associated with producing beef – to demonstrate areas that are doing well and identify those which could be improved. Keystone practices included those that mitigate occupational stress, support recruitment and retention, safe animal handling and public trust.

The initiatives in this section align with the following UN SDGs:



Positive contributions and potential risks throughout the supply chain were observed. In assessing the social impacts of the Canadian beef industry, four priority areas were identified for deeper analysis, with strengths, weaknesses and opportunities for improvement.



Labour Management



People's Health and Safety



Animal Care



Antimicrobial Use

Labour Management

Labour management refers to the working conditions of individuals working throughout the supply chain and how these conditions contribute to human health, sustainable workplaces and communities.

The labour gap

in the Canadian beef industry grew by 4,196 workers between 2017 and 2022 and is forecast to increase to 13,998 by 2029¹¹.



Industry stakeholders display a clear recognition in the value of hired labour and the need for continuous improvement in **socially responsible recruitment** and retention practices, such as benefits and wages, and professional development opportunities.

11. Canadian Agricultural Human Resources Council (CAHRC; no date).

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Table 1 • Labour management key observations

Strengths, Weaknesses and Areas for Improvement

Strengths	Weaknesses and Areas for Improvement
<p>1 Labour availability, recruitment and retention are creating workload levels with potential negative repercussions on people working in the industry.</p>	
<p>✓ Broad awareness across the industry that labour management needs critical attention.</p>	<p>→ All sectors experience this differently but due to a lack of resources, cow-calf operations are most vulnerable.</p>
<p>2 Recognition that sound labour management practices are needed to address workload levels and efforts are being made by individual businesses, both at the farm and packing plant levels.</p>	
<p>✓ Many farm operations with hired labour have adopted practices to support on-boarding (e.g. initial training, discussion about workers' rights and responsibilities) and to promote the professional development of employees (e.g., involving employees in decision-making, providing skill development opportunities).</p>	<p>→ Increased uptake to support human resource initiatives such as increased communication and dispute resolution would have a positive effect in the on-farm workplace.</p>
<p>✓ 95% conduct on-boarding activities – a similar proportion does professional development.</p>	<p>→ Safety measures should be integrated regarding im/migrant workers at packing plants to eliminate any extra risk they may face.</p>
<p>3 There is a potential benefit of integrating innovative approaches to dealing with workload levels and ensuring job satisfaction for the people working in the industry, on-farm and at the processing/packing level.</p>	
<p>✓ The industry strongly values hired labour; finding innovative ways to mitigate labour shortages is becoming increasingly important.</p>	<p>→ There is a strong economic barrier limiting the ability to adopt and implement new technologies on-farm that would result in lower staff needs.</p>

Results suggest that challenges around labour availability, recruitment and retention are increasing workload levels with potential negative repercussions on people working in the industry. **Policies and programs to support affected stakeholders to mitigate these challenges would alleviate the risks.**



Opportunity



STRATEGY Labour Management

GOAL Support innovation, research, refinement and commercialization of technologies throughout the supply chain that support economic viability and worker conditions.

KEY PERFORMANCE INDICATORS

→ Labour gap

2021 PERFORMANCE

✓ 250% increase in labour gap since 2017 (4,196 workers).¹¹

STRATEGIC ACTION ITEMS

1. Support initiatives that increase labour availability, training, recruitment and retention.
2. Promote implementation of practices to enhance labour management.
3. Support adoption of best management practices, business tools and new technology to reduce workloads across the beef supply chain, focusing particularly on family farm businesses, while considering practicality of implementation.



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The initiatives in this section align with the following UN SDG:



People's Health and Safety

Health and safety at work concerns the promotion and maintenance of the highest degree of physical, mental and social well-being, and capabilities of all individuals involved in business operations, including employees but also producers and the people living on the farm.

Positive conversations around stress and mental health have increased, building awareness and reducing the stigma of mental health challenges.^{12, 13}

Workload ranked among the top 5 stressors⁶ for beef farmers with three-quarters of those surveyed experiencing levels of disturbing stress affecting mental and physical health.

Taking an adaptive management approach to training and equipment use could significantly improve self-reported hazard awareness and safety.

Table 2 • People's Health and Safety key observations

Strengths, Weaknesses and Areas for Improvement

12. <https://www.domore.ag/>

13. <https://www.ontario.ca/page/mental-health-resources-for-farmers>

Strengths

Weaknesses and Areas for Improvement

1 There is room for improvement to adopt practices which prevent safety-related incidents, particularly on-farm.

✔ Awareness and preparation with respect to people's health and safety is increasing.

➔ Adoption rate of safety practices remains low.

➔ Focus is needed on training and use of personal protective equipment (PPE).

2 Producers experience high levels of stress due to on-farm work, even when adopting practices to manage physical and mental fatigue.

✔ The stigma of mental health is decreasing.

➔ About 50% of participants working on-farm indicated a large amount of stress leading to impacts on health such as sleep loss, changes in appetite, and body/headaches

✔ Resources to support farmers are increasing, and more becoming available to support worker mental health.

➔ About 75% of producers feel some degree of disturbing stress.

✔ 96% of beef producers reported following at least one stress-management practice.



Awareness and preparation of on-farm health and safety is increasing. **A focus on training and access to proper safety equipment would be beneficial.**



Opportunity

STRATEGY People's Health & Safety

GOAL 1 Create a culture of safety across the beef industry supply chain.

GOAL 2 Reduce serious, fatal and fatigue-related incidents by 1.5% per year up to 2030, by supporting education, awareness and improvements in farm and ranch safety.

KEY PERFORMANCE INDICATORS

- Percentage of farms/ranches reporting injuries/fatalities.
- % of beef producers experiencing stress due to workload.

2021 PERFORMANCE

- ✓ Average agriculture-related fatality rate per 100,000 farm population: 10.7
- ✓ Average annual decrease in agriculture-related fatalities is 1.4% (1990-2020).
- ✓ About 50% of participants working on-farm indicated a large amount of stress leading to impacts on health such as sleep loss, changes in appetite, and body/headaches.
- ✓ About 75% of producers feel some degree of disturbing stress.

STRATEGIC ACTION ITEMS

1. Collaborate regarding on-farm health and safety awareness and best practices implementation.
2. Enable dialogues regarding health and safety, including mental well-being, for all beef value chain participants.
3. Promote a culture of diversity, equity, inclusion and transparency for all people within the beef supply chain.

14. Canadian Agricultural Safety Association (February, 2023). Canadian Agriculture Injury Reporting (CAIR): Agriculture-related fatalities in Canada 1990-2020.

↓ Over 1990-2020 time period, average annual agricultural fatality rate decreased 1.4% each year (compared to 1.1% each year in 2002-2012 time period).¹⁴



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The initiatives in this section align with the following UN SDGs:

Animal Care

Animal care refers to animal health and welfare through activities that humans undertake as part of the beef supply chain. It is about providing for the physical and mental well-being of animals and meeting or exceeding consumer expectations.

The foundation for animal care is guided by the Five Freedoms which must be upheld:

Freedom from:

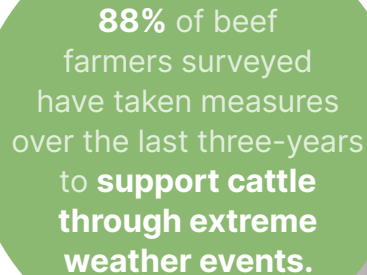
- hunger and thirst
- discomfort
- pain, injury and disease
- fear and distress
- and freedom to express normal behavior



97% of beef farmers surveyed supported animal welfare through training their handlers on **low-stress animal handling**, with 69% engaging through generational/spoken knowledge transfer.



81% of respondents declared having a **Veterinarian/Client/Patient Relationship (VCPR)**.



88% of beef farmers surveyed have taken measures over the last three-years to **support cattle through extreme weather events**.

Further outlining the care and handling of beef cattle, a Code of Practice¹⁵ was developed by the National Farm Animal Care Council in conjunction with welfare researchers, veterinarians, animal welfare groups and other stakeholders. The code highlights requirements and recommendations to ensure the health and welfare of beef cattle, while providing avenues for further improvement.



15. National Farm Animal Care Council (2013). Code of practice for the handling and care of beef cattle



Table 3 • Animal care key observations

Strengths, Weaknesses and Areas for Improvement

Strengths

Weaknesses and Areas for Improvement

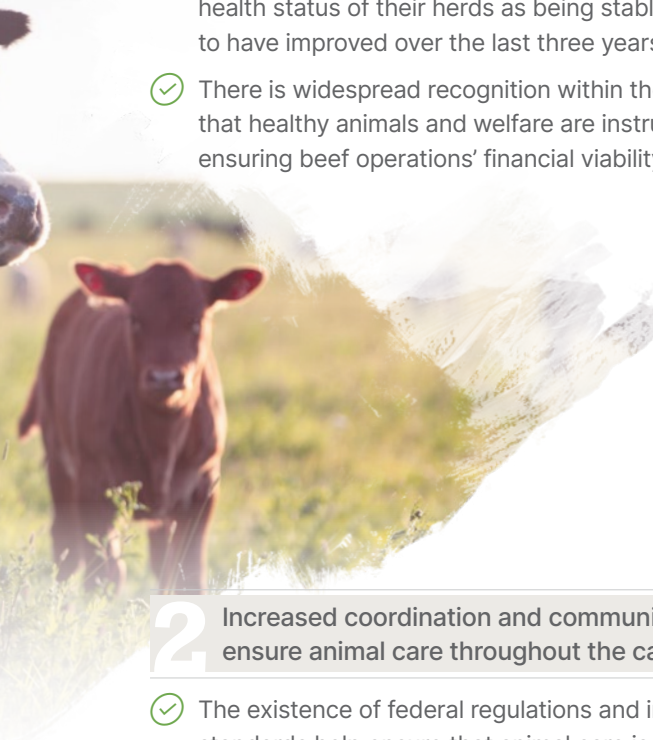
1 Animal care is a topic that has received particular attention within the Canadian beef industry over the years, with tangible and positive results, even though areas for improvement remain with respect to certain on-farm practices.

- ✓ Most producers consider the overall animal health status of their herds as being stable or to have improved over the last three years.
- ✓ There is widespread recognition within the industry that healthy animals and welfare are instrumental to ensuring beef operations' financial viability over time.

- ➔ Adoption rates of practices identified in the NBSA and/or Strategy could still be increased.
 - Uptake and implementation of the Code of Practice for the Care & Handling of Beef Cattle¹⁵.
 - Adoption of low-pain/low-stress techniques during typical procedures (e.g., castration).
- ➔ Specific areas that require additional improvement
 - Animal transportation (on and off-farm).
 - Health management of newly arrived cattle on the farm.
 - Performance of needle injection.
 - Improving working conditions and infrastructure can lead to reduced stress and better animal handling practices.
 - Animal handling training, experience, or mentorship may affect rates of animal stress and injury and decrease human fatalities on farms.

2 Increased coordination and communication across businesses, sectors, and industries may be needed to ensure animal care throughout the cattle's life cycle.

- ✓ The existence of federal regulations and industry standards help ensure that animal care is achieved and maintained throughout the animals' life cycle.
- ➔ Coordination across businesses and supply chain stages is likely suboptimal to fully secure animal care throughout the animal's life cycle.



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Opportunity

Animal care is a success story, but increased practice adoption, coordination and communication across businesses, sectors, and industries may be needed to ensure animal care throughout the cattle's life cycle.





STRATEGY

Animal Care

GOAL 1 Ensure the five freedoms of animal wellbeing by increasing adoption of on-farm management practices:

- ✓ 92% reproductive efficiency in Canadian beef production (85% in 2018)
- ✓ Adopt management and breeding choices that support animal welfare (e.g., calving ease, polled genes, pain relief)

GOAL 2 Establish and maintain a surveillance system to monitor cattle production practices across Canada.

KEY PERFORMANCE INDICATORS

→ Uptake and implementation of Code of Practice for the Care & Handling of Beef Cattle.¹⁵

2021 PERFORMANCE

✓ 81% of respondents declared having a Veterinarian /Client/ Patient Relationship (VCPR).

STRATEGIC ACTION ITEMS

1. Increase communication and coordination between all stakeholders to ensure animal health and welfare at every stage of the beef cattle life cycle.
2. Promote animal care awareness and implementation of practices through the dissemination of the Code of Practice for the Care and Handling of Beef Cattle.
3. Promote awareness of best practices for animal handling with respect to transport.
4. Support research, innovation and knowledge transfer regarding animal care protocols and products.
5. Communicate the importance of pain control protocols and products.
6. Improve genetic selection tools that support animal welfare, while considering environmental and productivity benefits.

88% of beef farmers surveyed have taken measures over the last three-years to support cattle through extreme weather events.

97% of beef farmers surveyed supported animal welfare with low-stress training for handlers.



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Antimicrobial Use

Antimicrobials (AM), which include antibiotics, antifungals, antivirals and antiparasitics, are instrumental for ensuring animal health in livestock agriculture. However, proper use is critical for mitigating adverse effects, and ensuring the health of animals, people and the environment.



While a range of perceptions on antimicrobial use (AMU) exist among industry stakeholders and consumers, federal regulations on AMU **support responsible AMU on farms.**

Protecting the health of animals through optimal nutritional, health, weaning management, marketing, and biosecurity practices is key to AM stewardship.

79% of respondents using AM declared that **veterinary and/or label instructions** on how to administer the product are **systematically followed.**

Table 4 • Antimicrobial use key observations

Strengths, Weaknesses and Areas for Improvement

Strengths	Weaknesses and Areas for Improvement
<p>1 Antimicrobial use is a complex topic with varying perceptions within the beef industry.</p>	
<p>✓ The presence of regulations at the federal level provides confidence that producers are using AMU safely and effectively.</p>	<p>→ There are a variety of opinions and perceptions from those in the industry with respect to AMU in Canadian beef production that may not be fully informed by objective assessment.</p>
<p>2 Ensuring the optimal management of AMU requires well-informed on-farm decisions and evidence suggests access to additional resources are needed at the farm level.</p>	
<p>✓ Most producers have adopted practices supporting the optimal management of AMU, including the establishment of a VCPR.</p> <p>✓ Most producers (79%) systematically use veterinarian advice.</p>	<p>→ Further training would be beneficial to drive continuous improvement.</p> <p>→ Room for improvement exists in adoption of management practices associated with AMU:</p> <ul style="list-style-type: none"> • further reduction of stressors. • increased access to veterinarians in some regions. <p>→ Treatment of sick animals, especially when not successful may have a direct impact on employee morale.</p>



Opportunity



The variety of opinions and perceptions with respect to AMU could pose risks to its use in the industry. **Room for improvement also exists with respect to the adoption of management practices associated with responsible AMU, including further reduction of stressors and increased access to veterinarians in some regions.**

Recent research shows that while 95% of cow-calf producers report using antimicrobials for herd health management, 88% of herds treat fewer than 5% of calves before weaning; 91% of herds treat fewer than 5% of the [mother] cows, and Oxytetracycline (Category III or Medium Importance) was most commonly used antimicrobial.¹⁶

STRATEGY

Antimicrobial Use

GOAL Ensure the effectiveness of existing and future antimicrobials is preserved to support human and animal health and welfare.

KEY PERFORMANCE INDICATORS

- The proportion (%) of isolates in beef cattle resistant to Category I (Very High Importance in human medicine)
- The proportion (%) of isolates in retail beef resistant to Category I (Very High Importance in human medicine)

2021 PERFORMANCE

- ✓ Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) surveillance found 0% *E. coli* isolates in beef cattle and retail beef resistant to Category I (Very Important to human medicine) antimicrobials.
- ✓ Most producers have adopted practices supporting the optimal management of AMU, including the establishment of a VCPR.
- ✓ 79% of producers report to systematically use veterinary advice.

STRATEGIC ACTION ITEMS

1. Build shared understanding for the importance of balanced health for people, animals and the environment in regard to antimicrobial use in beef cattle.
2. Promote importance of veterinarian-client-patient relationship (VCPR) regarding responsible antimicrobial use.
3. Support understanding of the importance of antimicrobials as a proven science-based tool in the beef industry to ensure animal care.

16. Fossen et al., 2023. Producer attitudes regarding antimicrobial use and resistance in Canadian cow-calf herds.

Government of Canada's Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) is now collecting on-farm antimicrobial use and resistance data, in addition to retail meat.



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ECONOMIC ASSESSMENT RESULTS



Economic sustainability is defined as the ability of a system to maintain productivity in the face of a major disturbance, as well as shifts in consumer preferences. This definition focuses on the resilience of the industry as a whole and its ability to adapt to changing market conditions.



Canadian beef producers operate within a highly competitive and dynamic market. The Canadian beef supply chain is affected by live cattle and beef supplies in the United States, as well as demand for Canadian beef globally. The Canadian beef industry was affected by multiple supply and demand shocks in 2020, when the COVID-19 global pandemic led to lockdowns in Canada and around the world, as well as the increased widespread prevalence of drought – specifically in 2021. The cattle industry is currently facing inflationary pressures with input costs rising faster than output (i.e., consumer) prices.

There are many factors to be considered when determining profitability due to the nuance of the Canadian beef supply chain. All sectors are interrelated and are not impacted in isolation.



Declining Terms of Trade

These factors include:

Declining terms of trade

Occurs when input costs are higher than the price received for the output. This is due to increasing productivity driving an increased supply of product and not enough demand resulting in a deflated price. To improve, an increase in the demand needs to be observed while reducing the cost of production.



Profitability

Profitability

As outputs for one sector are the inputs for the next, it is rare to see all sectors profitable at the same time. Therefore, the analysis focuses on long term profitability.



Cattle Cycle

Cattle Cycle

The Canadian beef industry follows a 10–12-year cattle cycle from peak to peak. As this assessment's analysis is a five-year average, that must be taken into consideration as it has the potential to look at the bottom versus the top of the cattle cycle.

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The initiatives in this section align with the following UN SDG:

Producer Viability

Producer viability refers to producers' financial ability and incentive to continue participating as part of the Canadian beef supply chain. Market signals come from several sources including individual auction markets, the Chicago Mercantile Exchange (CME) futures and Canfax (which provides voluntary price reporting for cattle by class, week, and province), and input prices.

The 2021 assessment indicates an overall increase in industry profitability on a per head basis, compared to 2014, although input costs have also inflated.



Cow-Calf Viability

- Significant increase for cow-calf returns in Alberta and Ontario provided opportunity for producers to rebuild equity during this time, although variation among operations regarding profitability is high.
- A 200 head cow herd provided a total income (from paid labour and profit margin on the cows) of \$90,954 annually in 2020, which is close to the Canadian median after-tax income for all families of \$92,400 for the same year. Higher calf prices have reduced the number of cows needed to support a family.
- On the flip side, cost of living and cost of production has also increased significantly.



Feedlot Viability

- Bunk capacity (maximum animal capacity at any given point in time) in Alberta and Saskatchewan increased by 19% or 271,500 head with an additional 19 feedlots with one-time capacity over 1,000 head from 2015 through 2022.



Packer Viability

- For every worker employed in the Canadian meat packing industry, another 3.4 workers are employed, including direct and indirect employment.⁴

While margins have been strong for the cow-calf and packing sectors in the past several years, it is the feedlot sector that has expanded. High feed costs have required cattle prices to increase for more equitable margins throughout the supply chain.



STRATEGY

Producer Viability

GOAL 1 Increase the financial viability of beef production in Canada.

KEY PERFORMANCE INDICATORS

- Long term cost of production
- Long term profitability.

2021 PERFORMANCE

- ✓ Cost of living and cost of production have increased.
- ✓ A 200 head cow herd provided a total income (\$90,954)¹⁷, close to the Canadian median after-tax income for all families.
- ✓ Additional 19 feedlots with one-time capacity over 1,000 head from 2015 through 2022.
- ✓ Research suggests that for every worker employed by farm-level production of cattle in Canada, 2.5 workers are employed either directly or indirectly in the Canadian economy.⁴

STRATEGIC ACTION ITEMS

1. Support increasing producer financial literacy and viability.
2. Encourage financial incentives for beef producers related to ecosystems goods and services provided by the beef industry.
3. Support innovation, research, refinement and commercialization of technologies throughout the supply chain that support economic viability and worker conditions.

17. Statistics Canada. (2022b). Market Income, Government Transfers, Total Income, Income Tax and After-Tax Income by Economic Family. Government of Canada. Retrieved August 12, 2022, from <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110019001>.

Margins have been strong for the cow-calf and packing sectors in the past several years.

Feedlot sector has expanded; high feed costs have required cattle prices to increase for more equitable margins throughout the supply chain.



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The initiatives in this section align with the following UN SDGs:



Demand for Canadian beef has remained strong, both domestically and internationally.

Consumer Resilience and Demand

Consumer resilience is the ability of consumers to support the Canadian beef supply chain, despite challenges that may occur. These challenges include, but are not limited to: price changes, product changes, safety challenges and recalls, and perceptions around animal welfare or animal husbandry issues.

Consumer demand is the ultimate driver for the long-term development of the cattle industry. A sustainable cattle industry has to evolve with the consumer market and respond to changes in consumer preferences. This includes identifying fads that have become trends and ensuring the systems are set up to respond to those consumer demands. The beef industry must compete with alternative protein options domestically and internationally to maintain resources and market share.

Long-term trends, medium-term perceptions, and short-term market impacts were assessed in determining consumer demand of Canadian beef. Long-term trends include a growing middle class and shifting consumer demographics with more urbanization. Medium-term perceptions are impacted by food awareness, including perceptions of food safety, beef quality, nutrition and healthfulness of beef. Short-term shifts may be due to prices and availability of substitute protein options.

International Demand

- Strong global demand for protein in general with growth of the population and disposable income.
- Strong choice for traditional animal-based protein. In North America we have seen a peak of alternative proteins and demand is now decreasing.
- How producers support demand – increased volumes of Canadian AAA and Prime produced

Research suggests that for every worker employed by farm-level production of cattle in Canada, 2.5 workers are employed either directly or indirectly in the Canadian economy.⁴ The Canadian cattle industry contributes \$51.6 billion in production of goods and services, \$21.8 billion to the Canadian GDP and \$11.7 billion in labour income annually.^{4,5} As such, the sustainability of the beef industry is imperative for the well-being and livelihoods of thousands of Canadians employed throughout the value chain as well as the millions of Canadian consumers demanding safe, high-quality, and nutritious protein options.



DEMAND is a consumer's willingness to pay for a specific quantity and quality of product.

TRENDS are the result of fundamental long-term changes in technology, society and the economy that play out over years or even generations.

FADS are driven by short-term changes in current consumer inclinations; they come and go.

STRATEGY

Consumer Resilience and Demand

GOAL 1 Increase demand for Canadian beef by building awareness and trust in sustainable beef production in Canada.

KEY PERFORMANCE INDICATORS

- Canadian beef retail demand
- International demand

2021 PERFORMANCE

- ✓ Canadian beef Retail Demand Index: 118 (2000=100) - 5% increase
- ✓ International Demand Index: 141 (2000=100) - 16% increase since 2013

STRATEGIC ACTION ITEMS

1. Support increased capacity of the beef supply chain to respond to market demands.
2. Support responsible communication of production practices that are of interest and concern to consumers.
3. Promote knowledge transfer and acceptance of sustainable and safe beef production technologies by producers, customers and policymakers, in both domestic and international markets.



Despite global events, climate impacts and market disruptions, an overall 5% increase in Canadian retail beef demand, and 16% increase in international demand since 2013.



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This report provides an update to the benchmark set in 2014 regarding the social, economic and environmental performance of the entire Canadian beef value chain, identifying the areas where the beef value chain has improved as well as opportunities for further improvement. Results showed improvements in the majority of environmental indicators - notably a 15% decrease in the GHG footprint of Canadian beef production since 2014, on track towards the industry's 2030 goal of a 33% reduction in GHG emissions intensity. Preserving the land used for beef production continues to be critical as it has the highest capacity to store carbon (currently estimated at 1.9 billion tonnes), promotes biodiversity and provides habitat for wildlife, particularly important for reproduction, in agricultural areas. Social assessment results highlighted the growing labour gap across agriculture and the commitment of the industry to diversity, reducing workload - especially for farmers, and supporting health and safety for all. The industry's high standards and commitment to animal care continues to be a positive story in Canada; the majority of farmers and ranchers have an active relationship with a veterinarian for animal care and responsible AMU. Commitment to continual training is evident across the beef supply chain. From an economic perspective, consumer demand for Canadian beef is strong both domestically and on a global scale, and the industry has shown strong resilience in the face of climate, supply and market shocks over the past several years. The Canadian cattle industry contributes \$51.6 billion in production of goods and services, \$21.8 billion to the Canadian GDP and \$11.7 billion in labour income annually.^{4,5}

The Canadian beef industry has a strong desire to see progress that reduces its environmental footprint and supports society's values while at the same help it to remain economically viable.

The CRSB's goals to advance the sustainability of the Canadian beef industry are intricately linked with a robust suite of 2030 goals that the industry has committed to, summarized on Page 14-17. Goals, key performance indicators and action items have been outlined in blue tables throughout the report, and more detailed actions are outlined in the National Beef Sustainability Strategy, through which the CRSB, its members, partners and stakeholders will be collaborating and tracking progress over the next several years - on the road to 2030.

The CRSB will continue to review both the NBSA and National Beef Sustainability Strategy approximately every seven years, to evaluate progress over time, to guide the future work of the CRSB and its membership, and to update the work based on newly available data and methodology.

Visit our website for more information and to access the full reports at crsb.ca.





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Partenariat canadien pour
une agriculture durable



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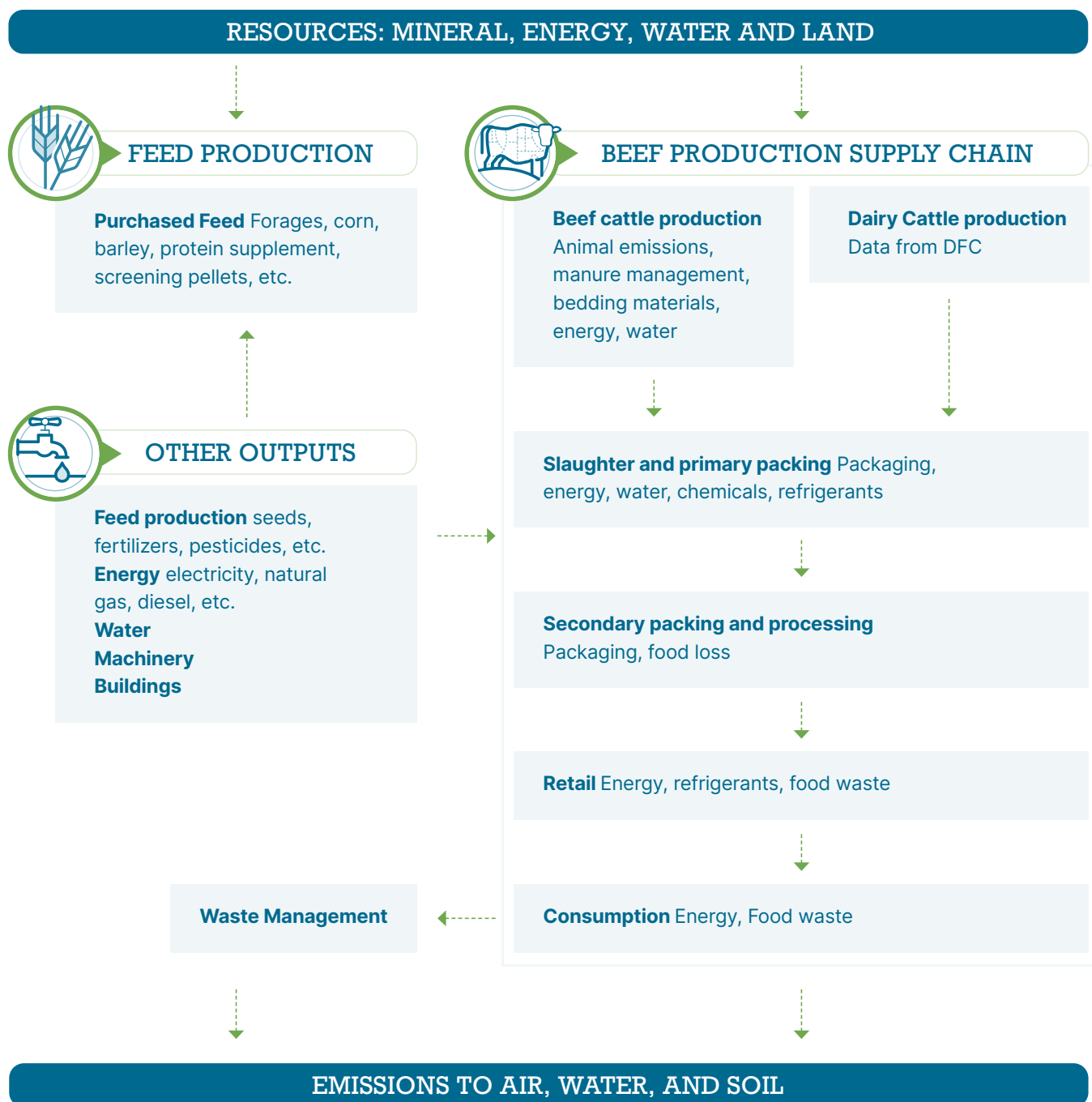
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Appendix A

Boundaries of the birth-to-farm gate Canadian beef production system modelled in the E-LCA.^{6,8}



Appendix

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Appendix B

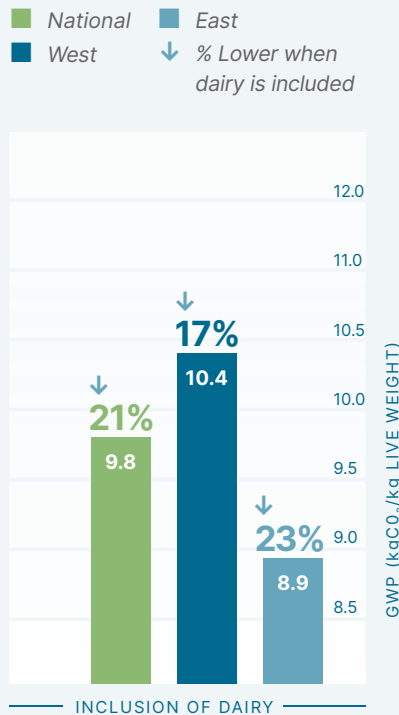
Carbon Footprint with the Inclusion of Dairy.^{6,8}

The carbon footprint when **including dairy animals produces 21% fewer GHG emissions on-farm** than 2014 (kg live weight).

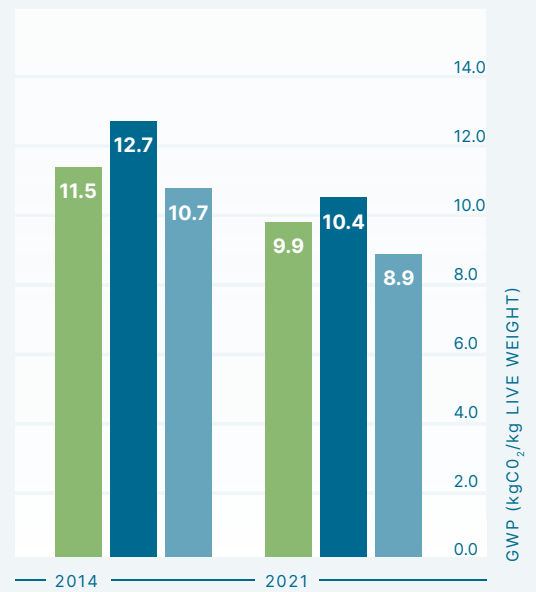
New to this assessment, contributions to the beef product from the dairy industry were accounted for. This includes dairy cows, calves, steers, and heifers that are produced in Canada and dairy steers imported into Canada and then slaughtered for beef.

The reason for a significant decrease in the carbon footprint when including dairy animals is because the **majority of emissions are allocated to milk production, as beef production is a co-product from producing milk**. Additionally, allocations for imported animals have a large portion of emissions attributed to the country of origin.

Carbon footprint (AR5) for National, Western, and Eastern production when dairy is included.



Carbon footprint for West and East when dairy is included, benchmarked between 2014 and 2021.



Appendix C

Percent contributions of all life cycle stages (per kg of boneless beef, consumed) to the national E-LCA indicators.^{6,8}

E-LCA Indicator	Life cycle stages					
	Farming	Transport	Processing	Packaging	Retail	Consumption
Carbon footprint	83.1%	0.4%	1.9%	4.1%	9.0%	1.5%
Fossil fuel depletion	39.2%	1.4%	8.2%	15.6%	34.2%	1.4%
Water depletion	89.7%	0.0%	0.3%	1.0%	8.2%	0.8%
Agricultural land occupation	94.0%	0.0%	0.0%	6.0%	0.0%	0.0%
Freshwater eutrophication	56.8%	0.0%	1.4%	11.4%	18.5%	11.9%
Terrestrial acidification	89.8%	0.1%	4.0%	1.6%	4.4%	0.1%
Photochemical oxidant formation, human health	56.3%	2.2%	18.8%	14.3%	7.9%	0.6%
Photochemical oxidant formation, terrestrial ecosystems	56.1%	2.2%	18.7%	14.7%	7.8%	0.6%

Appendix D

Results from the E-LCA for all functional units nationally and broken down by the Eastern and Western regions.^{6,8}

*Note: the results for different functional units cannot be directly compared

Functional Unit	Indicator	Units	National		West		East	
			2021	2014	2021	2014	2021	2014
1 kg live weight	Carbon footprint	kg CO ₂ eq	10.4	12.6	10.5	12.7	9.8	12.4
	Fossil fuel depletion	kg oil eq	0.4	0.4	0.4	0.5	0.3	0.4
	Water depletion	L	657.3	654.7	761.5	829.3	89.9	157.5
	Agricultural land occupation	m ₂ a	38.7	40.5	43.6	49.8	12.0	13.9
	Freshwater eutrophication	g P eq	2.6	4.1	2.4	3.3	3.9	6.3
	Terrestrial acidification	g SO ₂ eq	115.9	98.4	110.8	92.5	143.6	115.3
	Photochemical oxidant formation, human health	g NO _x eq	8.7	10.9	8.8	10.4	8.3	12.4
	Photochemical oxidant formation, terrestrial ecosystems	g NO _x eq	8.8	11.0	8.9	10.5	8.3	12.5
1 kg carcass weight	Carbon footprint	kg CO ₂ eq	17.3	20.9	17.5	21.0	16.3	20.6
	Fossil fuel depletion	kg oil eq	0.7	0.8	0.7	0.8	0.5	0.8
	Water depletion	L	1084.5	1080.2	1256.5	1368.4	148.3	259.9
	Agricultural land occupation	m ₂ a	63.9	66.8	72.0	82.1	19.9	23.0
	Freshwater eutrophication	g P eq	4.3	6.7	3.9	5.5	6.4	10.3
	Terrestrial acidification	g SO ₂ eq	191.6	162.8	183.2	153.0	237.2	190.6
	Photochemical oxidant formation, human health	g NO _x eq	15.3	18.9	15.5	18.1	14.5	21.3
	Photochemical oxidant formation, terrestrial ecosystems	g NO _x eq	15.5	19.1	15.6	18.3	14.7	21.5

Appendix D (Cont'd)

Functional Unit	Indicator	Units	National		West		East	
			2021	2014	2021	2014	2021	2014
1 kg boneless meat at processor's gate	Carbon footprint	kg CO ₂ eq	22.6	27.2	22.9	27.4	21.3	26.8
	Fossil fuel depletion	kg oil eq	1.1	1.2	1.1	1.2	0.8	1.2
	Water depletion	L	1385.4	1379.9	1604.3	1746.7	193.9	335.9
	Agricultural land occupation	m ₂ a	81.3	85.0	91.6	104.5	25.3	29.2
	Freshwater eutrophication	g P eq	5.6	8.7	5.1	7.1	8.3	13.3
	Terrestrial acidification	g SO ₂ eq	257.2	220.5	246.5	208.1	315.3	256.0
	Photochemical oxidant formation, human health	g NO _x eq	26.9	31.5	27.1	30.4	25.9	34.6
	Photochemical oxidant formation, terrestrial ecosystems	g NO _x eq	27.2	31.8	27.4	30.7	26.1	34.9
1 kg boneless beef, retailed, and consumed	Carbon footprint	kg CO ₂ eq	32.8	38.6	33.1	38.8	31.2	38.0
	Fossil fuel depletion	kg oil eq	2.6	2.7	2.6	2.8	2.3	2.7
	Water depletion	L	1919.2	1912.4	2192.3	2370.0	432.7	609.8
	Agricultural land occupation	m ₂ a	109.2	113.8	122.2	138.5	38.5	43.5
	Freshwater eutrophication	g P eq	11.9	15.8	11.3	13.8	15.3	21.6
	Terrestrial acidification	g SO ₂ eq	338.1	292.4	324.8	276.8	410.6	336.6
	Photochemical oxidant formation, human health	g NO _x eq	40.7	46.4	40.9	45.1	39.5	50.3
	Photochemical oxidant formation, terrestrial ecosystems	g NO _x eq	41.3	47.1	41.6	45.8	40.0	50.9
1 serving (100g), consumed	Carbon footprint	kg CO ₂ eq	3.3	3.9	3.3	3.9	3.1	3.8
	Fossil fuel depletion	kg oil eq	0.3	0.3	0.3	0.3	0.2	0.3
	Water depletion	L	191.9	191.2	219.2	237.0	43.3	61.0
	Agricultural land occupation	m ₂ a	10.9	11.4	12.2	13.9	3.9	4.4
	Freshwater eutrophication	g P eq	1.2	1.6	1.1	1.4	1.5	2.2
	Terrestrial acidification	g SO ₂ eq	33.8	29.2	32.5	27.7	41.1	33.7
	Photochemical oxidant formation, human health	g NO _x eq	4.1	4.6	4.1	4.5	4.0	5.0
	Photochemical oxidant formation, terrestrial ecosystems	g NO _x eq	4.1	4.7	4.2	4.6	4.0	5.1



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