

Executive Summary

The Dairy Farmers in Canada are now better equipped to understand and address the sustainability of milk production in Canada. Thanks to a thorough Environmental and Socioeconomic Life Cycle Assessment of the production, using internationally recognised tools, dairy farmers have a comprehensive assessment looking at a multitude of indicators. The socioeconomic assessment is also a first in the dairy sector.

What is the carbon footprint of Canadian milk? Its water footprint? How socially responsible is milk production? Which practices are more sustainable? What can be improved? Find out more in this report. This summary aims to streamline results in accessible concepts, while a detailed methodological report is available for consultation.

INTRODUCTION

In an effort to clarify the path towards sustainable milk production in Canada, the Dairy Farmers of Canada, in the context of the Dairy Research Cluster, commissioned the Life Cycle Assessment (LCA) of Canadian Milk.

The project's objectives were threefold:

- 1) To evaluate the environmental and socioeconomic impacts of dairy production in Canada;
- 2) To identify potential areas of focus for further improvements of the dairy sector's sustainability;
- 3) To provide the framework and the building blocks to support comparison and benchmarking.

The Life Cycle Assessment

In the last decade, the importance of sustainability and the potential impact associated with products and services has sparked the innovation of methods to better understand, measure and reduce potential impacts caused at different steps along the way. The leading tool developed is also the only tool that takes a comprehensive approach including all life cycle stages of materials involved, and their impact. Life cycle assessment (LCA), within an ISO standard framework, is an internationally recognized approach that evaluates the potential environmental and human health impact associated with products and services throughout their life cycle, from raw material extraction, including transportation, production, use, and end-of-life treatment. Among other uses, LCA can identify opportunities to improve the environmental performance of products at various points in their life cycle, inform decision-making, and support marketing and communication efforts.

Environmental performance is but one aspect to consider in regards to sustainability. The product's socioeconomic performance counts as well. A Social Life Cycle Assessment (S-LCA) has hence been performed to assess the socioeconomic performance of the Canadian dairy sector. A S-LCA focuses on businesses' behaviour and on the relationships they have with their stakeholders, such as their workers, the local community, their business partners, etc. This tool aims to evaluate the degree of social responsibility of businesses, here the Canadian dairy farms, towards their stakeholders by using a set of socioeconomic indicators related to a list of social issues of concern, going from working conditions and local engagement, to animal welfare and agroenvironmental practices. S-LCA's life cycle perspective also involves evaluating the risk of encountering social risks among the sector's upstream suppliers, which could harm the sector's reputation. S-LCA is a new tool based on the PNUE/SETAC's Guidelines for social life cycle assessment of products published in 2009. This socioeconomic assessment, which is a first in the dairy sector, is based on a unique, innovative and accomplished assessment framework.

The Environmental and Socioeconomic LCA of Canadian Milk

METHOD

Environmental LCA

The environmental LCA follows a strict set of rules and guidelines that are detailed below. Potential impacts on the environment were evaluated with a regionalized characterization of impacts whenever possible, and impacts were grouped under five categories, as seen in the table to the right.

The scope of evaluation considered begins with the extraction of all raw materials (called “cradle”) required along the life cycle, for each stage included in the scope. For this study, the scope was limited to the main sources of impact, from “cradle to farm gate”, plus transportation to processing plant, as pictured in the figure below.



Climate Change
(GHG's under IPCC 2007)



Water withdrawal
Water consumed



Eutrophication, Acidification
Land Use, Ecotoxicity



Toxicity (carcinogens and non-carcinogens)
Respiratory Organics and Inorganics
Ozone layer depletion, Ionizing radiation



Mineral Extraction
Non-Renewable Energy

IDF Guidelines & ISO 14040-14044



In 2010, the International Dairy Federation (IDF) released “A common carbon footprint approach for dairy, the IDF guide to standard lifecycle assessment methodology for the dairy sector”. The goal of this document was to enable comparable evaluation of carbon footprints that could help benchmark different studies and understand the variable contributions to climate change impact.

The environmental LCA presented here follows the IDF Guidelines on carbon footprints, which in turn follows guidelines of the ISO standards on LCA ISO14040-14044, with a more prescriptive approach to certain methodological choices, such as scope and allocation methods. In compliance with ISO standards, a full report is available, and stakeholders were consulted along the entire duration of the project.

Table 1 - Main sources of data

Source of Information	Data Provided
Cost of Production Surveys (ON, QC, NB, NS, PEI) Mail-in Surveys (AB, ON)	Feed grown and purchased Manure practices, pesticide use Herd size, milk produced, fat and protein content Energy consumed, water consumed
Articles, mostly: Sheppard et al. (2010) Sheppard et al. (2011)	Diet proportion (%), manure storage practices Fertilizer used in each province, ammonia emissions at farms
Provincial associations (most)	Transportation distances for milk Purchased feed sources Manure spreading tendencies
Statistics Canada (online)	Provincial crop yields, average crop surfaces per farm Herd size, milk production

Data Sources

The environmental LCA benefitted from many sources of quality data, while also linking with many collaborators along the way (Table 1). The main sources are listed in the table below. Additionally, commercial feed companies contributed information, as well as fertilizer distributors. Provincial regulations and publications were used to determine fertilization rates when information was not available.

As with any study, some information is less accessible or not existing. The major limitations in this study were around manure spreading and fertilization

practices. Additionally, quantities of feed given varied greatly in some provinces and were not available in others, hence feed quantity was recalculated to vary based on milk produced.

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Social LCA

Social LCA is a new approach that is not yet subject to ISO specific rules. The methodology rather follows the UNEP/SETAC's Guidelines, which in turn were based on ISO 14040-14044. These Guidelines describe the concepts and identify the main steps of implementation to conduct the S-LCA, but do not define any particular assessment methodology. The S-LCA perspective is described below, followed by the presentation of the assessment frameworks developed in this project to assess the socioeconomic performance of the Canadian dairy sector.

The S-LCA perspective

Similar to an Environmental LCA (E-LCA), an S-LCA evaluates the socioeconomic performance of a product at the different stages of its life cycle, from "cradle to grave". But instead of measuring the potential impacts of physical processes, this tool assesses businesses' behaviours to establish their socioeconomic performance with respect to their main stakeholders in regards to different social issues of concern.

The UNEP/SETAC's Guidelines provide the basic framework to conduct such assessment. It identifies for example the groups of stakeholders to include in an S-LCA (cf. Figure 1) and proposes a list of issues of concern to document at each stages of the life cycle. As it does not, however, provide a particular assessment framework, a specific one has been developed for this project that is compatible with the guidelines.



Figure 1 – Stakeholder categories

The assessment frameworks

The product system used in the assessment was similar to the one defined in the E-LCA section, with the difference that the assessment focused on behaviours rather than on processes. The main businesses involved in the system were identified, starting with the dairy farms and their organizations to also include their main upstream suppliers.



More specifically, a detailed analysis – called Specific Analysis – was conducted of Canadian dairy farms and their Boards. The aim of this framework was to provide a detailed analysis of the socioeconomic performance of the dairy sector by assessing the degree of its social responsibility towards its stakeholders. Behaviours were documented using primary data collected through surveys completed by over 300 dairy farmers located in six provinces, as well as by the dairy Boards. More than 20 issues of concern were documented using around 40 socioeconomic indicators (Figure 2).

<p>W</p> <ul style="list-style-type: none"> • Social benefits • Working hours • Salary and fringe benefits • Working conditions transparency • Health and safety • Professional accomplishment 	<p>LC</p> <ul style="list-style-type: none"> • Community engagement • Natural and built heritage • Cohabitation
<p>S</p> <ul style="list-style-type: none"> • Commitment to sust. dev. • Agroenvironmental practices • Animal welfare 	<p>VCA</p> <ul style="list-style-type: none"> • Responsible procurement practices • Responsible supplier practices

Figure 2 – Issues of concern documented at the farm level

The documented behaviours were assessed using an evaluation scale to determine their level of social responsibility (Table 2). Performance Reference Points (PRP), or thresholds, have been identified in each case to determine the socioeconomic performance of all particular behaviours. The description of each indicator and PRP is available in the full report.

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A Potential Hotspot Analysis (PHA) has been performed over the Canadian dairy sector's upstream suppliers. A PHA assesses the risk of encountering behaviours going against accepted social norms among the enterprises being part of the system's supply chains. The PHA has been conducted to provide a preliminary overview of the social issues found among the Canadian dairy sector's main supply chains to bring awareness over the socioeconomic risks related to current procurement practices and to point out issues for which deeper analysis is needed.

The PHA was performed using generic data, i.e. data available in national and international databases, NGOs' reports, websites, etc. According to data

Table 3: PHA's risk evaluation scale

		
Low possibility	Moderate possibility	High possibility

The possibility of encountering **social hotspots** has been assessed by documenting a list of social issues of concern using generic data. PRPs, but also experts' opinions have been used to determine the risk level.

availability, the assessment was conducted either at a business, sectorial or national

level using a risk evaluation scale (Table 3). The risk of encountering hotspots was identified at each stage of the system according to a list of social issues of concern related to the Guidelines' stakeholder categories.

Table 2: Behavioural responsibility evaluation scale

The assessment of the socioeconomic performance of the Canadian dairy farms and their Boards has been conducted using the following behavioural responsibility evaluation scale:

			
Risky behaviour	Compliant behaviour	Proactive behaviour	Committed behaviour

A **risky behaviour** is considered as a hazardous practice that can cause significant damages or create serious problems to the concerned stakeholders.

A **compliant behaviour** refers to a normal and expected practice. It corresponds generally to a minimal legal requirement or simply to an absence of initiative or commitment in situations where it is not required.

A **proactive behaviour** translates an in between engagement; the business goes beyond legal requirement, but has not yet reach a leading behaviour.

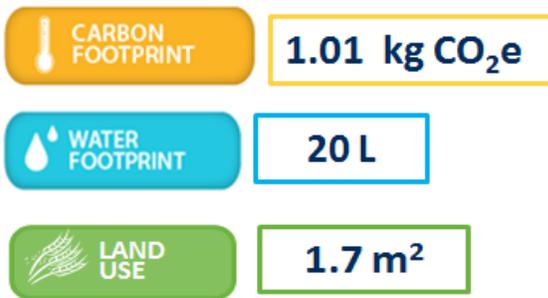
A **committed behaviour** is considered as the most socially responsible practice a leading enterprise could reach. It is a leading behaviour.

RESULTS

Environmental Performance

A profile of the average kilogram of milk produced in Canada can be summarized with the numbers below:

Footprint of 1 kg of FPCM



Equivalent impacts (non life-cycle)

6 km driven with a car 

a 2 minute shower 

0.5 kg of wheat (1-2 breads) 

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Potential Impacts over the Life Cycle

In order to understand what contributes to the potential impacts and how these contributions vary, results are detailed by category below.

Climate Change

The spread of greenhouse gas emissions was in line with similar publications. While energy, transportation and buildings and equipment had little impact (8% of the total), the most important emissions were caused by methane and nitrous oxide emissions, occurring, in decreasing order, from enteric fermentation, manure storage and feed fertilization (Figure 3).

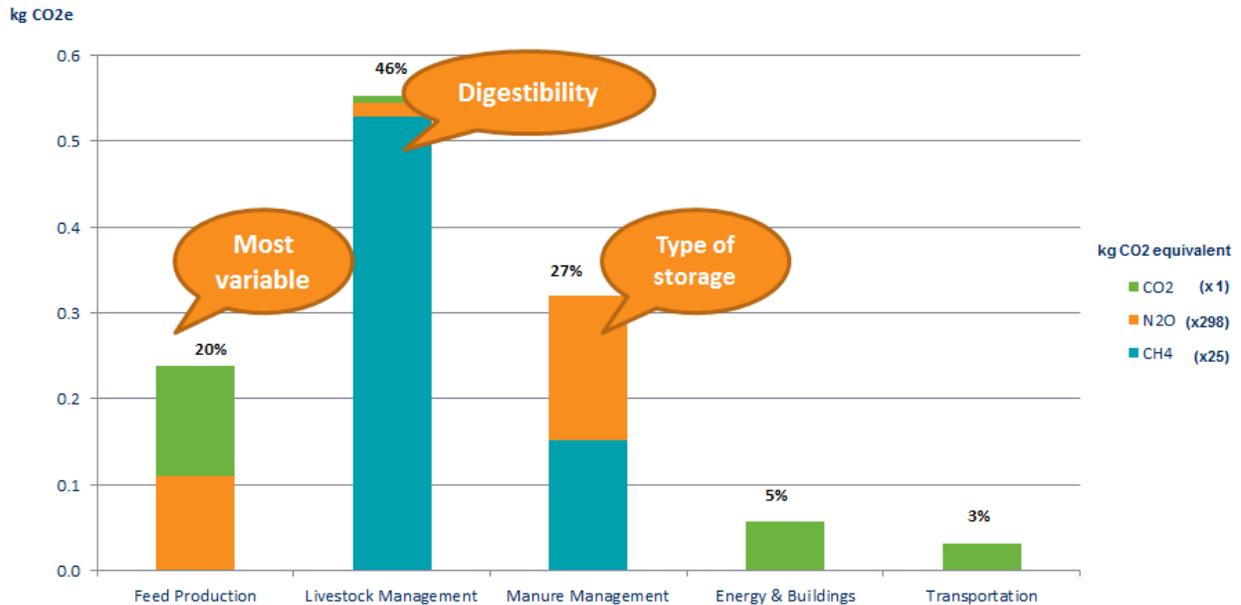


Figure 3 – Spread of GHG Emissions

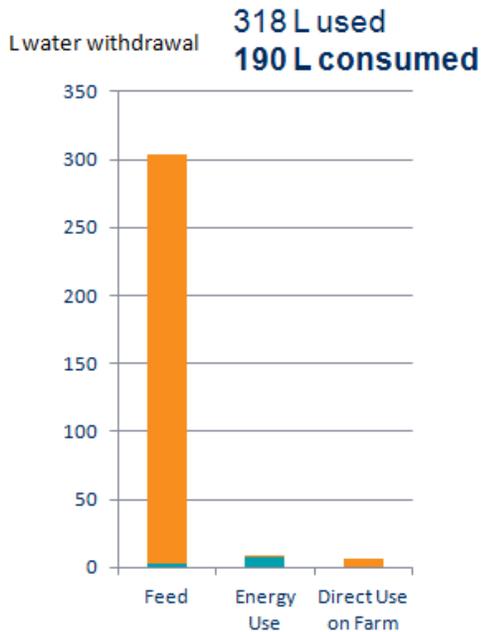
The results overall varied with respect to different **types of manure storage**, with **digestibility**, with concentrates for example having a higher digestibility than forage, and last but not least, with the highly variable practices with respect to **fertilization** in feed production. Manure spreading and incorporation techniques and concentrations, matched with different synthetic fertilizer types and concentrations, as well as spreading techniques, varied greatly and inconsistently, leaving room for a better follow-up and guidance.

The footprint of energy also fluctuated importantly between provinces, mostly due to a changing grid mix. Variability also resulted from geographical location, with nitrous oxide emissions from soils being much higher in humid provinces (Eastern Canada and BC) than in the prairies.

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Water Consumption

With Irrigation



The water footprint of milk production in Canada varies greatly from one farm to another, between 11 L and over 200 L of consumed water with a weighted average of 20 L, however with most farms being at the lower end of this scale. An example of each case is shown in Figure 4. Feed produced in regions using irrigation (1.2 %) contributes greatly to the overall footprint. For farms using non-irrigated feed, only a part of water consumption is linked to direct on farm use (drinking and cleaning water), while a non-negligible contribution is linked to water evaporated during energy production, for use at various stages of the life cycle. For this reason, energy efficient practices at the farm also contribute to reducing the water footprint of milk.

No Irrigation

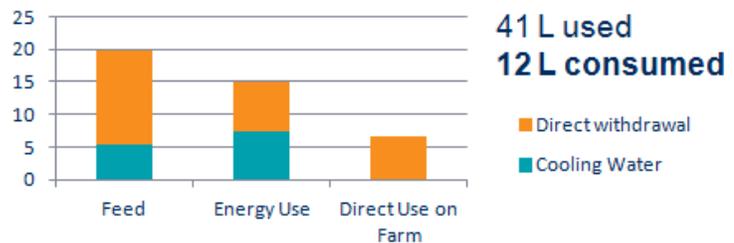


Figure 4 - Water withdrawal at different stages, examples with or without irrigation

Ecosystem Quality

When evaluating potential impacts on ecosystem quality, different categories of environmental indicators were evaluated, with land use, as the main threat, with some potential impact from the use of mineral supplements on ecotoxicity. Impact on biodiversity from ecotoxicity as well as arable land use are both sensitive to geographical location. The latter for example, measuring potential loss in biodiversity, was much more important in areas of dense industrial and agricultural activity (Figure 5).

Ecotoxicity can occur through a similar leaching effect, as a result of metals contained in feed. While most of the minerals contained in feed are assumed to be in a closed-loop system where the minerals contained in manure are spread on crops and absorbed by them to be returned to the cow, mineral supplements added in dairy rations are assumed to represent the share of minerals that is lost in the system (through leaching and soil accumulation) and must be compensated.

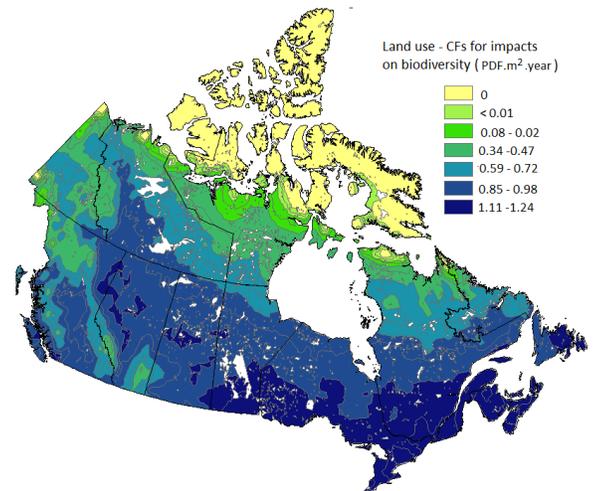


Figure 5 - Potential impact on biodiversity from land use

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Human Health

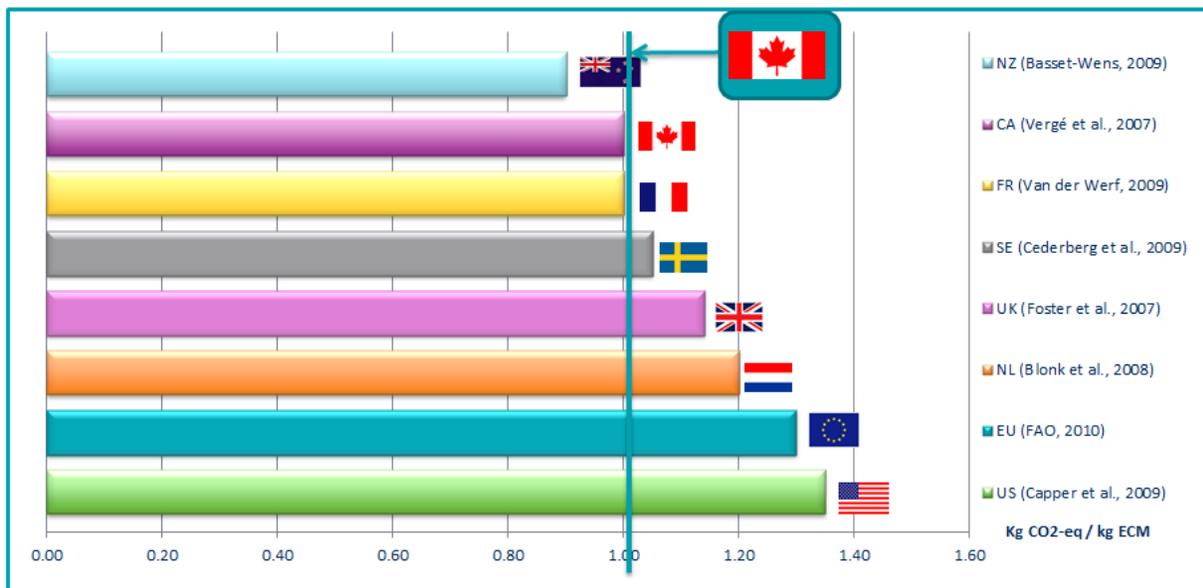
Impacts on human health are dominated by the emissions of ammonia from fertilizers, in housing and from manure storage. Impacts also exist along the supply chain in relation to fossil fuel combustion (emissions NO_x, SO₂, hydrocarbons) in electricity production and direct use. Additionally, potential impacts of toxicity also exist in relation to mineral content of manure, when spread on crops not used in feed. Zinc, most notably, is a substance that bio-accumulates over time and can prevent absorption of other essential minerals. The inclusion of mineral supplements is once again only evaluated as a sensitivity analysis.

Resource Depletion

Depletion of non-renewable resources, such as fossil fuels and metals, is also evaluated in an LCA. Feed production is once again responsible for most of the impact (75%), however resource depletion occurs upstream of the farm, in equipment manufacturing and diesel processing.

Benchmarking

Looking at the carbon footprint of milk, compared to alternative publications, Canada places among the top, next to New Zealand and along with France and Sweden. While New Zealand operates a particularly extensive pasturing system, France and Sweden also benefit from cooler climates that prevent important methane emissions from manure, and from relatively clean grid mixes. Some variability can result from methodological choices. Meanwhile, the US and the Netherlands find higher footprints, both using more intensive agricultural practices with an important contribution of feed from corn, a high-impact crop. The US has a much higher footprint from manure management, due to liquid storage in warmer climates.



With regards to Water Footprinting, a few publications are available that allow for benchmarking. Mainly, a French publication from l'Institut de l'élevage (2012) places the French milk's water footprint at 17 L/kg. A publication by Mekonnen and Hoekstra (2011) evaluates a few more, with the Chinese footprint at 132 L/kg, the Indian footprint at 148 L/kg and the Dutch at 42 L/kg. The variability is mostly a function of irrigation, with large countries composed of different climates demonstrating higher footprints.

Although it would be interesting to compare results with nutritional alternatives, such as soy milk and other animal proteins, doing so on a per kg basis is irrelevant, which a nutritional content so variable. A project beginning in June 2012 will attempt to define the most relevant way to compare the environmental impact of nutritional alternatives to milk. Stay tuned for further developments.

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The socioeconomic performance

The socioeconomic performance of the Canadian dairy sector can be portrayed in two ways. By describing the sector's socioeconomic contribution on the one hand and by providing a preliminary overview of the social risks found among the sector's supply chains on the other hand.

The Canadian dairy sector's socioeconomic contribution

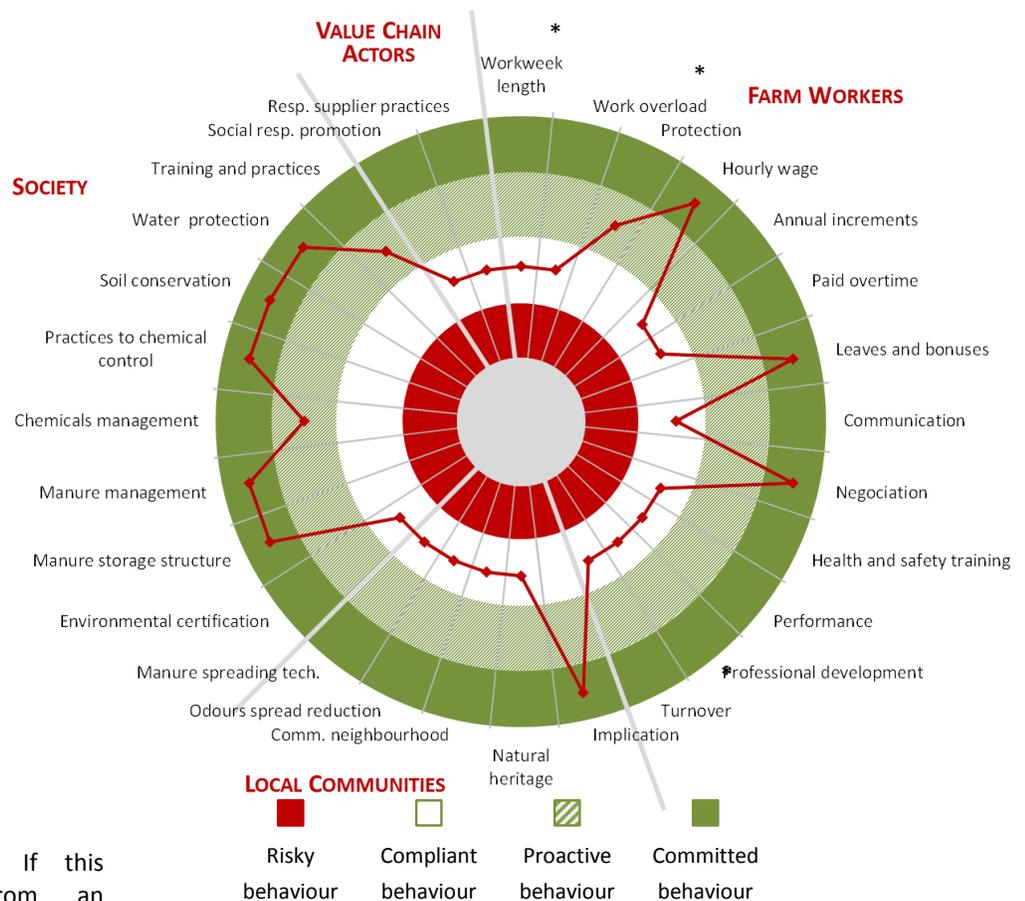
The economic contributions of the Canadian dairy sector are well-known. For example, in 2009, the sector's activities have generated over 127,000 direct, indirect and induced jobs, contributed approximately 7.2 B\$ to the national GDP and procured almost 1.4 B\$ in total tax revenue.

But there is more. Canadian dairy farmers are also corporate citizen whose behaviours – individually and collectively – impact their stakeholders. This S-LCA provided a detailed picture of this socioeconomic performance.

Figure 6 shows the average socioeconomic performance of Canadian dairy farms towards their stakeholders, i.e. the farm workers, their local communities, the society and their suppliers and business partners (including the consumers).

It is made clear from this assessment that Canadian dairy farms have an overall positive performance. It is furthermore obvious with respect to the agroenvironmental practices, whether it concerns water sources protection, manure storage or soil conservation. If this commitment is obvious from an environmental point of view, it is also significant in a socioeconomic perspective, as it also meets the Canadian society's expectation. Dairy farmers' engagement towards their local community is also significant, the vast majority being involved in their communities in many different ways. However, more could be done in terms of cohabitation, with producers adopting practices minimizing odours propagation.

The picture is also contrasted in regards to farm workers. Although dairy farmers provide overall working conditions that go beyond labour standards – to which they are mostly not legally subjected – there is room for improvements regarding various issues, such as professional training and communication of working conditions. The same holds true with respect to their suppliers and business partners, given that a majority of dairy producers do not usually consider their suppliers' performance in regards to social responsibility in their procurement decisions.



* Due to data availability, a committed behaviour was not assessed for these indicators
Figure 6 –The average socioeconomic performance of the Canadian dairy farms

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LOCAL COMMUNITIES		VARIABILITY	SCORE
Community engagement	Implication within the community		×
Natural and built heritage	Preservation of natural and built heritage		×
Cohabitation	Communication with the neighbourhood		×
	Odours spread reduction		×
	Manure spreading technology		×

* Gray zones are behaviours that were not assessed due to data availability

Figure 7 – Average score and variability of answers at the farm level; the case of local community

The assessment also demonstrates that the Canadian Dairy Boards are in average committed corporate citizens, especially in regards to local communities, as most of them support milk donation, scholarship and sponsorship to local organizations, even if these actions are not always part of a formal policy or agreement. Last year, Dairy Boards granted directly over 3.4 M\$ to their local communities, in addition to milk donation and participation to other initiatives. They are also committed relating to society by funding research in areas such as public health, nutrition and environment. Over 4.5 M\$ was directly invested last year in such activities, not including participation to other research clusters.

The assessment also pointed out issues for which dairy Boards could be more committed (Figure 8). This is the case for example with regards to the promotion of sustainable development and social responsibility, since only a minority of Boards hold formal commitments or have partnerships in those fields and grant resources to realize them. The same can be said in regards to the animal welfare issue. While the DFC have set up, in collaboration with the National Farm Animal Care Council, a Code of Practice to support and supervise producers, it has not been yet audited. And if provincial Boards provide trainings and support material on the subject, none have either set up a certification, a set of specifications or an audit system to complement this national initiative.

The results present only the average performance. For each of these issues, there are producers having more socially responsible practices than others (Figure 7). This suggests that there is always room for improvements, now and in the future. For example, with more producers adopting more socially responsible practices, the average socioeconomic performance could be enhanced. Moreover, given that a committed behaviour today can become a minimal expectation in the future, continuous improvement from all producers is also required to improve, but also to preserve the sector's socioeconomic performance.

Since Dairy Boards fulfill many tasks on behalf of dairy farmers in areas such as R&D and sponsorship, their behaviours were also assessed for some issues of concern. Figure 8 portrays their level of social engagement towards the stakeholders with which they interact.

	ISSUES OF CONCERN	VARIABILITY	SCORE
LOCAL COMMUNITIES	Milk donation*		×
	School milk*		×
	Scholarship*		×
	Sponsorship		×
SOCIETY	R&D		×
	Promotion of sust. development		×
	Animal welfare		×
VALUE CHAIN ACTORS	Promotion of social responsibility		×

* As these actions come under the provincial scope, the DFC's practices have not been taken into consideration.

* Gray zones are behaviours that were not assessed due to data availability

Figure 8 – Average score and variability of answers at the Boards level

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Overview of the supply chains

Finally, the study also looked at social risk potentially present in the suppliers upstream of the dairy sector, such as manufacturers of machinery, fertilizers, pesticides or pharmaceuticals. The main suppliers being located in Canada or the United States, the prevalence of social hotspots is generally lower than in countries such as China. The fact remains however that some risks seem present in a few links of the supply chains. This is the case in the fertilizer and oil extraction industries for example, where it was possible to document disturbing practices of collusion as well as bank rolling techniques from subsidiaries companies of some major players. Potential hotspots were also identified in the North American grain and oilseed sector with regards to working conditions, as they are generally not protected by labour standards. The analysis also brought up public health issues, as well as conflicts of use of natural resources related to many industries, among which the pesticides and pharmaceutical sectors. Some links are also characterized by a lack of competition.

Although the Canadian dairy sector has little power to influence these actors located far upstream, in a life cycle perspective, it falls under the responsibility of dairy farmers and their associations to get involved. This assessment can be seen as a starting point in this direction.

Conclusions

Overall, the LCA indicated an existing commitment from dairy producers to the supply chain's sustainability, which characterizes to an overall good performance – both at the environmental and socioeconomic levels. On an international level, Canadian milk places very well, with a relatively low carbon footprint and a water footprint among the best in provinces where there is no irrigation. While there is no available benchmark to compare the sector's level of social engagement, the assessment shows that Canadian dairy farms and their Boards are already socially committed corporate citizens in regards to many social issues.

An existing commitment to agroenvironmental practices, as identified in the S-LCA, suggests that evolving environmental recommendations could help sustain best practices and lower impact. With continuous improvement in mind, target areas were identified. Among them is the possibility of better tracking of fertilisation practices at the farm and to improve manure storage. It would be also profitable to provide guidelines on feed, based on impact. In a more socioeconomic perspective, it could be beneficial to promote more actively socially responsible behaviours among farmers, their Boards and eventually, their suppliers, to improve the sector's socioeconomic performance and, ultimately, its overall sustainability. This assessment provides the sector with an innovative, comprehensive and actionable roadmap to move in this direction.

LCA helps put everything in perspective, in a comprehensive and objective manner. It sheds light on where and how to improve. Specifically, this environmental and socioeconomic assessment was conducted to support the Canadian dairy producers, individually or collectively, in their decision making by introducing new parameters to consider in producing milk in an economically efficient, environmentally sustainable and socially responsible way.