



Carbon What is in it for my ranch?

ANSWERING THAT EVER-INCREASING QUESTION FOR 2023.

Graham Gilchrist, P.Ag. | Biological Carbon Canada | February 2023

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Canadian Forage and Grassland Association
466 Street 1B6, Wilmot Alley
Fredericton, New Brunswick

February 28, 2023

Dear Mr. MacLeod,

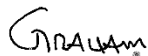
When the Association engaged Biological Carbon Canada (BCC), the second question was ‘what is in it for me.’”

Your Association is seeking answers to this question.

This report lays out answers to this question. It addresses business realities. It also addresses the cultural realities of a modern ranch and grassland owner.

BCC is available to discuss this with your Board and member associations.

Sincerely,



Biological Carbon Canada
PER: Graham Gilchrist, P.Ag.
CEO



Executive Summary

It is a game of numbers and diminishing landscapes across Canada. Today's best estimate is out of the 47 million hectares currently under agricultural management, 6.2 million are grasslands and pasture. Pre-settlement, the 47 million hectares were only grasslands.

The modern ranch in Canada does not need to change in 2023; until it has to. Carbon is a business disruptor.

The question posed is like a coin with a rounded edge. On the observe side (heads) is the owner asking this question. On the reverse side are the customer and their supply chain asking the same. The rounded edge prevents it from staying upright.

This ranch management discussion may help ranch owners examine the new issue of carbon.

A modern ranch needs a sustained level of carbon. It is part of what produces the dry matter the business uses or converts into a revenue source. Pollution tax policy impacts cash flow and the use of that revenue.

There are risks on the ranch border. These risks threaten ranch resilience and the biodiversity of the ranch landscape. Climate shifts may impact water access and the biodiversity of the living soils.



Carbon is also shifting customers and their wants. Therefore, the sale of livestock and forage products must continue to meet consumer needs.

Carbon policy also places a consumption levy on things a ranch buys. The primary agriculture sector is not 100% exempt from this levy. The ranch does shoulder some of the levy embedded in outside products and services.

Carbon also offers opportunities. In 2022, north American businesses announced over \$4 billion in greenhouse gas avoidance and reduction plans. The data associated with this change has value and currently is being traded.

The Canadian Forage and Grassland Association is very busy figuring out how to operationalize a voluntary market carbon offset protocol. The grasslands protocol is the only protocol in Canada that creates an offset from the emissions that are avoided; or did not happen.

So keeping the native range is good, right?

Despite all our technology, we owe our existence and way of life to a six-inch layer of topsoil and the fact that it rains.

The farm equipment association of Minnesota and South Dakota.



A Ranch and their Quality of Life Values

SENSE OF PLACE

Do these statements resonate with you as an owner of grasslands?

My sense of place is somewhere I find peace and quiet.

My sense of place is where I am free to decide things for myself.

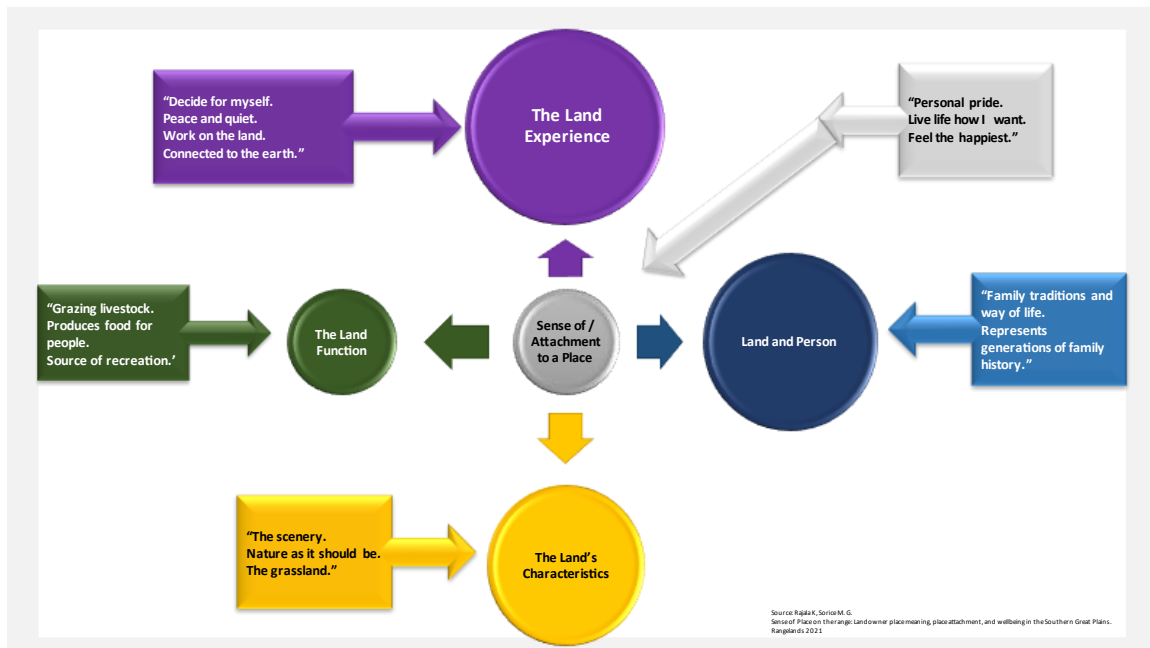
My sense of place is a source of family pride.

My sense of place is somewhere I feel connected to all living things and the earth.

My sense of place symbolizes a way of life I want to pass on to future generations.

These five statements may not resonate with you, but they were the top five statements reflecting the values of 2993 ranchers in a recent research paper¹.

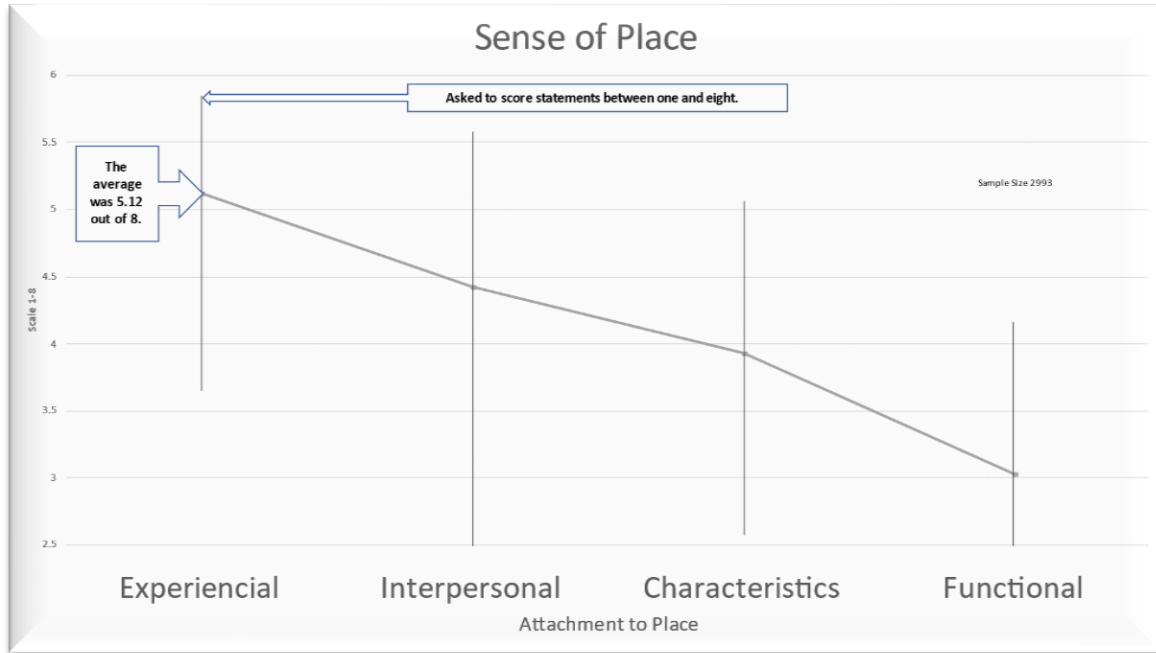
Ranch life has an essential sense of attachment. It reflects important aspects of who you are, a source of personal pride, and where there is a great sense of happiness.



¹ Rajala



The answers the ranchers gave the researchers emphasized the experience of their location. The ranchers' then ranked interpersonal next highest, followed by land characteristics, and finally the land's function.



This research echoes other papers on a ranch's quality of life (QLV).

It has been noted in many agricultural economic papers the traditional approach to investment decisions by farms and ranches finds discrepancies in land values and income streams. For example, the ranch's net earnings have difficulty keeping up with the cash flow for the current fair market value of the land.

There is strong evidence this profit and wealth motivation is not the most important factor in today's farm and ranch management².

This discussion paper has to address the QLV in the room. Rural living, land ethics, family attributes, simple decision-making matrixes, and other benefits rank as high as profit. Torell Allen challenges that it is the family unit and not the farm unit that is the unit of analysis.

The family unit will trade a lower profit for the desired QLV.

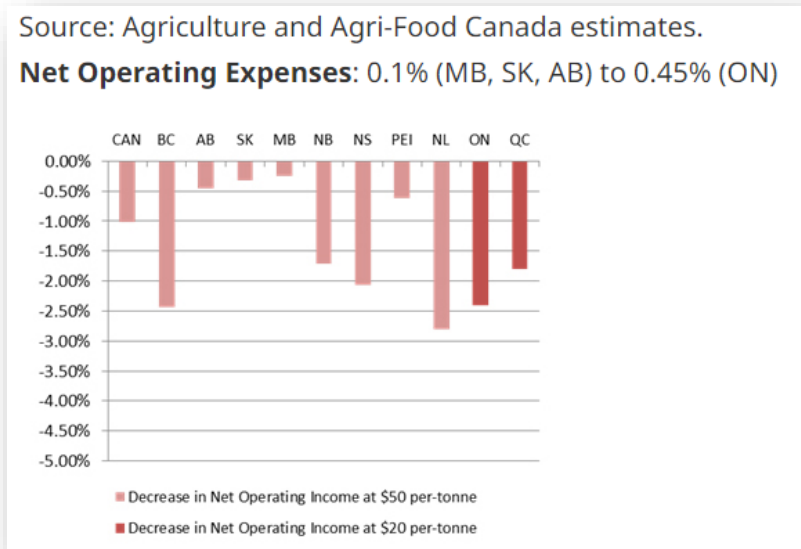


² Torell



Will a new carbon reality impact a ranch family's QLV?

Yes. The carbon levy will impact the cost of energy getting materials and supplies to the ranch and getting the final ranch product to market past the ranch gate. The Bank of Canada³ estimates the carbon levy will increase Canada's inflation by 0.4%. AAFC estimates⁴ the levy will increase costs on the ranch by just under 0.5% (@\$50/tonne).



Yes. Data gathering and management for soil quality will add costs to the ranch expense matrix.

Yes. Several farmers in 2023 commented on climate-smart programs offered by businesses in and around Nashville. These were large farms (9000 to 12000 acres). What was curious was their language. The current return provided was not enough to change

³ Bank of Canada Governor Tiff Macklem told members of the House of Commons Standing Committee on Finance in a letter obtained by Global News. 2022March3

⁴ <https://agriculture.canada.ca/en/sector/data-reports/climate-change-policy-financial-impacts-carbon-pricing>



their farm **culture**⁵. It was more than just the capital investment in equipment. It was re-tooling the full production cycle and farm rhythms.

Yes. Bayer, Nutrien, Corteva, and Syngenta, and a few others are offering in-house credits for sustainability efforts. There is a catch. If you are not a full-time customer, access to their programs may be limited. But, if you make the change, it may impact that local QLV.

Yes. A single ranch does not have the scale to efficiently access and bundle an offset. Aggregation is beneficial⁶. Aggregation is a necessary cost.

Ultimately, our company has to listen to our investors and shareholders and their sustainability wishes.

AI Driver – Bayer CropScience

Crossroads, 2023Jan24

The table below outlines a scenario between one ranch with 500 acres and ten ranches with 500 acres each. The costs are USD.

Expenses	Cost per Ranch One 5000 acre project.	Cost per Ranch One 500 acre project.
<u>Year One</u>		
Registration	\$790	\$4000
Assessment	\$1100	\$1100
Project Validation	\$1625	\$16250
<u>Annual</u>		
Registration	\$520	\$1000
Accounting	\$250	\$2500
Reporting	\$500	\$500
<u>Credit Issue</u>		
Verification	\$1050	\$10500
Marketing	\$345	\$345

⁵ <https://www.agweb.com/news/business/conservation/farmer-panel-climate-smart-program-rewards-must-outweigh-risks-earn> .

⁶ Brammer



A Very Quick Soil Health Overview



It is not the first time promoters of beneficial management changes made co-benefits claims.

Management interventions can change soil fertility, yield, productivity, and water retention. They are also tools for erosion control and other mitigation strategies for degradation events.

The current argument is adding soil carbon sequestration⁷ to the list of co-benefits. The flavor of the day is regenerative agriculture.

Why?

One can read the farm press and point at a price on carbon emissions as a likely suspect.

Modern agriculture needs soil carbon. A recent publication by the Council of Canadian academics observed the following.

Grassland systems absorb and release carbon in response to environmental conditions and land management practices, offering a range of opportunities for enhancing carbon sequestration or reducing GHG emissions.

The carbon respiration cycle helps grow the plants the farm business harvests. Carbon sequestration is part of the energy balance. This carbon cycle links directly with the nitrogen cycle. The management of these soils requires the balance of both soil carbon and soil nitrogen⁸.

⁷ Moinet

⁸ CCA



A sustained net change in soil carbon, sourced from atmospheric carbon, allows for sustained productive grasslands. This annual growth is the basis for carbon market instruments⁹.

The energy balance can be maintained when the agricultural business pulls the C from the soil for business purposes and replaces C (and nitrogen) from other places and sources. However, the practice can also release additional greenhouse gases.

Good farm managers will have monitoring systems and data on carbon stocks and soil fertility at points in time and procedures to evaluate this annual dataset¹⁰ over time.

Carbon sequestration can become static as the particle surfaces become full. Therefore, each soil profile has a maximum storage capacity when addressing mineralized soils. The particulate carbon (the living things) depends entirely on their living conditions. They may be steady over many years, growing if conditions are favorable, or declining if drought or mechanical interference degrades their living conditions.

The other management issue is the rate. Because a soil profile has a maximum capacity, the rate is time limited. Depending on where the soil profile is in the depreciation curve, there may be a lot or a little capacity left to be filled by the new management technique.

Choices in soil management also can degrade the capacity. For example, soil profile agitation with the corresponding soil warming, climate impacted net rainfall, and adding amendments all require additional work to understand their full impact on the ability of the soil profile to reach or add capacity.

At this point, the agricultural business's avoided emission, or reduced CO₂e emission is more effective than relying on the net improvement in soil sequestration¹¹.

The Canada Grassland Protocol is an avoided emission approach.

⁹ A plural term covering offsets, credits and other data purchases.

¹⁰ A concept of same place, same depth, and same time.

¹¹ Moinet



A Ranch and their Carbon Risk Observations and Assessments

Before Christmas, Agriculture and Agri-Food Canada (AAFC) announced a process to build a sustainability strategy¹² for Canadian agriculture.

Every once in a while, a ranch business should to an external sweep of issues on the horizon. In the literature, it is called an ESGT¹³ Risk assessment.

In general, an ESGT risk assessment will review a series of issues and their impact on the ranch. Below is a sample assessment matrix¹⁴.



A Sampling of ESGT Issues, Risks, and Opportunities

Table I.1 A sampling of ESGT issues – a sneak preview

<i>Environmental</i>	<i>Social</i>	<i>Governance</i>	<i>Technology</i>
<ul style="list-style-type: none"> • Climate Change • Sustainability • Water • Air • Earth • Carbon Emissions • Energy Efficiency • Natural Resources • Hazardous Waste • Recycled Material Use • Clean Technology • Green Buildings • Biodiversity • Animal Rights • Pandemics 	<ul style="list-style-type: none"> • Human Rights • Labor Rights • Child Labor • Human Trafficking • Human Slavery • Health & Safety • Workplace Conditions • Workplace Violence • Product Safety • Fair Trade • Data Privacy • Discrimination • Harassment • Bullying / Mobbing • Diversity & Inclusion 	<ul style="list-style-type: none"> • Corporate governance • Leadership • Culture • Business ethics • Geopolitics • Corruption/ bribery • Fraud • Money laundering • Anti-competition/ anti-trust • Regulatory compliance • Conflicts of interest • Compensation disclosure 	<ul style="list-style-type: none"> • Cyber-security • Ai geopolitics • Data mining • Internet of things • Artificial intelligence • Machine learning • Deep learning • Robotics • Automated robotic processing • Military robotics • Surveillance • Dark web • Fake news • Deep fakes – visual • Deep fakes – audio • Biometrics • Wearables • Nanotechnology • Bioengineering • Crispr

¹² <https://agriculture.canada.ca/en/environment/sustainable-agriculture-strategy>

¹³ Environment, Social, Governance, and Technology risk assessment.

¹⁴ Bonime-Blanc



The work AAFC did is a bit light on the SGT sections but is a good outline of the environment section.

WHAT ARE AAFC’S CARBON OBSERVATIONS?

The tables below outline their assessments.

Carbon Assessment for Adaptation and Resilience	Estimated Impact on QVL in the event the risk is realized.
<p>Higher temperatures, shifting precipitation patterns and more frequent and intense extreme weather events (e.g. droughts, floods, hurricanes, wildfires) will contribute to increased crop and livestock loss, soil health risks, the incidence of pests and diseases, and increased risk of supply chain disruptions.</p>	<p>There will be downward pressure on <i>culture and a way of life</i>.</p> <p>There will be detrimental pressure on values for <i>grazing and producing food for people</i>.</p>

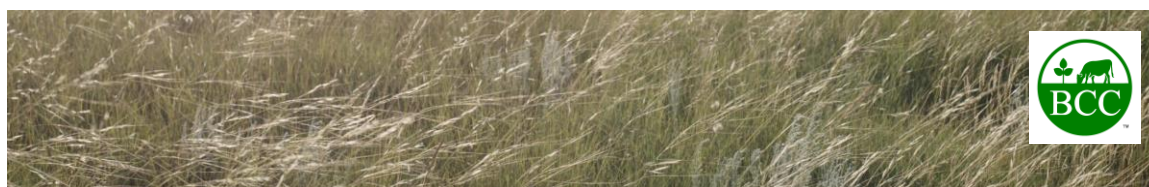
Carbon Assessment for Biodiversity	Estimated Impact on QVL in the event the risk is realized.
<p>The benefits of biodiversity to production include pollination, pest management, soil formation, nutrient cycling and water purification.</p>	<p>Biodiversity loss will shift the values associated with <i>stewardship and earth-connections</i>.</p>
<p>Declines in biodiversity on agricultural landscapes have resulted from the conversion of habitat such as grasslands, wetlands and forage/pasture lands to annual crops, as well as increased use of chemical inputs.</p>	<p>Conversion of grasslands will highly impact the sense of loss to the values on <i>my way of life and ability to pass on this to my generations</i>.</p>



Carbon Assessment for Climate Change Mitigation	Estimated Impact on QVL in the event the risk is realized.
In 2020, total agricultural emissions from production were estimated at 69 Mt CO ₂ e (10% of Canada's total).	This is perceived as a threat to values associated with <i>how I want to live my life</i> .
Agricultural practices release GHG emissions primarily from biological sources, such as livestock production (enteric fermentation), and the application of synthetic nitrogen fertilizers, manure management, and on-farm fuel use (e.g., operation of farm machinery).	This is perceived as a threat to values associated with <i>the ability to decide things for one-self</i> .
In 2020, agricultural soils stored almost 10 Mt CO ₂ e, meaning that agricultural soils sequestered more than they emitted, counteracting approximately 14% of total annual agricultural emissions.	This is perceived as a threat to <i>my pride</i> when called a polluter.

Carbon Assessment for Soil Health	Estimated Impact on QVL in the event the risk is realized.
Regionally, decreasing soil carbon levels, decrease in soil cover days, and higher risks to soil erosion are seen in Eastern Canada, largely due to the steady conversion of tame pastures and hayland to annual crops.	Conversion of grasslands will highly impact the sense of loss to the values on <i>my way of life and ability to pass on this to my generations</i> .
Soil biodiversity is an important component of healthy soils .	There will be detrimental pressure on values for <i>grazing and producing food for people</i> .

Carbon Assessment for Water Health	Estimated Impact on QVL in the event the risk is realized.
There is regional variability in these challenges across Canada, given differences in geography, production practices, climate, soil and water quality .	There will be a detrimental pressure on values for <i>grazing and producing food for people, and my ability to graze livestock</i> .



What is the Ranch's Management Response?

Based on this assessment, what could be your ranch's response?

Over the long term, a ranch must be proactive on these risks¹⁵. Highlighted are the risks identified by Allianz and are in AAFC's risk assessment. The other four risks may not apply directly to the ranch.

1. **Natural catastrophes**
2. **Market developments**
3. **Changes in legislation and regulation**
4. **Fire, explosion**
5. **Loss of reputation or brand value**
6. **Climate change**
7. Business interruption
8. Cyber incidents
9. New technologies
10. Political risks and violence

In summary, the ranch has five responses. These would be:

1. Lower your operating costs. Examine matching the business cycle to the forage cycle and spending that results from a mismatch. Open females past calving are a cashflow drain. Cut and moved hay for winter feed is a cost center. Lastly, a favorable margin is better than maximizing kg sold.¹⁶

The carbon levy is expected to impact (increase) the ranch's cost matrix by 0.5%¹⁷ in western Canada and overall across Canada by 1%.

- a. Example - A sustained effort to reduce diesel use by one litre per acre per year (out to 2050) would lower the farm's GHG footprint by 75.6 kg of CO₂e and lower your direct expenses by \$30.80 (NPV¹⁸ \$14.02).
2. Meet customer demands.
 - a. Example – A plant in Alberta is paying \$0.30/bu for the GHG footprint data on the product delivered.
3. Improve brand perception.
 - a. Example – The value delivered by TrustBix to verified ranches.
4. Respond to investor pressure.

¹⁵ Allianz Risk Barometer

¹⁶ Thank you to the folks at Ranching for Profit.

¹⁷ AAFC

¹⁸ Risk rate 6.5%



- a. Example – A major meat processor received a 1% discount in the mortgage rate to deliver on the underwriting bond’s sustainability matrix outcome delivery.
5. Comply with regulations.
- a. Example – Adding and expanding buffer zones¹⁹ around wetlands lowers risk of pesticide contamination.
 - b. Example – All publicly traded companies in Canada must now report on supply chain risk from climate and any GHG assets (offsets) must be material.

The table is a snapshot of possible ranch management responses to the risks identified by AAFC.

Assessment	Short Term Changes	Medium Term Changes	Long Term Changes	Your Ranch’s Culture Shift
Resilience	Purchase cost-effective extreme weather insurance. Change management measurement system to earnings per acre and away from per cow or per kg. Change earnings measurement to an accrual basis. Invest in people improvements.	Securing financial stability by increasing EBDITA ²⁰ as a % of Revenue. Lower the ranch business’s current liabilities to a target of 15% of Revenue or lower. Invest in livestock improvements. (Healthy animals have a lower carbon abatement cost.)	Self-insured disaster fund. Invest in land improvements.	The culture shift is partially binary. Being or losing resilience will shift the current way of life’s value of <i>peace and quiet</i> , and a shift in the same life value of <i>personal legacy</i> .

¹⁹ Alberta Pulse Growers - Watershed PMRA Study

²⁰ Earnings before paying interest and taxes, plus expense charges for depreciation and amortization.



Biodiversity	Evaluate acres at risk on the whole farm or ranch.	Change soil management to achieve an outcome of no more decline in soil organic matter for 100% of paddocks.	Change management to secure consistent growth in carry capacity for all uses.	A growth in biodiversity strengthens the values associated with the landscape.
Climate	Know the farm's GHG footprint is known.	The farm's footprint is reduced by 10%.	The farm is at 2005 levels for GHG emissions.	The 0.5% change in inflation ripples through all the ranch values.
Soil Health	Soil health inventory is complete on all soil zones.	Soil sequestration is now stable.	Soil health across the whole farm is growing at a sustained rate of 0.2% per year ²¹ .	Soil health is family health.
Water	Assessment on rainfall and evaporation risk for all water sources.	Modify sources for livestock water so they are no longer dependent on direct rainfall.	All production practices are modified for the water quantity available.	Water feeds all.

²¹ McConkey – *The SOC gains were modest. The proportional SOC gain over 21 years was only 4% of the initial SOC for the 0-30 cm depth.*



A Health Business First

A sustainable business is first a financially stable business with long-term growth in retained earnings (cash reserves).

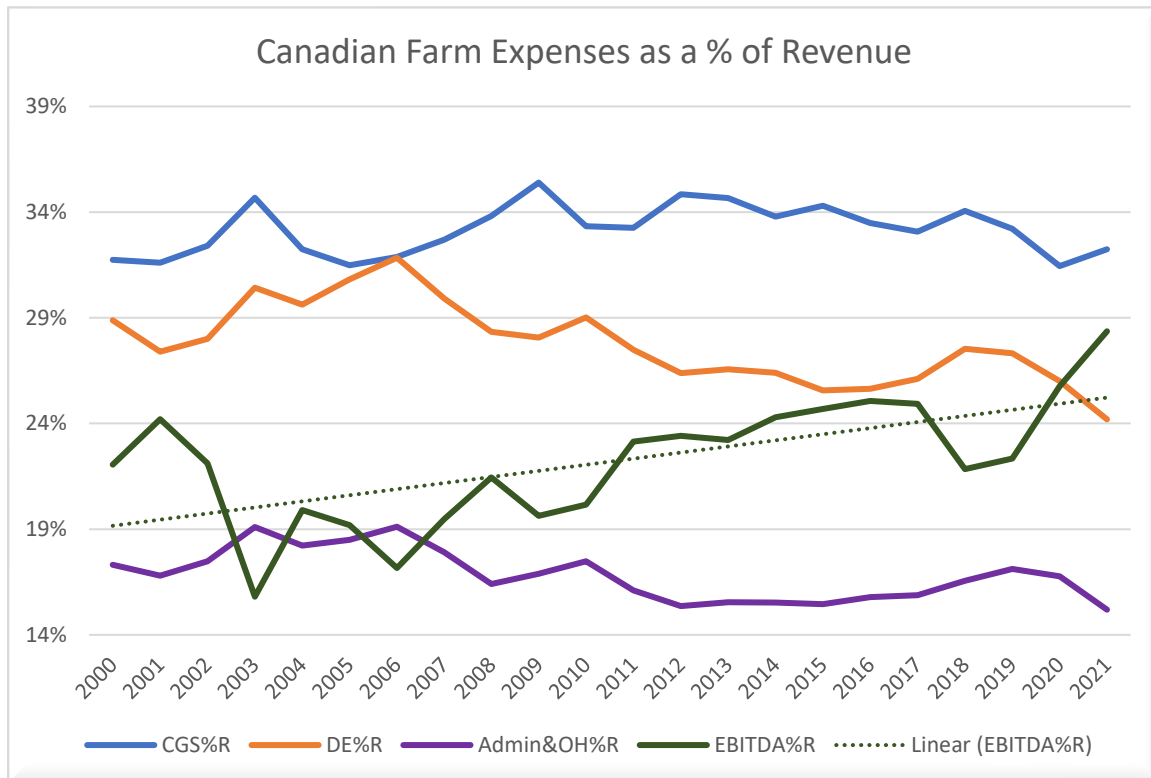
An examination of the material below indicates that Canadian farms and ranches have a debt structure and cash flow challenges. This issue threatens the ranch's ability to adapt and invest in the new business realities. In 2021, the threat is slightly less, as short-term trends have earnings growing and current liabilities shrinking as a percentage of revenue.

YOUR FINANCIAL REALITY

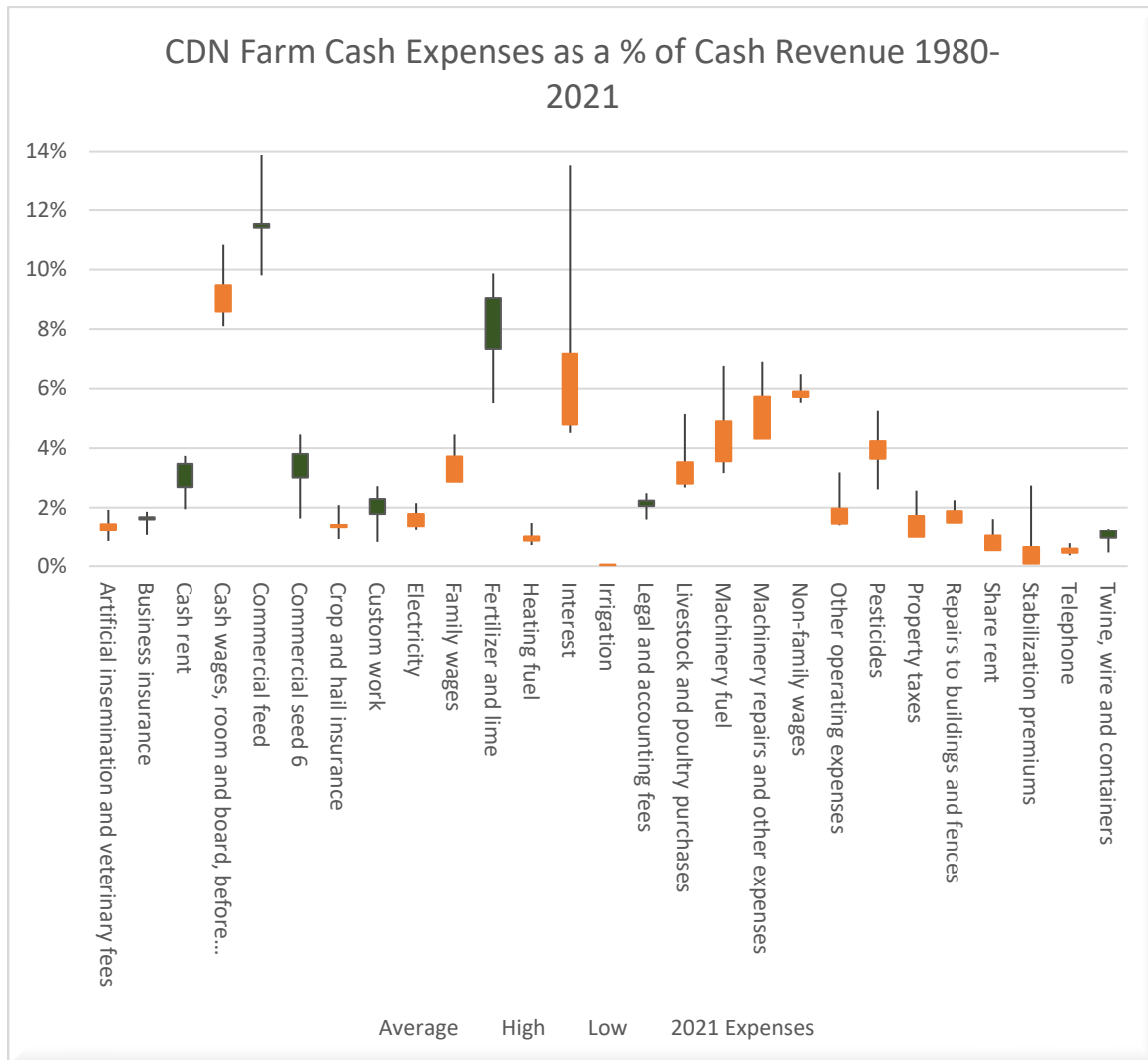
Statistics Canada has been tracking farm income and expenses for a while.

Below is a series of charts outlining the spending and expenses for Canadian farms from 1980 to 2021.

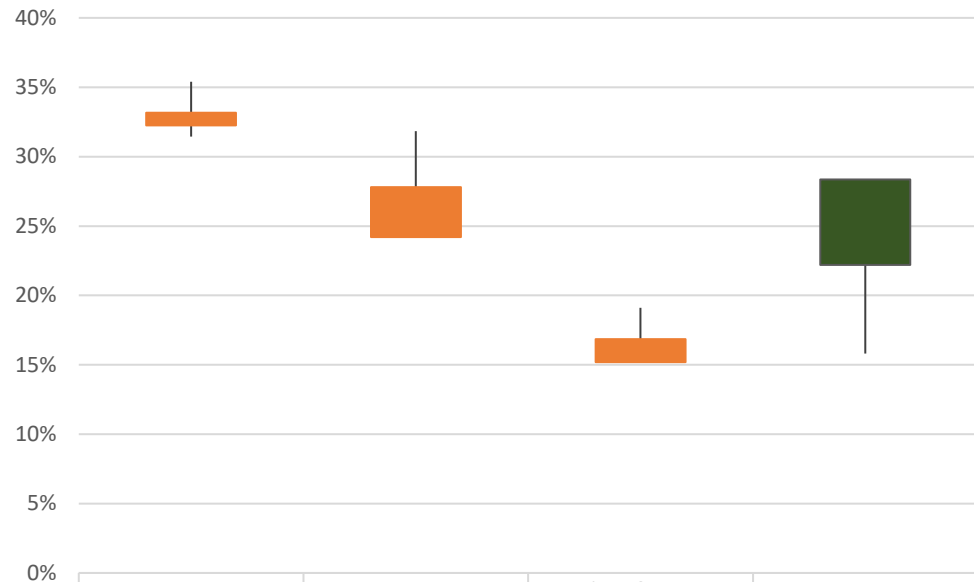
The trend for earnings as a percentage of farm revenue is upward. This is good news.



This is a stock chart of the line expenses in the Statistics Canada report. The line shows the high and the low for the expense line. When the box is green, the current year's data (2021) is above the average. The top/bottom of the line is the highest/lowest data point over the 41-year period.



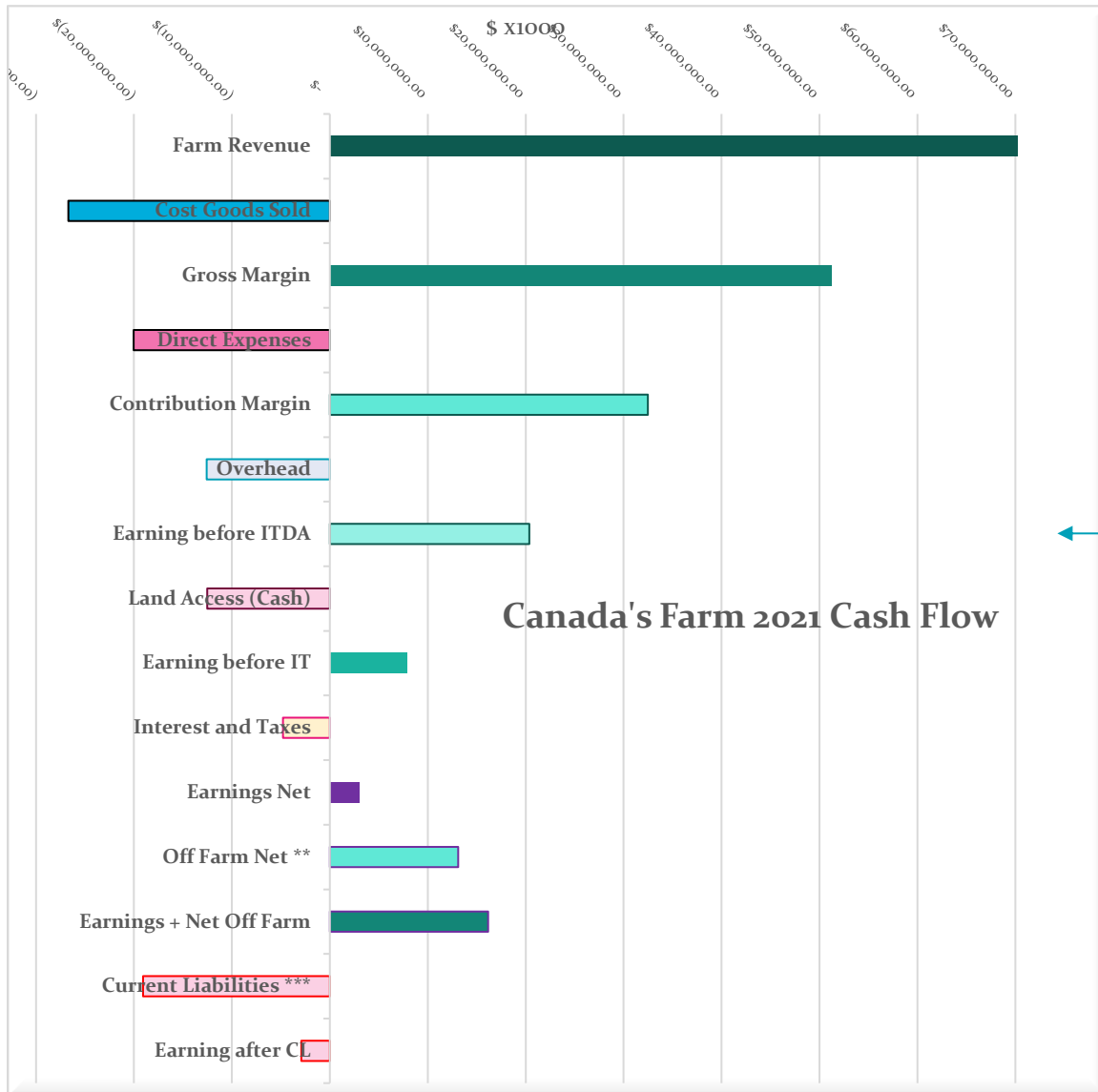
CDN Farm Cash Expenses as a % of Cash Revenue 1980-2021



	CGS%R	DE%R	Admin&OH%R	EBITDA%R
Average	33%	28%	17%	22%
High	35%	32%	19%	28%
Low	31%	24%	15%	16%
2021 Expenses	32%	24%	15%	28%

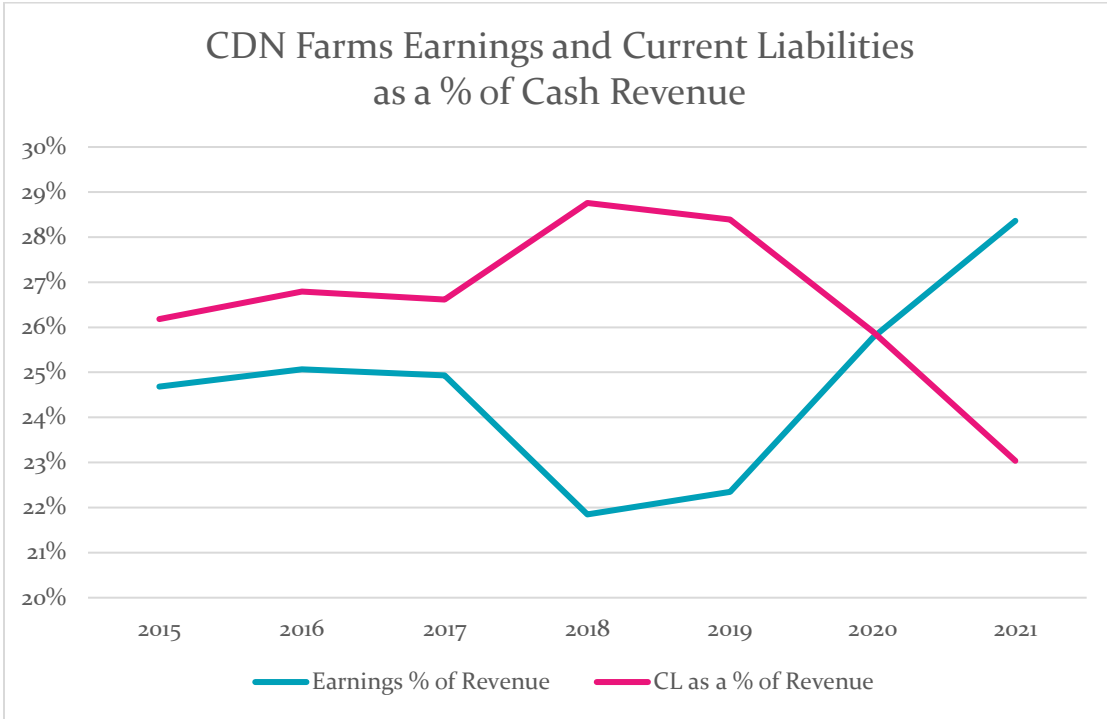
Average High Low 2021 Expenses





Canada Farms	Average	High	Low	2021%	Your Farm?
Cost Goods Sold %R	33%	35%	31%	32%	>
Direct Expenses %R	28%	32%	24%	24%	>
Admin&OverHead %R	17%	19%	15%	15%	>
EBITDA %R	22%	28%	16%	28%	>





The graph above tracks the last seven years of how much cash is available for land access and other non-operating cash flow uses.



Asking the Right Ranch Management Questions

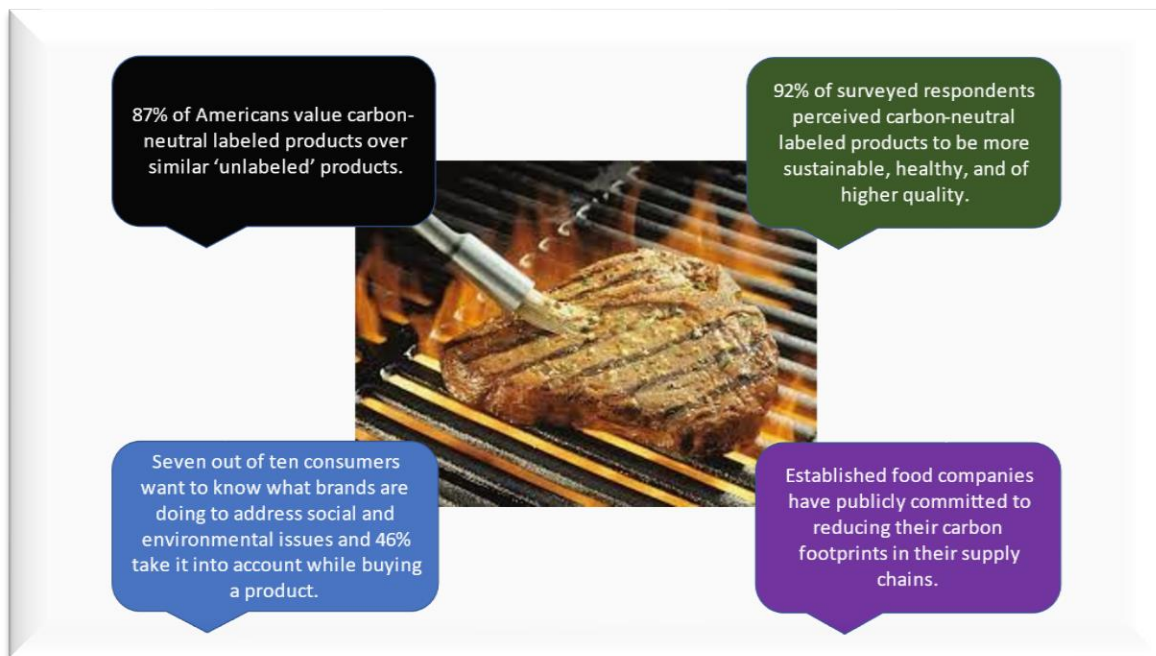
It is a critical question.

As a business owner, any ranch should be asking this question.

The question is, **what benefit does my farm or ranch deliver to my customer?**

There are a few rules in doing this. These are:

- Don't confuse benefits with features: don't describe the product's features.
- Describe the result that the customer experiences²² by using your product or service.
- In other words, explain how it solves **their problem**²³.



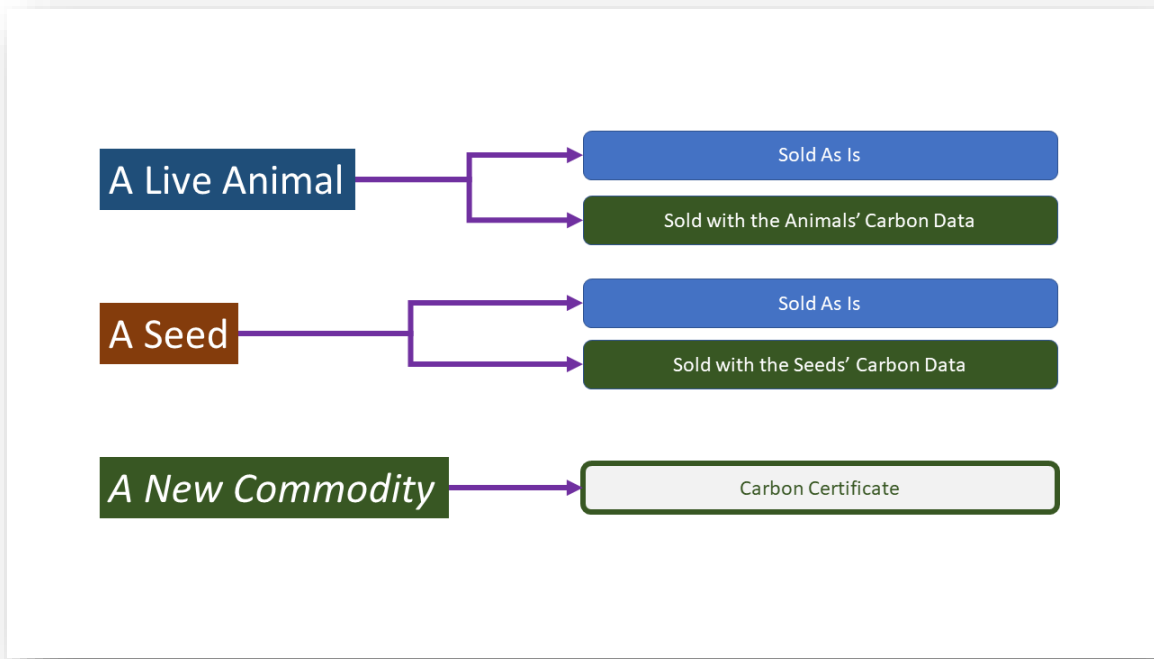
²² <https://www.climateneutral.org/blog/understanding-how-consumers-value-climate-neutral-certification>

²³ Jorge Gasca <https://threestepsbusiness.com/what-is-in-it-for-me/>



THE FARM PRODUCT BENEFIT MATRIX

Based on the marketplace assessment, BCC can sum up the customer benefit matrix for a farm.



The farm can continue as usual and sell its existing commodity product.

The market is now sourcing greenhouse gas data. The customer asks for the size of the footprint associated with the product they buy.

A good example is the wine at the liquor store with a GHG footprint.



The new market is an avoidance or a reduction in the farm's greenhouse gas footprint.

#1234-5678-9ABC-DEFI

Warning: Not a Real Certificate For Education Use Only

Certificate of Ownership

This is to certify that

Your Farm Name Here

is the true and uncumbered owner of one tonne of a greenhouse gas reduction. This tonne is created under the Climate Action Reserve's Grassland Protocol Version 1.0.

Anshu Bengarce
• Anshu Bengarce
• Verifier

Aiko Watanabe
• Aiko Watanabe
• Creator

#1234-5678-9ABC-DEFI

Warning: Not a Real Certificate For Education Use Only

Notice

Location of Creation: 53.xx, -113.xx
Registry: CSA Canada

Supplier Warranty: The creator of the tonne is fully liable to replace the tonne. The project is verified by an arm's length third party.

Restriction of Use: Voluntary market only.

CSA GROUP

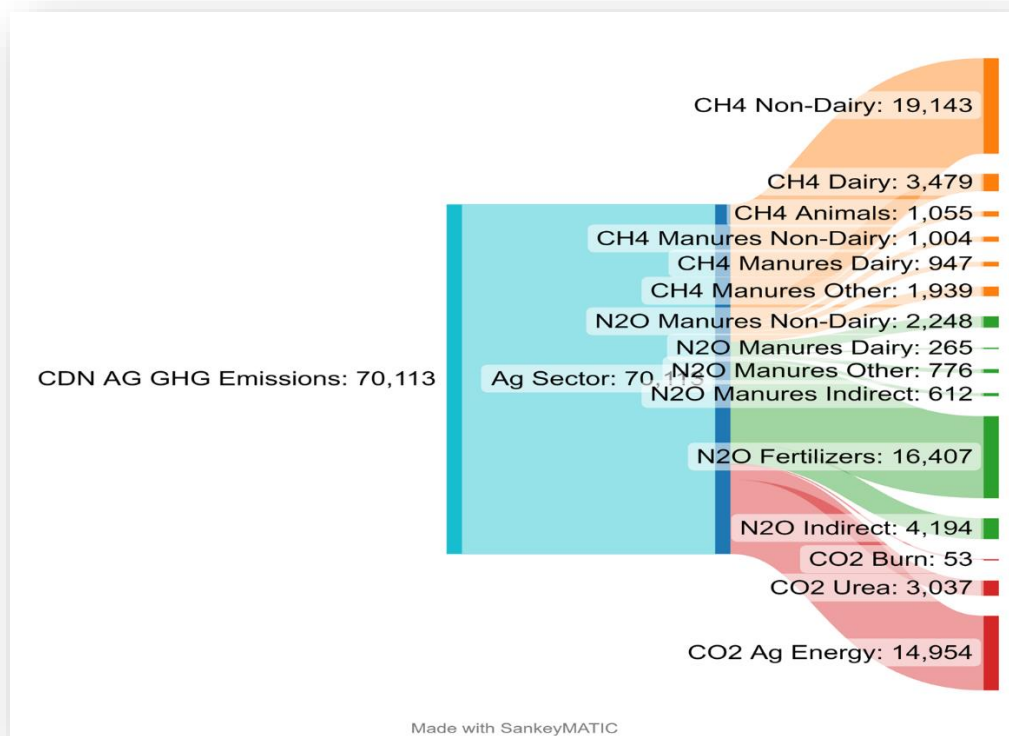


My Ranch Footprint

In simple terms, the new management system impacts the following:

- CO₂ – An avoidance or reduction in CO₂.
 - A reduction in fossil fuel consumption.
- CH₄ – There is a net reduction in methane production.
 - A change in animal enteric fermentation,
 - A net change in manure emissions, or
 - A change in the animal inventory.
- N₂O – There is avoidance or reduction in the production of N₂O.
 - A reduction in fossil fuel consumption.
 - A net change in manure emissions.

2020 Canada Agriculture Emission Amounts



YOUR FARM'S CALCULATIONS

A copy of the calculator is available at <https://biologicalcarbon.ca/esg-emission-calculator/>.

Farm Name			
Greenhouse Gas Scope One and Two Net Emissions Report			
For the Year Ending (Month, Day, Year)			
Source	(A) Amounts	(B) Emission Factor ¹	(A x B) Estimated Emissions per year
Livestock Ch4 Enteric			
Dairy Cattle	#	142.93 kg	kg
Non-Dairy Cattle	#	71.05 kg	kg
Sheep	#	8 kg	kg
Swine	#	1.5 kg	kg
Poultry	#	NE (0)	0
Horses	#	18 kg	kg
Not Listed Animals	#	Consult Background Tables	kg
Total CH4 (Enteric) Emissions from Livestock			(A) kg
Livestock Ch4 Manure			
Dairy Cattle	#	38.92 kg	kg
Non-Dairy Cattle	#	3.73 kg	kg
Sheep	#	0.28 kg	kg
Swine	#	4.82 kg	kg
Poultry	#	0.05 kg	kg
Horses	#	2.6 kg	kg
Not Listed Animals	#	Consult Background Tables	kg
Total CH4 Emissions (Manure) from Livestock			(B) kg
Livestock N2O Manure			
Dairy Cattle	#	0.91 kg	kg
Non-Dairy Cattle	#	0.70 kg	kg
Sheep	#	0.04 kg	kg
Swine	#	0.01 kg	kg
Poultry	#	0.01 kg	kg
Horses	#	0.48 kg	kg
Not Listed Animals	#	Consult Background Tables	kg
Total N2O Emissions (Manure) from Livestock			(C) kg

¹ Based on ECCC IPCC Background Tables

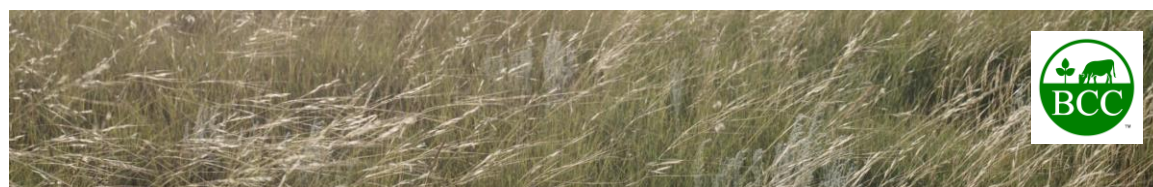


Yearly Farm Operations			
Source	(A) Amounts	(B) Emission Factor ²	(A x B) Estimated Emissions per year
Operations	As Applied		
Inorganic Fertilizer (kg of Nitrogen)	kg	0.01 kg of N ₂ O	kg
Organic Fertilizer (kg of Nitrogen)	kg	0.01 kg of N ₂ O	kg
Animal Manure Applied (kg of Nitrogen)	kg	0.01 kg of N ₂ O	kg
Organic Fertilizer (kg of Nitrogen)	kg	0.01 kg of N ₂ O	kg
Burning of Annual Crops	Tonnes of Dry Matter	2.5 kg per 1000 tonnes of CH ₄	kg
Burning of Annual Crops	Tonnes of Dry Matter	0.06 kg per 1000 tonnes of N ₂ O	kg
Limestone	kg	0.000125 kg of CO ₂	kg
Urea	kg	0.0002 kg of CO ₂	kg
Total CO ₂ e Emissions from Fertilizers and Other Sources			(D) kg

Yearly Farm Energy and Fuels			
Source	(A) Amounts	(B) Emission Factor ³	(A x B) Estimated Emissions per year
Farm Diesel		2.89 kg per litre	kg
Farm Gasoline		2.23 kg per litre	kg
Farm Natural Gas		52.6 kg per Gj	kg
Farm Propane		1.565 kg per litre	kg
Farm Electricity		Per Kwh See Table	kg
Total CO ₂ e Emissions from Energy Consumption			(E) kg



Land and Soil Sinks			
Source	(A) Amounts	(B) Emission Factor ⁴	(A x B) Estimated Emissions per year
Lands	# Hectares		
Annual Cropland under Management ⁵		See Ecozone Table	kg
Native Grasslands under Management		(zero) ⁶ -26 kg ⁷⁸⁹	(kg) <small>This number will be negative.</small>
Tame Forage under Management		(zero) ¹⁰ -110 kg ¹¹¹²¹³	(kg) <small>This number will be negative.</small>
Intensive Grazing under Management		-340 ¹⁴ kg	kg <small>This number will be negative.</small>
Forrest to Cropland	New Hectares Added	See Ecozone Table	kg
Grassland to Cropland	New Hectares Added	3696 kg	kg
Cropland to Urban		10256 kg	kg
Grassland to Urban		21400 kg	kg
Total CO2e Net Emissions from Land Sources			(F) kg



Summary of Emissions		
Total CH4 (Enteric) Emissions from Livestock	(A)	kg
Total CH4 Emissions (Manure) from Livestock	(B)	kg
Total N2O Emissions (Manure) from Livestock	(C)	kg
Total CO2e Emissions from Fertilizers and Other Sources	(D)	kg
Total CO2e Emissions from Energy Consumption	(E)	kg
Total CO2e Net Emissions from Land Sources	(F)	kg
Total GHG Footprint	Sum	kg

Ecozone Sink Tables

Ecozone	Cropland remaining cropland	Forest converted to Croplands
RZ10 Boreal Plains	-0.157	4.401
RZ11 Subhumid prairies	-0.653	3.498
RZ12 Semiarid prairies	-0.354	3.798
RZ13 Taiga Plain	1.092	2.797
RZ14 Montane Cordillera	0.146	5.215
RZ15 Pacific Maritime	0.399	11.429
RZ5 Boreal Shield East	0.358	7.171
RZ6 Atlantic Maritime	0.219	6.974
RZ7 Mixedwood Plains	0.581	8.920
RZ9 Boreal Shield West	-0.093	2.829

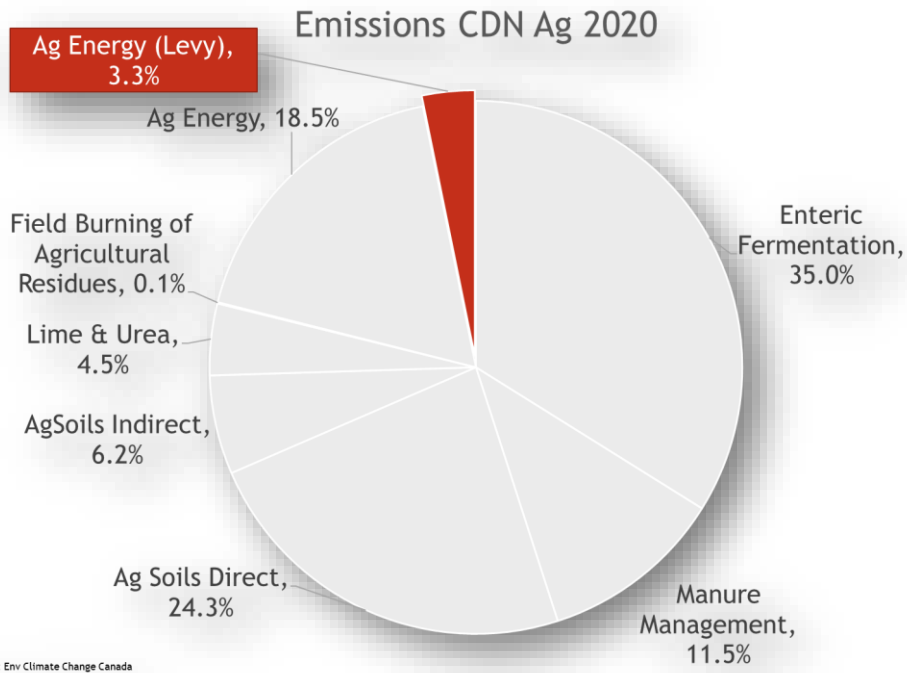


The Myths Versus Reality

A quick review of the farm press is summed up with this cartoon.



The full circle represents 10% of Canada's emissions or 70 million tonnes. The levy covers only 3.3% of the emissions in 2020 from the agricultural sector.



Conclusion

This discussion paper is not designed to be an anthology of the best answers. However, the ranch management team knows their skills, limitations, and business circumstances.

Carbon and the policy on pollution is disrupting the ranch's QVL.

The business world is changing to pressures of investors and customers. This pressure is arriving at the ranch gate. Unfortunately, these new pressures cause challenges to the value-based decisions ranch owners face daily.

There are opportunities to impact cash flow. Opportunities to lower costs. There are options to change revenue sources.

All choices will challenge your QVL.



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Appendix



AAFC Assessment

Below is the full AAFC assessment.



Adaptation and Resilience	Assessment
	<p>Climate impacts on the agriculture sector are already being felt today, and will intensify in the future.</p> <p>Higher temperatures, shifting precipitation patterns and more frequent and intense extreme weather events (e.g. droughts, floods, hurricanes, wildfires) will contribute to increased crop and livestock loss, soil health risks, the incidence of pests and diseases, and increased risk of supply chain disruptions.</p> <p>Adaptation means planning for and acting on the impact of climate change. It involves being ready to respond to climate change events (reactive) as well as making changes to where we live and what we do before climate change events occur (anticipatory).</p> <p>Farmers and ranchers have helped the sector adapt to the impacts of climate change; however, sector efforts need to be more proactive and increase efforts to prepare for, and recover from, future disasters.</p>

Biodiversity	Assessment
	<p>The benefits of biodiversity to production include pollination, pest management, soil formation, nutrient cycling and water purification. Agricultural landscapes with more biodiversity are also more resilient to climate change impacts.</p> <p>Wildlife habitat capacity on agricultural land has remained generally stable, but low, to 2015. However, there have been strong pressures to convert land to annual cropping since that time that have not yet been assessed.</p> <p>Declines in biodiversity on agricultural landscapes have resulted from the conversion of habitat such as grasslands, wetlands and forage/pasture lands to annual crops, as well as increased use of chemical inputs.</p>



The genetic diversity of crops, which provides the basis for crop and breed selection and supports resilience to environmental stresses, is globally considered to be on the decline.

Mitigation of a Change in Climate

Assessment

In 2020, total agricultural emissions from production were estimated at 69 Mt CO₂e (10% of Canada's total).

Agricultural practices release GHG emissions primarily from biological sources, such as livestock production (enteric fermentation), and the application of synthetic nitrogen fertilizers, manure management, and on-farm fuel use (e.g., operation of farm machinery).

Agriculture is one of the main sources of Canada's total methane emissions, contributing approximately 30%.

Canada's total agricultural GHG emissions have stayed relatively stable since 2005, and is projected to increase slightly by 2030. Emissions associated with crop production increased by 102% between 1990 and 2020.

Canadian soils have been a carbon sink since 1990s due to increase in no-till/low-till practices.

In 2020, agricultural soils stored almost 10 Mt CO₂e, meaning that agricultural soils sequestered more than they emitted, counteracting approximately 14% of total annual agricultural emissions.

Climate change impacts all other priority areas, including water, biodiversity, and soil health.



Soil Health

Assessment

Healthy soils are fundamental to the sustainability of agriculture in Canada.

In general, soil organic matter has been increasing on agricultural lands in Canada. The Prairie Region in particular has seen significant improvements in soil organic carbon over the past 30 years due to a reduction in tillage intensity and area under summerfallow.

Regionally, decreasing soil carbon levels, decrease in soil cover days, and higher risks to soil erosion are seen in Eastern Canada, largely due to the steady conversion of tame pastures and hayland to annual crops.

Storing carbon in the soil is an important role for the agriculture sector to contribute to climate change mitigation – in 2016 Canadian, agricultural soils removed 11.2 million tonnes of carbon dioxide from the atmosphere.

Soil biodiversity is an important component of healthy soils.

Water Health

Assessment

Agricultural producers rely on clean and reliable surface and groundwater for all aspects of agricultural production.

The sector currently faces many freshwater challenges, including drought and flooding, impacts of growing agricultural production on water quantity and quality, and the availability of freshwater given the needs of other users.

There is regional variability in these challenges across Canada given differences in geography, production practices, climate, soil and water quality.

Risks from phosphorus, nitrogen, pesticides and pathogens are “moderate/high” in many areas and continue to increase while nitrogen build-up in soils across Canada increases the risk to the groundwater.



Shifting precipitation patterns and an increase in the frequency and intensity of extreme events from climate change will bring challenges thus emphasizing the need to build climate resilience through enhanced water management.

A warming climate may result in expanding agriculture to new areas, intensifying crop production, and impacting land use which can alter water supply and drainage (e.g., irrigation expansion, loss of wetlands) and water quality (e.g., changing inputs).

Water quality and quantity is highly interconnected with soil health, biodiversity, climate mitigation and climate adaptation.

Water governance in Canada is complex – water management is shared by the federal, provincial, municipal, and, in some cases, territorial and Indigenous governments.



My Place is Here.

Here are the value statements expressed in the research.

Land and its Characteristics

My place has beautiful natural scenery

My place is a grassland

My place is habitat for wildlife

My place reflects nature the way it used to be in this area before

Europeans arrived

Land and Functional Meaning

My place is for grazing/browsing livestock

My place is a source of income

My place is for making a profit

My place is for hunting and/or fishing

My place is a business

My place produces food for people

My place is for outdoor recreation other than hunting and/or fishing

My place is for growing crops

Land and Experiential Meaning

My place is where I am free to decide things for myself

My place is somewhere I find peace and quiet

My place is somewhere I enjoy the process of working on the land as much as the results

My place is somewhere I feel connected to all living things and the earth

My place is somewhere I am responsible for conserving native prairie and its species

My place is where I do the kind of work I love

My place represents my personal legacy

My place represents my way of life

My place is where I reduce the level of stress in my life

My place is where ordinary tasks feel more like leisure than work

My place is somewhere I have few obligations to anyone else

My place is a source of inspiration

My place is somewhere I balance my needs with the needs of plants and wildlife

My place is somewhere I feel more like a caretaker of the land than an owner

My place is somewhere I gain or find perspective on my life

My place is somewhere I escape from my day-to-day routine

My place is somewhere I feel little pressure to get things done



Land and Interpersonal Meaning

My place is a source of family pride

My place symbolizes a way of life I want to pass on to future generations

My place represents my family's traditions and culture

My place is for enjoying time with friends and/or family

My place is somewhere I uphold my family's legacy

My place keeps my family connected to each other

My place represents generations of my family's history in this area

My place is part of a community of friendly neighbors

My place helps me connect with my professional network

