RESEARCH REPORT

# Circular Food Solutions in Canada: A Coast to Coast Landscape Scan

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OurFoodFuture Guelph-Wellington

zeroWASTE NATIONAL ZERO WASTE COUNCIL
*An Initiative of Metro Vancouver*

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The National Zero Waste Council is a collaborative, leadership initiative of Metro Vancouver that brings together business, government and the community to advance waste prevention and the circular economy in Canada.

Guelph-Wellington is bringing people, ideas and technology together to build Canada's first circular food economy.

## ACKNOWLEGEMENTS

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This research project is part of **Circular Economy Leadership Canada's** ***CE Solution Series***, and the ***Circular Food Systems*** work stream. The project builds on the Council's ***A Food Loss and Waste Strategy for Canada*** and Guelph-Wellington's ***Our Food Future***.

The research is an introduction to existing circular food system solutions in Canada, and will help inform strategies and tactics that will build a circular food system across the country.

# Background

Canada's agri-food industry—which includes all the enterprises that produce, sell, and deliver food—is one of the country's most important economic sectors and has generated about $143 billion towards Canada's GDP.[1] At the same time, the value of food—from farm to fork—lost or wasted (FLW) every year in Canada is estimated to be worth $49 billion.[2]

Much of this issue can be addressed by rethinking our conventional agriculture, fishing/aquaculture and food practices in ways that help to regenerate our natural resources and reduce food loss and waste, or where this is not possible, create new value from it. This line of thinking—also known as the circular economy model —is gaining traction across the globe as a way of building a more sustainable economy.

The aim of this project was to identify, compile and present examples of food solutions that are contributing to making Canada's food system more circular, focusing on examples from particular communities, particular sets of actions and actors which have not previously been profiled in published resources. Given the desire for communities in many different contexts to learn from others, and innovate for circularity, the project also aimed to present preliminary analysis of the key challenges and opportunities faced by the initiatives profiled, and their enabling factors for success.

The report is a first step towards the development of recommendations for multi-point action that will shift food systems to becoming more circular.

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# 1.0 INTRODUCTION

The Canadian agri-food system is a key pillar of Canada's economy. The overall sector is made up of several industries: primary agriculture, food and beverage processing; food retail and wholesale; food service; and inputs and service suppliers. In 2018, the system generated $143 billion, accounted for 7.4% of GDP, and provided one in eight jobs in Canada.[3] In addition to land-based agriculture, Canada also has one of the biggest fishing economies in the world. In 2018, commercial fisheries, including sea and freshwater fisheries, contributed more than $3.7 billion to Canada's economy and employed 45,907 people. Fish and seafood processors, which include product preparation and packaging facilities, contributed more than $6.6 billion and employed 26,429 people that year.[4] In 2019, Canada's aquaculture sector was valued at more than $1.2 billion contributing to the local economies of many small and coastal communities.[5]

Being a country where food supply exists in abundance has made Canada the fifth largest exporter of agricultural and agri-food products in the world. Despite this, more than four million Canadians are food insecure. This even though an estimated 35.5 million metric tonnes of food representing 58% of all the food produced in Canada, is lost or wasted annually. This is estimated to be worth $49 billion. [6] This inefficient use of resources generates land-use impacts, avoidable water usage and GHGs across the food supply chain and imposes large waste disposal costs on local governments.

Northern, rural, and Indigenous communities in Canada are disproportionately impacted by food insecurity in Canada. Due to their geographically remote locations, the food supply chain is lengthier for rural communities, resulting in periodic and irregular shipments, elevated food prices among communities that, on average, also have lower income levels, and nutritionally depleted food stocks. Indigenous peoples, in particular, have had disruptions to their land and traditional food systems which has impacted the transfer of intergenerational knowledge on harvesting and hunting skills, and healthy eating habits. This not only contributes to poor physical and mental health outcomes among households but also to a weakened sense of community belonging.

Some of this can be addressed by rethinking our conventional food production and consumption practices in ways that help to regenerate our natural resources and reduce food loss and waste, or where this is not possible, create new value from it. This line of thinking—also known as the circular economy model —is gaining traction across the globe as a way of building a more sustainable economy.

Circularity in food systems promotes three main principles that are derived from the idea food is a source of life and should be valued as such:

- to regenerate the natural systems that support food production
- to design out food waste and pollution
- to keep food and nutrients in their highest and best use.

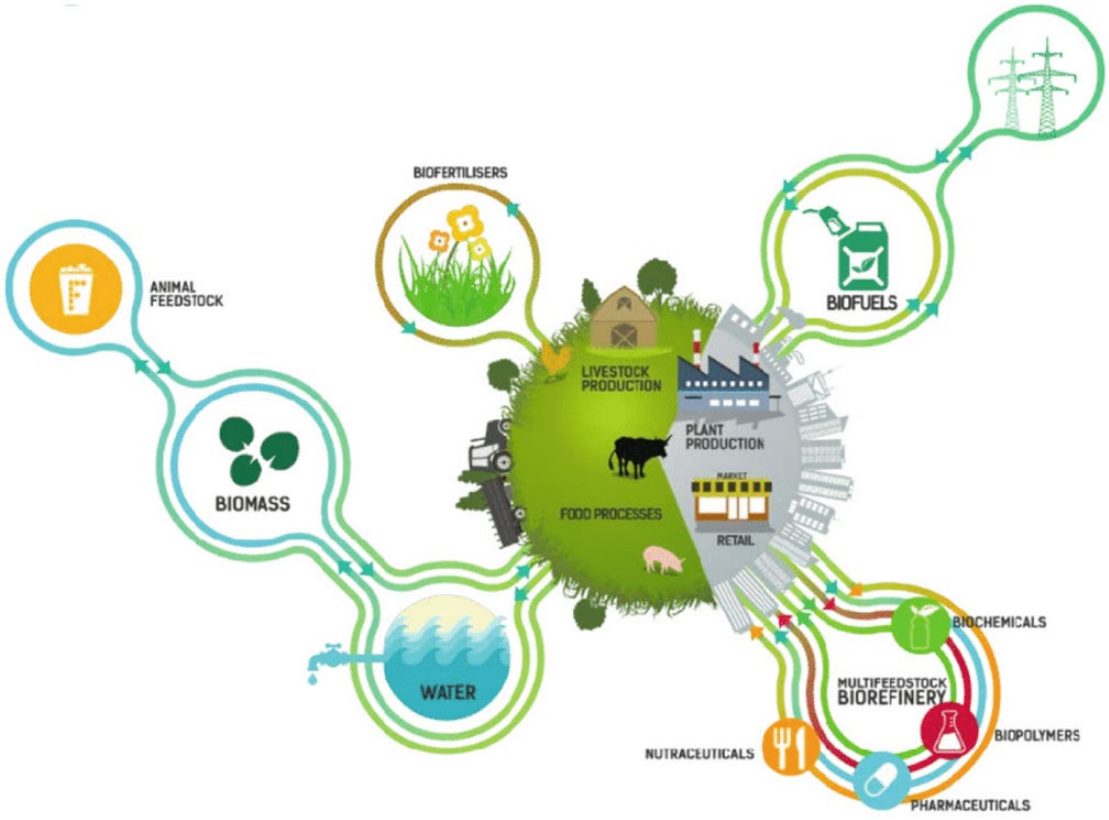



*Figure 1: Circular Agri-Food Systems*[7]

This maximizes the value of resources and product life, minimizes the impact on the environment, and reduces the demand for virgin resources in the production system. These principles can be applied through the entire supply chain from primary production to consumption and waste disposal, requiring a systemic perspective and the participation of stakeholders at every level.

Circular food solutions can take many forms. The strategies and practices considered circular and how these are defined vary among the organizations working on circular economy and FLW issues across Canada. These organizations include the National Zero Waste Council, the Our Food Future Project, RECYC-Quebec/ Institut EDDEC, and Simon Fraser University's Food Systems Lab, among others.

While there is no standard definition of what encompasses a circular food system, there is consensus that circular food solutions offer a broad value proposition. By regenerating natural systems, they can deliver environmental benefits, such as improved soil quality and water quality, reduced GHG emissions and decreased land conversion. They can also provide economic opportunities by generating new jobs or through the creation of value-added products produced from FLW. These environmental and economic benefits, in turn, generate various social benefits such as better health outcomes and enhanced food security.

The climate action benefits of a more circular food system are especially important given Canada's ambitious target of achieving net-zero emissions by 2050. The agri-food industry is big a contributor to climate change. The agriculture sector alone is responsible for 8%[8] of Canada's GHG emissions as a result of high-input, high-emissions farming practices that rely heavily on fossil fuels, fertilizers, pesticides, plastics, and other inputs.[9] Another estimated 2% of emissions are generated from the FLW that is sent to landfills.[10] The agriculture sector is also disproportionately affected by climate change. Across the country, crops lie unharvested under snow, late frosts kill blossoms on fruit trees, extreme weather events damage crops and soil, and droughts become more and more frequent.[11] A more circular agri-food system can help both adapt to some of these impacts as well as reduce GHG emissions through various pathways.

This report presents snapshots of circular food system solutions found in Canada, focusing on examples from particular communities, particular sets of actions, and actors which have not previously been profiled in published resources. Given the breadth and complexity of practices that are required for a full transition to a circular food system, this project did not aim to exhaustively identify examples of every kind practice of practice that is considered circular but rather focused on bringing to the national spotlight some lesser-profiled examples — especially from rural, northern and Indigenous communities. The report also offers a preliminary analysis of the key challenges and opportunities faced by these initiatives and highlights the factors that contributed to their success.

Section 2 of this report explains the criteria and methodology used to identify these examples. This is followed by an inventory of the examples compiled along with detailed profiles of select examples in Section 3. Section 4 presents some key findings and observations. Section 5 closes the report with some high-level conclusions.

# 2.0 METHODOLOGY

The solutions identified for this study were compiled using the following avenues:

- A literature scan of major Canadian agriculture and food-related reports (For example: *A Food Loss and Waste Strategy for Canada*, *The Avoidable Crisis of Food Waste, Characterization and Management of Food Loss and Waste in North America*)
- An internet scan using selected keywords (For example: regenerative agriculture, food loss and waste, food hubs, community-led food initiatives etc.)
- A social media campaign run through Facebook, LinkedIn and Twitter channels
- Direct email outreach to known sectoral experts, researchers and community leaders
- A call for submissions through partner organization newsletters

For the purpose of this study, a food solution was considered circular if it met one of the following four objectives defined by a RECYC-Quebec/ Institut EDDEC framework:[12]

- Rethinking production and resource consumption: including sustainable agriculture, process optimization, use of sustainable inputs and responsible food consumption etc.
- Maximizing resource utilization: including improving food conservation, redistributing surplus food, sharing/renting/leasing of equipment etc.
- Extending the life of resources: including transforming by-products and surplus food into animal feed, upcycled food and beverages, recycling equipment etc.
- Giving resources new life: including nutrient recovery and energy recovery.

These solutions were categorized into five themes:

1. Food system security and resiliency by applying circular economy thinking
2. Eliminating food waste by applying circular principles to food processing and manufacturing
3. Seizing new economic opportunities through a circular food systems approach and technologies
4. Culture/behaviour shift and motivating action to drive circular food system transformation
5. Local (and traditional) economies and social connections through circular food systems

Solutions identified along these themes focused on four main areas:

Terrestrial Food Production

Aquatic Food Production

Processing and Manufacturing

Northern, rural, and Indigenous communities

In addition, the following cross-cutting lenses were applied:


Climate change and climate action: Including linkages to carbon sequestration, organics and soil management, regenerative agriculture/aquaculture, and methane mitigation by reducing FLW going to landfill.

Supply chain and business model innovation: Including new business opportunities, technologies, and linkages to improved food distribution, advanced manufacturing, and avoiding FLW.

Technology and innovation: Leveraging new applications, data approaches, digital platforms, and technologies to enhance sustainable agri-food production and management; and food manufacturing that minimizes waste and expands food products.

Social capital and equity-building: Including considerations for maximizing the social and community benefits across circular food-related activities and investments.

This effort resulted in the identification of close to 200 examples of circular food solutions. These span communities large and small, urban and rural, and from coast to coast to coast who are engaging in activities across the food supply chain. These are presented thematically throughout Section 3. While many of these solutions employ multiple circular practices and can therefore be slotted under more than one theme, they have been included in the theme the researchers felt was the best fit to avoid duplication.

Project researchers also reached out to a short-list of 35 of the most innovative circular food solutions found to better understand their organizations' work. Of these, 21 organizations agreed to lend their time to this study through a short survey and a semi-structured interview. These are profiled as spotlights in Section 4.

# 3.0 CIRCULAR FOOD SOLUTIONS IN CANADA

## 3.1. Food Security & Resilience

The International Covenant on Economic, Social and Cultural Rights, ratified by Canada in 1976, establishes that every Canadian has the '*right to adequate food and to be free from hunger*'. However, despite being the fifth largest agricultural producer in the world,[13] four million Canadians, including 1.15 million children, are food insecure.[*] Moreover, this number is certainly underestimated as the survey it is based on does not include people living on First Nations reserves, people in some remote northern areas, or people who are homeless – i.e., three groups at high risk of food insecurity.[14] Food insecurity is explicitly linked to profound negative health impacts. Among children, it can lead to the development of a variety of chronic health conditions, including asthma and depression. Similarly, among adults, it has been linked to higher rates of chronic diseases, including mental health problems, arthritis, asthma, and diabetes. As a result, food insecurity places a substantial burden on the health care system.[15]

Food insecurity is often linked with a household's financial ability to access adequate food and disproportionally impacts Indigenous and Black households in Canada, as one of many manifestations of colonialism and structural racism. Inuit, First Nations, and Métis adults experience five to six times higher levels of food insecurity than the Canadian national average.[16] Further, the highest rates of food insecurity are also found in Northern Canada.[17] Nearly 70% of Nunavut lives in food insecurity. Similarly, household food insecurity rates of 70% have been documented in northern Ontario.[18]

As demonstrated during the Covid-19 pandemic, the issue of food security is exacerbated by a lack of resilience[†] in the Canadian food system. The current, largely linear food system is vulnerable to labour disruptions, long-distance supply chains, extreme climate events, political disputes, and food safety and public health emergencies.[19]

Circular food systems help increase the resilience and diversity of supply chains, thereby reducing food insecurity. Circular food solutions that support resiliency and diversity can include alternative production practices among both land and aquatic farms; a focus on more local food production and shorter supply chains; as well efficient food recovery for human consumption.

[*] Food insecurity is the inability to acquire or consume an adequate diet quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so.

[†] Food system resilience is defined as the capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances

### 3.1.1. Canadian food solutions

#### *Regenerative Agriculture*

Regenerating natural systems is a key tenet of the circular food economy. This can be supported by applying circular practices on both terrestrial and aquatic farms. On land, regenerative agriculture practices include no/reduced tillage, cover cropping, crop rotations, soil amendment with compost and/or manure and strategic grazing, integrated livestock management, agroforestry, etc. These practices can improve soil health, improve water quality, and increase biodiversity, thereby building resilience as well as economic viability. These practices also help increase the amount of organic carbon added back into the soil, while reducing the relative loss from erosion and soil respiration, making regenerative agriculture a key climate solution.

Regenerative agriculture practices on farms, vineyards and ranches have been picking up across Canada. These practices are not necessarily new and in many cases were practised by older generations and Indigenous communities before industrial agriculture took root. Indigenous food production systems are also regenerative, but within Traditional Knowledge systems, this is known as having a reciprocal relationship with the Earth, or the Creator. This hyperlocal knowledge has been passed down orally and has been adapted over many generations while remaining extremely relevant for rural Indigenous communities today. Some examples of regenerative agricultural practices are showcased in the table below. Many more examples can be found on the Regenerative Canada Website.

## TapRoot Farms: Regenerative Agriculture

A family-owned and operated farm that produces a wide range of fruits and vegetables, and raises livestock using regenerative, agroecological and carbon farming techniques.

**Founded by:** Josh Oulton & Patricia Bishop
**Established:** 2008
**Location:** Port William, Nova Scotia

**Driver:** The desire to farm in a way that regenerates the earth and creates community value.

**Solution:** TapRoot Farms is a 280-acre family-owned farm that has adopted the UN Sustainability Development Goals (SDGs) as a framework for decision-making and as a tool for farm planning. The farm produces both certified organic and non-organic produce that is available for purchase at local retailers, and through a community shared agriculture (CSA) program.

Regenerative farming practices utilized on the farm include:

- 3-5 year crop rotations: that allow the soil to build micronutrients during the fields time of rest when it is used for hay/pasture
- reduced and strategic tillage: including gentle seed bed prep and elimination of moldboard ploughs
- cover cropping: ensuring that something is always growing on the soil, using grain, clover, grass or native plants.
- livestock farming: that helps fertilize the soil, prepare the soil for planting and build farm resilience
- use of animal manure: sourced from their own animals and other local farms
- use of compost tea: created by composting their cardboard and vegetable trimmings

In addition, TapRoot Farms also supports the local community through the below initiatives:

- offering 20 garden plots to those who don't have access to land and providing growing support on a 'pay/share what you can' basis
- providing free (donor-funded and delivered by volunteers) fresh fruits and vegetables to those in need within a 10-minute radius of the farm
- posting gleaning opportunities when there is an abundance of crops left in the field after harvest for self-use or donation
- donating still edible food to food banks
- 70% of the produce grown at TapRoot Farms is certified organic. The farm is audited by a 3rd party (CanadaGAP®) each year to ensure the farm is following best practices.

Find out more about this circular food solution here

### *Sustainable Aquaculture*

Similarly, solutions exist that can make aquaculture more sustainable and circular. Aquaculture has been identified as a key industry to grow Canada's Blue Economy, with an annual GPD contribution of $31.7 billion and 300,000 jobs across a variety of sectors.[20] However, ecological concerns are associated with the aquaculture industry in Canada, including concerns of non-native species escape, sea lice infestations, inefficient feed conversion ratios, and increasing outbreaks of Piscine Reovirus. The most circular solution available in the aquaculture industry is the practice of Integrated Multi-Trophic Aquaculture (IMTA). IMTA involves growing finfish, shellfish and kelp (seaweed) together, thereby mimicking nature where one species finds a feeding niche in the waste generated by another species, leading to efficient use of nutrient inputs and the generation of several ecosystem services. IMTA also delivers some climate benefits since seaweed sequesters carbon (although only temporarily) and can be a substitute for fish protein in aquaculture feed, thus reducing the carbon footprint of fed seafood aquaculture. It also creates multiple streams of revenue that can mitigate the risk of single species harvest failures. While this practice is not very capital intensive and has proven to be economically viable in the long run, Canada is lagging behind countries like Norway in its uptake. This is largely due to insufficient domestic market demand for seaweed (although the global market is worth around USD 40 billion[21]), industry resistance to new approaches, and a regulatory framework that was designed to support single species aquaculture farms, making it tough for farms using alternative techniques to get licenses and permits.

## Turquoise Revolution: Integrated Multi-Trophic Aquaculture

A consulting and research firm promoting IMTA systems to evolve aquaculture practices towards being the most efficient food production systems of the future.

**Founded by:** Dr Thierry Chopin (Chopin Coastal Health Solutions Inc) & Dr Steve Backman (Magellan Aqua Farms Inc.)
**Established:** 2016 and 2003
**Location:** Saint John/ St. Stephen, New Brunswick and Bay of Fundy

**Driver:** Lack of economic diversification among aquaculture farms along with an untapped potential to utilize organic and inorganic aquaculture co-products, to cultivate additional crops while reducing the environmental impact of aquaculture.

**Solution:** Turquoise Revolution has piloted and demonstrated the viability of IMTA in Atlantic Canada. It believes that this production system can deliver environmental sustainability (nutrient biomitigation and other ecosystem services), economic stability (improved output, product diversification, risk reduction and job creation in coastal communities) and societal acceptability (better management practices, improved regulatory governance and appreciation of differentiated and safe products) within a circular economy approach.

Dr Chopin was involved with a salmon/kelp/mussel IMTA system previously; with Magellan Aqua Farms, he is now raising sea scallops and kelps. (The publications of Dr Chopin are posted on ResearchGate.) In an IMTA setting, fine and larger organic particles from salmon are captured by shellfish and other invertebrates, while seaweeds absorb dissolved inorganic nutrients. This system not only creates new revenue streams from seaweeds and invertebrates for the farm but also allows it to charge a price premium on the finfish produced. The seaweeds cultivated are a superfood, rich in vital oligoelements, micronutrients, macronutrients, proteins, etc. They also transiently sequester $CO_2$, making them part of the solution for mitigating climate change and coastal acidification. To further improve sustainability, Turquoise Revolution is now working on sourcing boats and machinery using electric and solar energies to lower its seaweed harvesting and drying carbon footprint and participate in the decarbonization of the aquaculture sector.

Find out more about this circular food solution here.

While IMTA is a completely circular system, it is also possible to integrate smaller aspects of circularity into traditional aquaculture farms. For example, growing native species, feeding them fish feed made from FLW that would otherwise go to landfill, treating wastewater and retrieving the nutrients, or utilizing the by-products generated for creating value-added products. Practices that reduce FLW or the need for virgin resources contribute to climate mitigation. While there is no certification for circularity, the Aquaculture Stewardship Council (ASC) is a global certification for environmentally and socially

responsible aquaculture farms. To date, 37 farms in Canada have received this certification and are listed on the ASC website. However, a key challenge for sustainable aquaculture farms in Canada remains the mainstream perception that fish farming is causing environmental damage.

## Golden Eagle Sable Fish: Sustainable Aquaculture

Sustainable aquaculture farm raising native finfish species to encourage the development of a stable and diversified aquaculture system.

**Founded by:** Terry Brooks
**Established:** 2014
**Location:** Kyuquot Sound, British Columbia

**Driver:** Lack of species diversification and concerns about environmental impacts of traditional aquaculture.

**Solution:** Golden Eagle Sablefish is a locally owned farm that hand-raises sablefish in its native environment. Being a native species, it has reduced risk to the ecosystem in the event of fish escape and has a lower risk of infection, therefore requiring very few antibiotics. The farm works in partnership with the Kyuquot-Checleseht First Nation, who granted permission for the farm to operate on their territory due to its sustainable practices. In return, Golden Eagle Sablefish provides career opportunities to the Indigenous community who have historically been fishers.

Operating as an alternative to industrial fish farming, Golden Eagle Sablefish keeps its environmental footprint low by feeding its fish undesirable cuts of protein, that would otherwise be wasted. This is sourced from no more than 2,000 km away to reduce transportation costs and emissions. Transport emissions are also minimized by sending the fish to be processed in local facilities. Where required, Golden Eagle Sablefish has relatively low dependence on wild fish feed (1.3lb of wild fish for every 1lb of farmed fish) and only uses sustainable forage fish that is not sourced from illegal, unreported, or unregulated fisheries and is not deemed to be vulnerable, endangered, or critically endangered by the IUCN Red List. In addition, it has resisted the industry standard of gill tagging to reduce plastic use and has committed to implementing sustainable packaging.

It inspires more local action and increases market demand for native species by partnering with top local chefs to raise awareness for the species as an excellent alternative to salmon and other predatory fish such as tuna.

Golden Eagle Sablefish is recommended by the Ocean Wise Seafood Program and has been rated as a Green Best Choice by Monterey Bay's Seafood Watch Program.

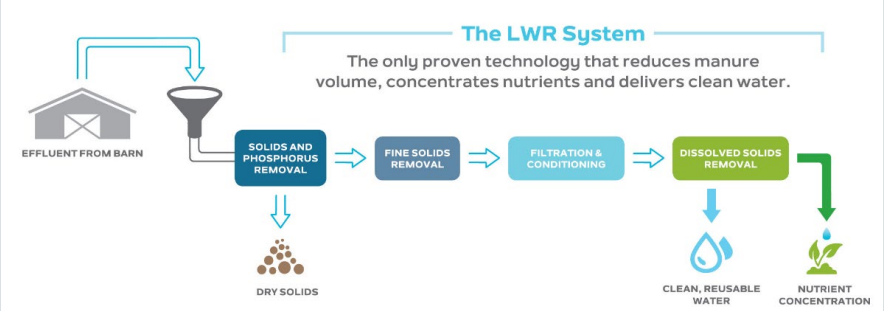
Find out more about this circular food solution here.

### *Alternative Production Technology Solutions*

Many of the regenerative and sustainable production practices mentioned above are supported by innovative businesses that specialise in ag-based technology solutions. These include solutions that help traditional production practices become more circular by, for example, developing soil amendments or fertilizers made from waste or nutrient and water recycling technologies. They also include solutions to make production more resource-efficient by, for example, developing precision agriculture technologies or more efficient fish harvesting equipment. However, despite the availability of such solutions, their uptake has been somewhat limited in Canada. This may largely be due to financial constraints. Even though many of these technologies have short payback periods, can in some cases generate new revenue streams and have demonstrated environmental benefits which in turn can increase farm productivity, there is hesitancy among farmers to try new production techniques given farming's extremely low-profit margins. Also, unlike some other countries which are increasingly incentivising regenerative best practices through regulations, tax credits etc., Canadian farmers have few external incentives to change their practices.

## Livestock Water Recycling: Nutrient Recovery & Wastewater Treatment

Agri-tech company that is the world's leading provider of manure treatment technology that helps livestock farmers increase farm efficiencies and become more environmentally sustainable.




**Founded by:** Karen Schuett & Ross Thurston **Established:** 2003 **Location:** Calgary, Alberta

**Driver:** Untapped manure management market. Traditionally, manure from livestock farms gets stored in massive lagoons, generating GHG emissions. Runoff from storage and spreading activities has the potential to contaminate surrounding land, rivers, and lakes.

**Solution:** Livestock Water Recycling (LWR) has designed a system to treat and separate manure into nutrient concentrates and clean water. This patented wastewater treatment system uses mechanical and chemical treatments to separate valuable nutrients from water on-site at livestock operations. The LWR system delivers three products: clean potable water, dry solids containing phosphorus and nitrogen, and nutrient-rich liquid with micronutrients and potassium. These components can be used on-site to water and fertilizer crops or can be sold to create new revenue streams.

This technology has seen initial adoption and validation on dairy farms in the US and in the Middle East as a result of their government regulations and incentives but has yet to be implemented in Canada. In 2021, Livestock Water Recycling was awarded funding from Emission Reduction Alberta - Food, Farming, and Forestry Challenge to install its first treatment plant in Canada.

The LWR System is the only proven and fully operating technology that reduces the overall volume of manure, concentrates nutrients and delivers a renewable, high-quality water source. This system can recycle up to 75% of water used on farms as well as reduce the manure footprint by 75%. It can take the stress off full lagoons and storage pits and eliminate nutrient overload by strategically applying fertilizer as needed, where necessary, reducing the risk of nutrient runoff. It also provides a minimum 20-30% return on investment.

Find out more about this circular food solution here.

Some technology solutions in Canada are going beyond incremental improvements and are revolutionizing whole production practices – for example, hydroponic and aquaponic practices. Hydroponic systems replace soil with alternative materials to support roots, growing plants directly in nutrient-rich water. Aquaponics is the combination of aquaculture and hydroponics together in one integrated system. These systems are inherently circular. Hydroponics systems recycle water and can be designed to cycle nutrients as well. Aquaponics, on the other hand, uses a circular-symbiosis approach, where the biological waste of a fish farm is used as the biological food to produce plants. These solutions also address challenges such as land, nutrient, and water scarcity and require less energy use and food miles, reducing reliance on long supply chains. Because these systems allow growers to produce food locally, year-round, regardless of external conditions and achieve net higher yields with fewer resources, they are becoming especially prevalent in northern Canada among remote and Indigenous communities. In addition to improving food security, they also generate new job opportunities for these communities. However, these systems are not widely accessible as they have a high upfront capital cost. Where they have been adopted, anecdotal evidence suggests that most communities have accessed government grants to support their establishment.

## ColdAcre Food Systems: Northern Food Production Solutions

Business of growers, builders, designers, consultants, and suppliers of innovative and sustainable growing systems for fresh and nutritious food year-round.


**Founded by:** Tarek Bos-Jabbar
**Established:** 2018
**Location:** Whitehorse, Yukon

**Driver:** Long and interrupted supply chains in remote and northern communities resulting in unavailability of fresh and affordable food.

**Solution:** ColdAcre produces a diverse selection of leafy greens, like bok choy, arugula, kale, mizuna and rainbow chard, as well as micro greens, and sells them in compostable packaging to grocery stores, restaurants and cafes in Whitehorse, and to residents through a subscription box.

It also designs, builds, and maintains custom made food solutions to support other producers in the Yukon and Northwest Territories. One of the solutions it offers is CropBox- a high-productivity hydroponic garden in a retrofitted 40-foot shipping container. This containerized agriculture solution can produce up to 18,000 lbs of fresh produce year-round in any climate. It is highly efficient, using 90% less water and 80% less fertilizer than conventional agriculture methods. It can also come with R60 insulation and an Arctic Entrance to provide more space to harvest and package produce. This localized food production cuts down the carbon footprint of food transportation. In addition to being able to provide fresh, healthy and local food, this solution also represents an economic opportunity for communities to grow and provide employment.

ColdAcre has also partnered with Solvent Inc, to design an energy solution that can power the CropBox in an off-grid setting, called PowerBox. The PowerBox is a shipping container that is filled with batteries. It can tie into a solar array and has a battery and generator backup for year-round power production.

Find out more about this circular food solution here.

### *Shortening Supply Chains*

Going beyond how food is produced, the geographic area where food is produced determines the length and complexity of food supply chains. Many food innovation organizations are finding ways to shorten supply chains to help foster food security and resilience. This has the added benefit of reducing transport-related GHG emissions. These are largely prevalent in urban areas and encompass solutions such as using creative places to grow food like unutilized rooftops, warehouses and lots. Some have even developed online platforms to directly connect producers with consumers, thereby cutting out intermediaries, increasing profit margins and supplying fresher food products.

### *Food Recovery Solutions*

Finally, given the Canadian paradox of high food insecurity on the one hand, and high food waste volumes on the other, a large proportion of food solutions involve food rescue and recovery for human consumption. By diverting FLW from landfills, these solutions help mitigate methane emissions generated during organic waste decomposition. These take various forms in Canada. Some have formed gleaning networks to collect surplus food from the farm, others rescue food from retail and restaurants. Some have a physical presence, while others have developed online platforms. There are also some initiatives that both rescue food for human consumption, and also partner with businesses to upcycle it into new food products or compost it where it is not safe for consumption. Food recovery organizations with culinary education, community kitchens, advocacy and other programs are also present. While many food recovery operations exist in Canada, they tend to be hyper-local and operate in isolation. A key challenge facing larger and more efficient food recovery practices in Canada is the lack of connections and a more organized network of food recovery actors. Transport and logistics present other barriers, due to Canada's vast geography. Finally, low tipping fees for FLW disposal at landfills disincentivizes generators of FLW to seek solutions such as making donations. These solutions require additional labour cost to organize and oversee.

## FoodMesh: Food Recovery

Digital solution provider that unites all elements of the food supply chain to help organizations quickly and easily divert their surplus food to the people in our communities who need it most.

**Founded by:** Jessica Regan & Francisco M.
**Established:** 2016
**Location:** Vancouver, British Columbia


**Driver:** Missing connections between generators and potential users of FLW.

**Solution:** FoodMesh is a digital food recovery solution provider that connects different parts of the supply chain into one digital network, facilitates the exchange between organizations that have surplus food with organizations that need it, and tracks the diverted food, providing actionable business intelligence to prevent food waste in the future.

It runs three major programs:

- Retail Food Recovery Program: provides retailers with data to help them reduce the volume of their surplus food and divert the surplus they have to organizations that can put that food to its highest end-use – first to charitable organizations to turn into meals, then to farmers for animal feed, and then to composters.
- Marketplace: an online B2B Marketplace connecting organizations that have surplus food to a FoodMesh-verified network of organizations to either buy that food at a reduced cost or claim it as a donation (if they are a charity).
- Wholesale Food Purchasing Program: helps charitable organizations purchase their most-needed food items directly from wholesalers at a reduced cost and supports access to any surplus food the wholesaler has, for donation or at a heavily discounted price.

In addition, FoodMesh also partners with municipalities and regional governments to help them build concentrated food recovery networks in their area. These regional networks bring local food businesses, charitable organizations, and farmers together into a connected and efficient food system.

The FoodMesh network is made up of 2,500+ registered organizations from all elements of the food supply chain. To date, this network has rescued over 10 million kgs of food, donated over 14 million meals to charities, abated 20 million kgs of CO2 and saved over $48 million.

Find out more about this circular food solution here.

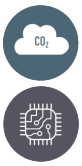
### 3.1.2. Examples of Canadian food solutions

*Table 1: Inventory of Canadian circular food solutions to build food security and resilience*

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| **Regenerative Farming** | | | | | | |
| Ceres Farm | Olds, Alberta | Business | A gourmet mushroom farm producing with inputs from local breweries and agricultural by-products. Their modular cultivation system is industry leading in product quality, plastic use, emissions reduction, and yield per square foot. When the mushrooms are done growing, the protein content of the spent grains have increased enough that they can be pelleted and sold as high-quality animal feed. |  |  | Rethinking Production and Resource Consumption |
| Covert Farms | Oliver, British Columbia | Business | A wine farm that is integrating livestock agriculture into the vineyards to aid in soil remediation and provide added manure for fertilizer. They are also shifting towards dry farming in their vineyards which would have co-benefits such as enhanced resiliency to climate change and an increase in wine quality. |  |  | Rethinking Production and Resource Consumption |
| Demers Greenhouses | Carrières Lévis, Quebec | Business | A food production business that operates out of greenhouses and sheltered fields. Their production techniques reduce GHG emissions, recover biogas from waste to heat greenhouses, create 100% compostable packaging, limit the use of pesticides, and recycle water and fertilizers in the greenhouse. |  |  | Rethinking Production and Resource Consumption |
| Halfway River Farm | Hantsport, Nova Scotia | Business | A small, solar-powered farm that grows flavourful, nutrient-dense, chemical and pesticide-free, non-GMO veggies from organic seeds. They use no-till practices, |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | mulching, and composting to develop their soil. Disturbing the soil as little as possible encourages the growth of mycorrhizal fungi and other soil life which enhances nutrient cycling and plant health. | | | |
| Hayes Farm | Fredericton, New Brunswick | Non-profit/ Community Initiative | A community-led project that aims to inspire New Brunswickers toward a resilient and thriving food system by providing them with the skills, expertise, and support to practice human-scale regenerative agriculture. The farm also hosts a regenerative farming internship program to educate the next generation of regenerative farmers. |  |  | Rethinking Production and Resource Consumption |
| Heartwood Farm & Cidery | Acton, Ontario | Business | A regenerative farm producing craft cider, maple syrup, and grass-fed beef and selling these products through their online store. They also offer an array of immersive, on-farm experiences that feed people's need to connect with the natural world and introduce them to the farm. |  |  | Rethinking Production and Resource Consumption |
| Highfield Regenerative Farm | Calgary, Alberta | Business | An urban farm, started in partnership with the Compost Council of Canada and the City of Calgary. They are transforming a vacant property into a vibrant and productive urban farm through soil revitalization, food production and community programming. The project will produce locally grown food, raise general awareness of urban agriculture, generate entrepreneurial opportunities, and strengthen the communities. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Holistic Management Canada | Operates throughout the Prairies | Non-profit/ Community Initiative | An education and accelerator organisation that empowers farmers to make ecologically, economically, and socially sound decisions for their farms and communities. The Regenerative Accelerator Program sets out to speed up the adoption of regenerative agriculture practices on farms in Manitoba. |  |  | Rethinking Production and Resource Consumption |
| Maple Bloom Farm | Grand Tracadie, P.E.I. | Business | An organic, regenerative, and bio-intensive market farm in rural Prince Edward Island. They grow vegetables and microgreens year-round, for sale in its local food box, farmers' markets, and local restaurants. |  |  | Rethinking Production and Resource Consumption |
| McCain Farm of the Future | Florenceville, New Brunswick | Business | A food production company that is building three “Farms of the Future” to showcase how regenerative farming practices and the latest agricultural technology and innovations can be implemented at scale. In partnership with leading academics and suppliers, each farm focuses on demonstrating that more sustainable practices can also create a more financially viable future for farming, while at the same time increasing food production. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Olds College Smart Farm | Olds, Alberta | Institutional | A cutting-edge farm at Olds College is converting the whole of their farming operation to a Smart Farm. This will help them connect with existing agriculture operators in order to provide a product development and demonstration venue to accelerate agriculture technology and agri-food development. At the same time, the Smart Farm serves as a cutting-edge learning environment for students, producers and the agriculture sector. |  |  | Rethinking Production and Resource Consumption |
| Porcupine Creek Farm | Carcross First Nation, Yukon | Indigenous Community Initiative | A First Nation-run farm that focuses on regenerative practices and existing reciprocally with the Earth. Their goal is to provide healthy food grown locally and sustainably. Manure is composted and returned to the fields. |  |  | Rethinking Production and Resource Consumption |
| Spiral Farm | Elora, Ontario | Business | A small market garden growing produce for Guelph. Using almost exclusively hand tools, the farm is heavily influenced by stockfree farming and permaculture principles and is shifting to no-till practices. No by-products of animal agriculture (i.e. blood or bone meal, compost from industrial animal facilities) are used. |  |  | Rethinking Production and Resource Consumption |
| Sundance Harvest Farm | Toronto, Ontario | Business | A year-round urban farm that consists of a 1/3-acre site which includes two greenhouses. They strive to provide resources, knowledge, and guidance for youth who are marginalized within the food system to help them start their own food sovereignty movements and create their own urban farming practice. Their programs |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | include a free urban agriculture mentorship program called Growing in the Margins, which nurtures and grows the farm projects of BIPOC, LGBTQ2S and youth with disabilities from seed to harvest. | | | |
| Twisted Roots Farm | Judique, Nova Scotia | Business | A farm with a commitment to land stewardship based on regenerative agriculture and agroforestry. Twisted Roots Farm grows uncertified organic produce along with ethically raised livestock on a forested pasture. |  |  | Rethinking Production and Resource Consumption |
| Winterhill Farm and Garden | Rockwood, Ontario | Business | A family-owned small farm specializing in mixed organic vegetables, pastured chicken and pastured eggs. They also offer farm to table local delivery of their products. They manually weed with hand tools, use insect row covers, and run their chickens through the garden to eat the weed seeds and bugs and at the same time fertilize the soil. |  |  | Rethinking Production and Resource Consumption |
| **Sustainable Aquaculture** | | | | | | |
| Les Bobines | East Hereford, Quebec | Business | A leading rainbow trout producer in Quebec with a focus on sustainable aquaculture. They purchased and installed an advanced industrial-scale waste treatment system which had the ability to reduce waste from a land-based rainbow trout aquaculture farm. Land-based aquaculture prevents impacts to the natural marine environment and effects on other species. |  |  | Rethinking Production and Resource Consumption |
| Miracle Springs Inc. | Mission, British Columbia | Business | A land-based fish farm that draws water from a spring aquifer. They have installed a recirculating aquaculture |  |  | Rethinking Production and |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | system (RAS) technology into the operation of their farm. The implementation of this technology will reduce water use by 95% and reduce waste by allowing for the recapture of phosphorous and efficient use of food inputs. When cleaning the ponds, the waste goes into a settling pond where tubifex worms recycle the feces and clean water filters through a sand/gravel/dirt bank before going back into the creek. | | | Resource Consumption |
| Nova Aquaponics | Halifax, Nova Scotia | Business | An integrated aquaculture and hydroponic system which pumps nutrient-rich water from fish pens into algae growth chambers, making feed for the fish or biofuels and allowing the water to be recycled back into the fish pens. Only loses water taken up by plants or lost to evaporation and integrates vertical farming with aquaculture to minimize the required footprint. They sell two sizes of aquaponics systems for small-scale and commercial-scale users. |  |  | Rethinking Production and Resource Consumption |
| Sustainable Blue | Burlington, Nova Scotia | Business | A land-based aquaculture system that features a closed system, where wastewater is treated and excess nutrients are sent to a digestor to create electricity to supply the plant. Their goal is to create a completely sustainable salmon fishery. |  |  | Rethinking Production and Resource Consumption |
| **Technology Solutions for Alternative Agricultural Practices** | | | | | | |
| Ag Business & Crop Inc. | Palmerston, Ontario | Business | A precision agriculture solutions company that provides a range of tools including the Wintex Automated Soil Samplers that are user-friendly, with operations easily carried out |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | from the driver's seat. They optimize and create efficiencies in large scale food production operations. | | | |
| AquaGrow Farms | Mississauga, Ontario | Non-profit/ Community Initiative | An aquaponic food bank that has six grow beds, a seedling nursery, and three fish tanks that will produce approximately 2,500 servings of fish and 28,000 servings of greens each year. All the healthy greens and protein-rich fish that are grown are distributed to member agencies across Mississauga. From there they are given to hungry members of the community who otherwise would have limited access to fresh, healthy food. |  |  | Rethinking Production and Resource Consumption |
| Bioform | Vancouver, British Columbia | Business | A bio-plastic producer that has created a low energy extrusion technology which enables them to create 100% compostable film with nutrient additives for farmers to use to suppress weeds during the growing season and till/disc back into their soil at the end of the growing season to help regenerate their soil before the next crop, saving money on labour costs to remove the films and fertilizer application to keep soil healthy and productive. |  |  | Rethinking Production and Resource Consumption |
| DaganTech | Toronto, Ontario | Business | An agriculture technology company that created a crop monitoring program called Farm360Ai. This platform automates crop monitoring using neural networks trained to detect and predict corn and soybean yields from satellite imagery and weather data. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| GR365N Ltd. | Puslinch, Ontario | Business | A hydroponic company that aims to design/build custom hydroponic systems. They also have a home delivery system for fresh leafy greens. Their systems use 95% less water than traditional farming methods and yield 10x more per square foot. They also use organic water-soluble nutrients in our water and recycle this water in their systems. |  |  | Rethinking Production and Resource Consumption |
| Lucent Biosciences Inc. | Coquitlam, British Columbia | Business | An agriculture input technology company that is replacing expensive, less effective and polluting fertilizers with non-polluting, cost-effective, sustainable alternatives. They have developed a new type of micronutrient fertilizer that solves problems with existing micronutrient products. Lucent's uses state-of-the-art cellulose technology as a chelate, instead of synthetic molecules like EDTA. Over time, the cellulose decomposes naturally and becomes a source of carbon in the soil. |  |  | Rethinking Production and Resource Consumption |
| NorthStar Agriculture | Whitehorse, Yukon | Business | An agriculture development company that provides innovative food sovereignty solutions to communities of all sizes, especially those located in remote regions like the North. They focus on a socially-minded approach, sustainability first planning, innovative solutions for unique climates, and integration of renewable resources throughout all projects. One key initiative that NorthStar is working towards is a geothermally heated aquaponic system in the Yukon. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Terramera | Vancouver, British Columbia | Business | A global agriculture technology corporation that has created a soil amendment that can optimize natural soil inputs by 10X, outperforming synthetic soil inputs. This product can reduce the requirements for nutrient additives to the soil, thereby reducing greenhouse gas emissions and other environmental impacts from fertilizer. |  |  | Rethinking Production and Resource Consumption |
| Uprooted Farm Corp. | Elora, Ontario | Business | An innovative agricultural company that uses hydroponics technology to bring year-round, locally grown and chemical free produce to consumers from inside shipping containers. They want to increase the supply of this produce available to the people Wellington & Waterloo Counties. |  |  | Rethinking Production and Resource Consumption |
| Urban Stalk Inc./Guelph Food Bank | Guelph, Ontario | Business | An agri-science organization dedicated to the continuous innovation of hydroponic technologies to develop micro-habitats for various crop types. Their goal is to both reduce negative environmental impacts from agricultural activities along with correcting the social inequality to food access in at-risk and urban communities. Urban Stalk firmly believes that food should be a given commodity, not a traded one. |  |  | Rethinking Production and Resource Consumption |
| **Shortening Supply Chains** | | | | | | |
| Fish Market App | St Johns, Newfound Land and Labrador | Business | A start-up social enterprise focused on increasing availability of and access to locally caught, sustainably harvested fish and seafood by connecting fish harvesters to local consumers in Newfoundland and Labrador. Fishers can directly sell their | |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | catch to local consumers, increasing their revenue while contributing to food sovereignty, and consumers can connect with fishers, increasing their access to locally caught seafood while contributing to fisheries sustainability. | | | |
| Kaien Island Urban Farm | Prince Rupert, British Columbia | Non-profit/ Community Initiative | An urban farm project that will take place in a vacant downtown lot. They Strive to increase food security, and upcycle farm equipment such as crab traps and garden beds. |  |  | Rethinking Production and Resource Consumption; Extending the Life of Resources |
| Lufa Farms | Montreal, Quebec | Business | An urban greenhouse food-growing organisation. Every day they deliver thousands of food baskets filled with their rooftop-grown veggies directly to their customers. Lufa Farms meet this daily challenge with a vision to create a better food system, encompassing rooftop farms and localized agriculture in all shapes and sizes. This means farming on rooftops in cities, partnering up with local farmers and food makers, and creating a community of pick-up points to deliver all this food as directly as possible. |  |  | Rethinking Production and Resource Consumption |
| NuLeaf Farms | Calgary, Alberta | Business | A vertical farm platform that is converting existing warehouse space into automated indoor farms to grow sustainable, local food inside communities all year round. |  |  | Rethinking Production and Resource Consumption |
| Smart Locavore | National | Business | A website where local producers large and small can post produce that they have available for sale. The website facilitates a buyer getting in contact with sellers through adverts posted to purchase. | |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| TopSoil | Victoria, British Columbia | Business | An urban food production solution that was created to facilitate farming in unused spaces such as rooftops and properties currently under development. This allows food to be consumed the same day it is harvested and brings food production straight to the source of consumption. Their partnerships include local restaurants, Indigenous wellness centres, schools, and dense residential neighbourhoods. |  |  | Rethinking Production and Resource Consumption |
| **Food Rescue** | | | | | | |
| Feed it Forward | Toronto, Ontario | Non-profit/ Community Initiative | An app that takes food destined for landfill and provides it to food insecure individuals. People who have extra food are able to list food on the app marketplace as well as people wanting to buy it. There is also the option of filtering the results for travel distance and specific food items. | |  | Maximizing Resource Utilization |
| Feedback App | Toronto, Ontario | Business | A digital app for restaurants to sell surplus food during off-peak hours for a discounted price, reducing food waste. They allow restaurants to optimize revenue, while allowing customers obtain food that was otherwise not going to be sold. | |  | Maximizing Resource Utilization |
| Food Depot Alimentaire | Moncton, New Brunswick | Non-profit/ Community Initiative | An organization that serves food banks, community kitchens, after-school programs and other supportive agencies across New Brunswick. Their primary functions include food storage and distribution, fundraising and food collection, security, and advocacy for the people they serve and the agencies they support. | |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Food for Life Canada | Burlington, Ontario | Non-profit/ Community Initiative | A charity that rescues surplus food, sharing goodness with community, and returning inedible food and soiled cardboard to the earth through composting and vermiculture. | |  | Maximizing Resource Utilization; Giving Resources New Life |
| Foodsharing Ottawa | Ottawa, Ontario | Non-profit/ Community Initiative | An organisation that rescues surplus food from local businesses and provides it to local community food centres. At the Caldwell Family Centre, Foodsharing Ottawa has installed a community fridge to allow for the storage of perishables and hopes to expand this program in the future. | |  | Maximizing Resource Utilization |
| Found Forgotten Food | Halifax, Nova Scotia | Non-profit/ Community Initiative | A collaborative organization that reduces food waste in Nova Scotia in partnership with food producers, community groups food banks, and volunteers. This initiative focuses on gleaning and food rescue at farmers' markets for donation or preservation. They also accept surplus food from food banks for preservation. | |  | Maximizing Resource Utilization |
| La Tablée des Chefs | Longueuil, Quebec | Non-profit/ Community Initiative | A local charity created to feed people in need and to develop culinary education for youth. They reinvest most profits back into their social mission. La Tablée des Chefs offers its sustainable food recovery program in 47 establishments in Canada, allowing the recovery of 246,172 portions of food. Since 2013, they have been collecting food surpluses in Vancouver and Calgary, as well as in Mexico and France. | |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Leftovers Foundation | Calgary, Alberta | Non-profit/ Community Initiative | A technology-enabled food rescue platform that rescues food from restaurants and delivers to local shelters and pay-what-you-can food boxes, and acts as a kick-starter for other food rescue programs. | |  | Maximizing Resource Utilization |
| Quest Food Exchange | Vancouver, British Columbia | Non-profit/ Community Initiative | A food recovery and redistribution platform that recovers quality surplus food and necessities from suppliers at all levels of the supply chain and redistributes these goods to clients of social service agencies, government, and non-government programs, churches, schools and hospitals in a traditional grocery market setting. | |  | Maximizing Resource Utilization |
| Scrapless | Vancouver, British Columbia | Business | An app focused on Vancouver that connects consumers with surplus food primarily at the restaurant level. They divert excess food, supports local business, provides affordable meals, reduces carbon emissions on an easy-to-use platform. | |  | Maximizing Resource Utilization |
| Second Harvest | National | Non-profit/ Community Initiative | A food rescue initiative that redistributes nutritious, unsold food from across Canada to charities, non-profits and Indigenous communities in every province and territory. Their free, essential service helps nourish people through school programs, seniors' centres, shelters, food banks, and regional food hubs. | |  | Maximizing Resource Utilization |
| The Regional Food Distribution Association | Thunder Bay, Ontario | Non-profit/ Community Initiative | An association that connects food producers with 20 Northern Ontario First Nations. They also distribute food to various foodbanks in the region. | |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| The Richmond Food Recovery Network | Richmond, British Columbia | Non-profit/ Community Initiative | A food recovery network that was created in partnership with FoodMesh and the City of Richmond. They built a network of food businesses, charities, and farmers to connect those with surplus food to those who need it. Through the network, businesses with surplus food are able to safely and easily divert that food to those who could put it to good use – whether to charities for meals, or farmers for animal feed or composters. | |  | Maximizing Resource Utilization; Extending the Life of Resources; Giving Resources New Life |
| Waste Free Wolfville | Wolfville, Nova Scotia | Non-profit/ Community Initiative | A community project that collects food nearing expiry from local retailers and distributes it within the community. |  |  | Maximizing Resource Utilization |

‡Legend

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| | | | | |
|---|---|---|---|---|
| Focus Area | Terrestrial Food Production | Aquatic Food Production | Processing and Manufacturing | Northern, rural, and Indigenous communities |
| Lens | Climate Action | Business Innovation | Technology Innovation | Social Capital |

## 3.2. Eliminating Food Loss and Waste during Processing and Manufacturing

The existing food system in Canada is not designed to prevent food loss and waste. As defined by the Food and Agriculture Organization of the United Nations (FAO), food loss[§] and waste[**] (FLW) is the total amount of food in the supply chain that is not consumed. While the volume of FLW is not officially measured in Canada, it is estimated 35.5 million tonnes, representing 58% of all the food produced in Canada, is lost or wasted annually. Of this, 32%, or 11.17 million tonnes, is considered avoidable: food that was produced as an edible food product that was never consumed. The balance, 68% or roughly 24.3 million tonnes, is classified as unavoidable: by-products of an edible food product that are not generally edible themselves, such as animal bones.[22]

In addition to contributing to food security challenges, FLW has a big environmental impact. It is estimated that 56.5 million tonnes of $CO_2e$ is associated with FLW described above. In addition, this FLW generates a water footprint of 35.5 million tonnes. The carbon and water footprint of FLW represent about 60% of the food industry's carbon and water footprint respectively. Strikingly, the environmental footprint of all food consumed is smaller than that of the FLW produced.[23]

FLW is produced at every stage of the food supply chain. However, close to half of the total FLW is generated at the stage of processing and manufacturing.[24]

In addition to spoilage, key reasons for food losses during the processing and manufacturing stage include:[25]

- process and equipment inefficiencies
- lack of flexibility to reincorporate or repurpose off-spec products
- inaccurate supply and demand forecasting
- rejection due to quality standards
- poor quality inputs
- trimming and culling
- production line changes.

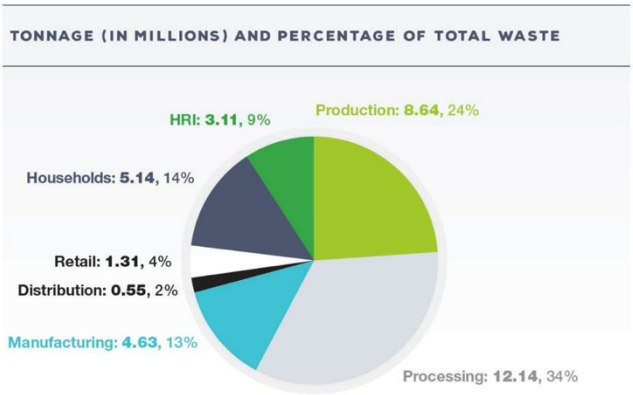



*Figure 2: Tonnage (in Millions) and Percentage of Unplanned, Post-Processing (Avoidable), Potentially Edible FLW in Canada*[26]

[§] Food loss is the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retailers, food service providers and consumers.

[**] Food waste refers to the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers.

Designing out this FLW to mimic an efficient natural system where there is no such thing as 'waste' is a fundamental tenet of a circular food system. Circular food solutions to reduce FLW at source during processing and manufacturing can take many forms including better demand forecasting, improving processing and manufacturing operations and equipment, and finding ways to utilize by-products. Examples of these are presented in the following sections.

Circular food solutions that reduce FLW at other stages of the supply chain (production, consumption, etc.) and that focus on reducing the amount of FLW that reaches landfill once generated (through recovery, reuse and recycling) are interspersed across the other themes of this report.

### 3.2.1. Canadian food solutions

#### *FLW reduction by SMEs*

Recognising the social, environmental and economic costs of generating FLW, many multinational food and beverage companies with Canadian operations (including Maple Leaf Foods, McCain Foods, Kraft Heinz Canada, Unilever Canada, General Mills, Nestlé and Kellogg's) have recently made public commitments to reduce operational FLW. Some smaller processors and manufacturers in Canada have also begun to take measures to reduce their FLW. However, these organizations rarely highlight this in the information they make public making them difficult to identify.

In many cases, these measures are supported by specialized FLW prevention consulting companies that conduct full-spectrum assessments of processing and manufacturing facilities and then strategize and implement FLW prevention interventions that can improve their bottom line. These consulting companies are especially useful to smaller companies that do not have the capacity to conduct such audits and analyses in-house. While some government funding exists to help upgrade technology and improve efficiencies, small food processors and manufacturers often lack the bandwidth to make grant applications and only adopt extremely cost-effective solutions that they can fund themselves. Those that have operations across multiple stages of the food supply chain are more likely to seek circular food solutions.

## Maizal Tortillieria: Zero Food Waste Processor

Small food processing business with a commitment to zero-waste operations to improve food security and support local and sustainable farming.

**Founded by:** Ivan Wadgymar
**Established:** 2012
**Location:** Toronto, Ontario


**Driver:** Large volumes of FLW generated during food processing.

**Solution:** Maizal Tortillieria is a food processor that produces and sells tortillas, totopos and tamales locally to restaurant and foodservice providers as well as directly to customers at farmers markets. It also grows a small portion of the locally grown corn it uses for its products. Maizal Tortillieria is strongly committed to producing zero food waste. Once a week, it collects any organic waste produced at its facility and takes it back to its farm. Here it is either used for animal feed or is composted and applied to the farm. This contributes to the organic and regenerative practices applied at the farm that include preserving non-GMO heritage grains and building healthy soil and water. In addition, Maizal Tortillieria also offers zero-waste solutions for wholesale partners. This innovative farm to table to farm practice has earned Maizal Tortilleria a place on the City of Toronto's Circular Economic Working Group where it is sharing its supply chain and waste management methods as an example for other businesses and policy innovators.

In 2018, Maizal Tortilleria successfully diverted 12,000 lbs of waste from landfills.

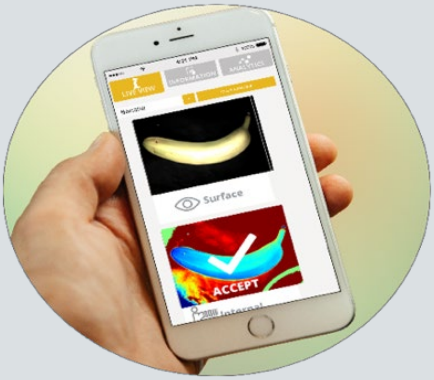
Find out more about this circular food solution here.

### *FLW Reduction Technology Solutions*

As the demand for FLW reduction solutions grows, cutting edge ag-tech companies in Canada are responding by developing technology solutions to meet this need. Since lack of data on where and why FLW is generated is a barrier for reduction, many solutions focus on making it easier for companies of all sizes to collect, manage, and analyze large amounts of data. Such technologies are increasingly leveraging artificial intelligence and machine learning to allow for more in-depth insights and prediction power to optimize food systems. Developing these technologies relies on a highly-skilled workforce and funding for research and development. In most cases, the uptake of such solutions is motivated by the objective of cutting waste disposal costs and hence is extremely price sensitive.

## Savormetrics Inc: Technology Enabled FLW Reduction

Agri-tech business providing AI-driven sensor solutions to the food and agriculture industries to help them reduce food waste due to spoilage and/or out of spec products.




**Founded by:** Harjeet Bajaj
**Established:** 2017
**Location:** Mississauga, Ontario

**Driver:** Large volumes of FLW generated across the supply chain, resulting in lost revenue.

**Solution:** After much R&D, Savormentrics has developed technology solutions that utilize advanced artificial intelligence and machine learning algorithms to:

- Develop new, more meaningful food quality metrics
- Develop taste metrics
- Predict shelf-life
- Predict best time to harvest
- Predict ripening processes
- Predict yields for food processing applications
- Identify contaminants
- Track the movement of foods and predict its impact on
- Quality metrics through the food supply chain
- Develop efficient grading classifications

Their flagship product the Big Zapper is a fully integrated, real-time food quality analysis tool. It allows for desired biochemical and biophysical quality metrics to be extracted and analyzed for quality check and risk mitigation. Savormetrics' devices and algorithms can also accurately predict decay curves and provide an estimate of the remaining shelf-life of food products. Further, their software translates the data collected into meaningful business knowledge that supports easy decision making and seamless integration onto business processes. This enables smarter buying practices, inventory management, pricing practices as well as supply and demand predictions.

With an average payback period of three months these solutions are extremely cost effective and have seen an uptake not only in Canada but also internationally, with customers on nearly every continent.

Find out more about this circular food solution here

### 3.2.2. Examples of Canadian food solutions

*Table 2: Inventory of Canadian circular food solutions to reduce food loss and waste*

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| **Regenerative Farming** | | | | | | |
| Byblos Bakery | Calgary, Alberta | Business | A large bread product manufacturer in Canada, it is one of the largest producers of pita in Western Canada. Byblos has identified nine food processing inefficiencies that could be addressed to capture $725,000 annually. These include reducing the length of the seed hopper and building a second reclaim chute, increasing conveyor capacity, and minimizing process variance in mixing and proofing. |  |  | Rethinking Production and Resource Consumption |
| Campbell Canada | Etobicoke, Ontario | Business | A food processing company specializing in soup that has reclaimed lost and waste food in their production line. They have done this by capturing products left in transfer pipes, improved sorting and quality assurance of received vegetables, and redesigning the can filling procedure. |  |  | Rethinking Production and Resource Consumption |
| Hans Dairy | Mississauga, Ontario | Business | An Ontario dairy business specializing in South Asian dairy products. They have been able to reduce food processing waste through new infrastructure that draws remaining dairy products from transfer lines throughout production. This saves an estimated 67,000 litres of dairy products per year. |  |  | Rethinking Production and Resource Consumption |
| Que Pasa Foods / Nature's Path | Delta, British Columbia | Business | A food processing corporation with an overall waste diversion rate of 96 per cent. The Que Pasa Foods manufacturing facility in Delta, B.C. obtained a TRUE Gold certification in April 2016, in recognition of its |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | efforts in managing food waste and other garbage, working with suppliers and training its employees around zero waste strategies. Their robust zero waste program isn't just about making sure garbage isn't sent to the landfill; rather, it represents a change in the way the company thinks about how it makes, uses and disposes of material in a responsible manner. | | | |
| The Calgary Italian Baker | Calgary, Alberta | Business | A family owned and operated bakery that explored how to prevent food loss and waste and related utility consumption within their operation. This initiative involved piloting of Provision Coalition's food loss and waste toolkit in tandem with a facility food waste prevention assessment conducted by Enviro-Stewards and yielded opportunities such as improving the bread line dough transfer, improving the forming process, and reducing the rate of burned muffins. |  |  | Rethinking Production and Resource Consumption |
| **FLW Reduction Business Support** | | | | | | |
| Enviro-Stewards Inc | Elmira, Ontario | Business | A consulting company that takes a holistic approach and conducts a full-spectrum assessment and implementation focused on prevention, resource conservation, and improving clients' bottom line. They strive to capture the value food resources have before being classified as waste which is a common downfall of traditional solid waste audits | |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Panevo | Vancouver, British Columbia | Business | A consulting organization that has helped many clients improved their circularity and reduce waste through process optimization. They offer innovative technology solutions that enable clients to gain valuable insights, avoid losses, maximize savings, verify performance and ensure compliance | |  | Rethinking Production and Resource Consumption |
| Provision Coalition | Guelph, Ontario | Business | A food and beverage industry advisory service helping companies from across the food system increase revenues, reduce costs and elevate their brand - purposefully. Through its R-Purpose (resiliency through purpose) & R-Purpose Micro business models, they help companies create value, realize savings and positively impact the environment. | |  | Rethinking Production and Resource Consumption |
| Sodexo-Waste Watch | Nationwide | Business | A food waste consulting company that focuses on food service and uses scales paired with tablet computers to quantify and identify causes and means of food waste. They are helping create a culture of preventing food waste by tracking current sources of waste to determine where they can improve, while raising awareness and influencing the behaviors of customers and employees. | |  | Rethinking Production and Resource Consumption |
| **Packaging Solutions** | | | | | | |
| Cascades | Kingsey Falls, Quebec | Business | A unique innovative food packaging solution created by Cascades, that was developed entirely using a circular economy approach and eco-design principles, a first in North America. Their design, which involves a patented water-based coating, protects | |   | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | it from moisture without compromising the recyclability of the cardboard. Food integrity and freshness are preserved, and food waste is reduced. | | | |
| **Cold Chain** | | | | | | |
| CryoLogistics Refrigeration Technologies | Victoria, British Columbia | Business | Developed technology that allows companies to ship perishable goods with specific temperature control from source to destination by combining liquid carbon dioxide with high-efficiency vacuum insulation and proprietary heat exchange and digital control systems. | |  | Maximizing Resource Utilization |
| VersaCold | Vancouver, British Columbia | Business | Combines cold chain innovation with IoT. They have IoT sensors placed in all 27 of their warehouse facilities, trailers and reefer units, which allows them to continuously monitor the temperature and humidity of shipments and warehouses. They also provide real-time web access to our transportation management system so customers can accurately track your shipment status all the way through delivery. | |  | Maximizing Resource Utilization |
| **FLW Technology Solutions** | | | | | | |
| Fiddlehead Technology | Moncton, New Brunswick | Business | A technology corporation that uses machine learning to find new solutions to some of the fast-moving consumer goods (FMCG) industry's most complex problems. The result is more accurate demand forecasts and competitor foresight, allowing companies to find their blind spots and be more competitive. | |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| NutriSCOPE Inc. | Woodbridge, Ontario | Business | A multi-tenant, Software-as-a-Service (SaaS) cloud platform that helps with food safety, traceability, and sustainability. The NutriSCOPE network enables the participants to author, publish, and consume data seamlessly, eliminating data duplication. Instant availability of current and historic data provides food safety and recall capabilities across the supply chain, in line with consumers' expectations and with governing bodies' regulations. | |  | Maximizing Resource Utilization; Giving Resources New Life |

††Legend

††

| | | | | |
|---|---|---|---|---|
| Focus Area | Terrestrial Food Production | Aquatic Food Production | Processing and Manufacturing | Northern, rural, and Indigenous communities |
| Lens | Climate Action | Business Innovation | Technology Innovation | Social Capital |

## 3.3. New Economic Opportunities

As highlighted in the previous section, at least 32% of all FLW generated in Canada is potentially avoidable. Based on the average price per tonne of food, this FLW is valued at close to $50 billion. Both avoidable and unavoidable FLW offers an opportunity to develop new business lines that use this 'waste' as feedstock for creating value-added products. In 2016, the rendering industry alone –which converts by-products from the meat and livestock industry into usable materials – was valued at $6.52 billion in Canada.[27]

According to the internationally accepted food recovery hierarchy, source reduction should always be the first strategy to deal with FLW, followed by reuse for human and animal consumption. What remains after that can and should be either recycled or recovered, thereby becoming a secondary material source for the economy. Here, recycling refers to material recycling that can create new products that don't involve complete material degradation. This can include upcycled food and beverage products as well as non-food products such as bio-based plastics, textiles, cosmetics, pharmaceuticals etc., while recovery can involve the recovery of either nutrients or energy (in that preferred order).[28]

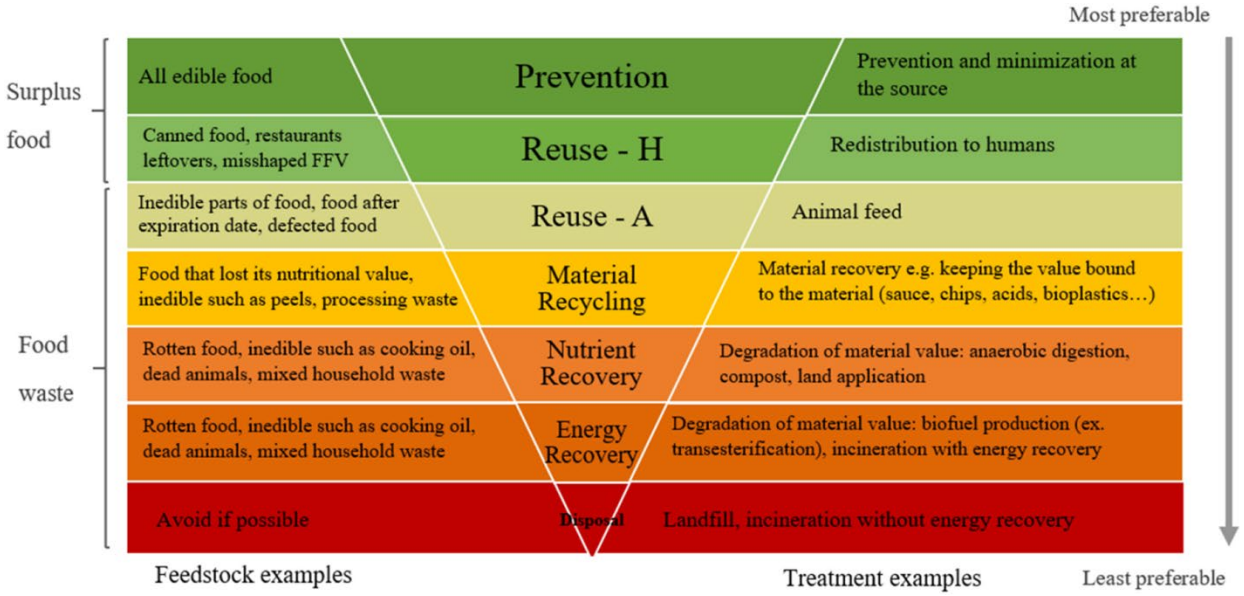



*Figure 3: Hierarchy for food loss (surplus) and waste*

Recycling and recovering valuable materials and nutrients help keep these in use longer and is another key tenet of a circular food Hierarchy for food loss (surplus) and waste[29]system. As noted in the previous section, these practices also help reduce the GHG emissions associated with FLW going to landfill. Circular food solutions that create new economic opportunities include the use of FLW to create agriculture and aquaculture production inputs, upcycled food and beverage products, insect-based proteins, animal feed, bioenergy, and other bio-based products.

### 3.3.1. Canadian food solutions

#### *Animal Feed*

Food solutions sourcing FLW to create animal feed for livestock appear anecdotally to be well-established in Canada, whereas those sourcing FLW for fish feed for aquaculture are relatively less common.

Another emerging circular food solution in Canada is the production of insect protein-based products using FLW feedstocks. Compared to conventional protein sources like corn, cattle and soy, insects can be raised using fewer inputs, water, energy, and space. By far the most common insect reared is the Black Soldier Fly Larvae (BSFL) which are especially efficient at converting feed-in biomass and have a high production yield per hectare. Common products on the market made from BSFL include fish feed, bird feed, animal feed, pet treats and fertilizers.

#### *New Food & Beverage Products*

Food solutions that upcycle food FLW into new food and beverage products are also proliferating in Canada, the majority out of urban areas in Quebec, Ontario, and British Columbia.

## Outcast Foods: Upcycling FLW

Sustainable food tech company that upcycles FLW into healthy snacks, supplements and ingredients that are both good for people and the environment.

**Founded by:** TJ Galiardi & Dr Darren Burke
**Established:** 2017
**Location:** Dartmouth, Nova Scotia

**Driver:** Aesthetically unpleasing or "ugly produce" often deemed to be unsaleable by producers, processors and retailers ending up as FLW.

**Solution:** Outcast is the first patent-pending zero waste upcycling technology company in Canada. It collaborates with local partners including farmers, food processors and grocery stores to divert rejected, irregular and surplus fruits and vegetables that are destined for landfill. Using proprietary processes, this is then transformed into plant-based protein powder, micronutrient supplements and other nutraceuticals. These are 100% vegan, non-GMO, certified organic, gluten-free, soy-free, and sugar-free. They are sold in recyclable bags made with compostable material directly to customers through large retailers, as well as to other processing firms to use as an ingredient in their operations. They can be used for several nutrient dense, long shelf-life products including protein powders, branded dietary supplements and pet foods.


*Source: www.outcastfoods.com*

Recognising the GHG emission reductions that occur by diverting FLW from landfill, Outcast has recently begun to sell carbon credits that generate additional revenue for the business. Due to its success and growing demand, it is currently constructing a second processing and distribution centre in Burlington, Ontario. This plant will be the world's first, purpose-built facility dedicated to upcycling the many different types of waste stream food.

Outcast foods processes roughly one million pounds of produce a month. Its upcycled plant-based protein powder has a 400% lower water footprint than conventional whey protein powder.

Find out more about this circular food solution here.

## Trendi Tech Inc.: Food Recovery and Upcycling

Agri-tech company that uses AI-driven robotics to help the farm and food industry rescue and upcycle food waste into delicious products.

**Founded by:** Craig McIntosh & Carissa Camppeotto
**Established:** 2018
**Location:** Vancouver, British Columbia

*Source: www.trendi.com*

**Driver:** Volume of FLW generated across the food supply chain while a large population is food insecure.

**Solution:** Trendi has developed a mobile processing unit driven by Artificial Intelligence (AI) and Machine Learning (ML) that can go directly to the source of otherwise wasted food, rescue it while it is freshest, and converts it into a shelf-stable dry material on-site and off-grid. This material, called BioFlakes, reduces the size and weight of the FLW by 80%, thereby reducing emissions during transportation to a refinery where it is milled into a powder. This powder is intended to feed people and animals or be used as soil amendments or for various industrial applications (like biofuels, textiles, pharma, nutria, etc.), in that order. BioFlakes can also be blended into a white label option and/or Trendi's house label, Enhanca. One 10g sachet of Enhanca adds flavour and nutrients to water, two sachets make juice and three sachets blended with ice-cream can make a smoothie. Trendi has also developed a robotic, and autonomous vending kiosks called The Hydration Station, which can use Enhanca to dispense beverages in high traffic areas like schools, events, offices, airports, etc.

In addition, Trendi has developed a circular app that can connect the sources of FLW, to upcyclers and the end user. All data collected by Trendi is added to an AI/ML model that can create inferences for their various technology solutions and to support their mission to end food waste and hunger.

While Trendi is still in its early stage of development, by 2023, it aims to operationalize 35 Biotrim units, donate 1,000,000 + servings of fruits and vegetables, upcycle 300,000 kgs of food, and build over 200 partnerships.

Find out more about this circular food solution here.

Most of these are examples are unique in the waste stream utilized and products developed, however, spent grains is one of the more popular food waste products that businesses are upcycling into products including flour, bread, and gourmet mushrooms substrate. Most of the businesses are operating on a relatively small scale and selling their products in their local area.

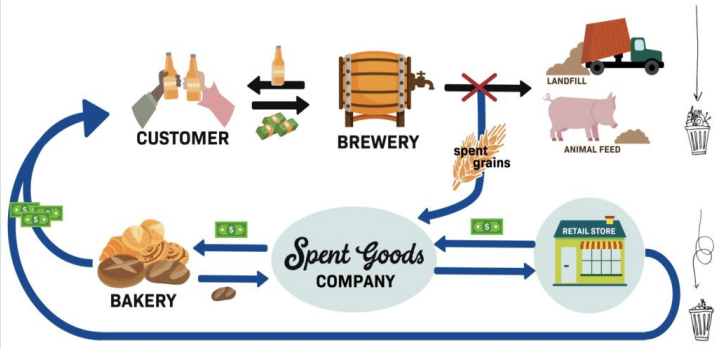
## The Spent Goods Company: Upcycling FLW (Spent Grains)

A B2B facilitator that highlights the value proposition of limiting FLW to help fight climate change.

**Founded by:** Dihan Chandra
**Established:** 2018
**Location:** Toronto, Ontario

**Driver:** Underutilization of high-in-fibre and protein spent brewer grain. Ontario alone produces about 16 million kilos of spent brewer grain annually. While the reuse of spent brewer grains is quite common in other parts of the world like Brazil, almost all craft breweries in Ontario discard their spent grains. This typically ends up in landfills, leading to GHG emissions. Some large breweries have partnerships with farmers to have their grains collected for animal feed, but few farms are interested in investing the time required to collect grains from craft breweries, which need regular pickup due to the perishable nature of the spent grains and limited storage options at breweries.

**Solution:** The Spent Goods Company acts as a convener, creating partnerships between craft breweries and local bakeries. A brewery provides a small fraction of its spent grains to a bakery at no-cost, who then turns this into upcycled products like bread, pretzels, crackers, and pizza dough. These are then bought by the Spent Goods company at wholesale prices, to be marketed and sold to customers at a profit through farmers markets, local food stores and online. Some products are also bought by the breweries from the Spent Goods to sell at their facility, thereby making a profit from waste whose disposal would otherwise have cost them money.




As of June 2021, the Spent Goods Company has offset 3.6 mT eCO2, sold 90K loaves of bread, 31 reselling partners, and has created 9.5 FTE jobs.

Find out more about this circular food solution here.

### *Industrial Uses*

Beyond agriculture and food products, some innovative businesses in Canada have also found ways to utilize FLW to produce other bio-based products such as biodegradable plastics, menstrual pads, cosmetics, soaps, lubricants, detergents, textiles (clothing and shoes), etc.

### 3F Waste Recovery: Upcycling Organic By-products

A Manufacturing business that creates high-value natural products from organic waste streams.

**Founded by:** Ben Wiper
**Established:** 2017
**Location:** Main Brook, Newfoundland and Labrador

**Driver:** Large volume of FLW generated by the aquaculture and commercial fisheries.

**Solution:** Designed as a circular economy business, 3F Waste Recovery takes a systemic approach to tackle waste management challenges and turn these into value-added socioeconomic opportunities. It applies both traditional and new, innovative manufacturing solutions to transform harvest waste from **f**ish, **f**arm, and **f**orest (3F) into marketable products that can be sold in established markets where there is growing demand.

3F focusses on products made from fish by-products (heads, backbones, and skins), sheep by-products (wool and bones) and forestry sawdust. To source its marine feedstock, 3F together with a provincial processor formed a partnership company, Marine Scientific Ltd., that consolidates fisheries by-products at economically feasible volumes. It has also formed a partnership with a local farmer, Mike's Farm of Hawke's Bay, and a local forester to source farm and forestry feedstocks. The current product line includes (or will soon include) cosmetic grade collagen, pet treats, seafood compost, wool insulation, moose and sheep soap, lanolin grease and compressed wood pellets. The cardboard and sawdust blended pellets have created the region's first cardboard recycling program and aims to revitalizes the regional lumber industry.

3F Waste Recovery has successfully diverted 20 MT of waste in the past 12 months and increased revenue by 400%.

Find out more about this circular food solution here.

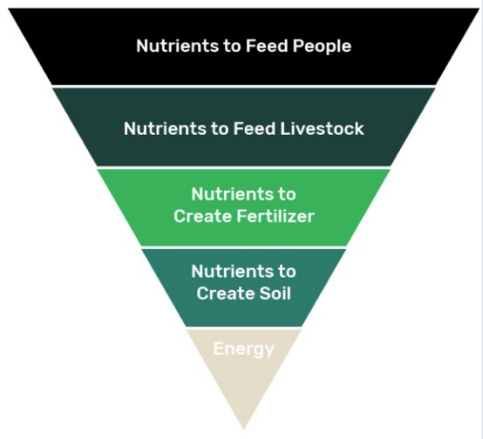
### *Nutrient Recovery*

In a truly closed-loop agricultural economy, all nutrients and organic matter are returned to the soil that they grew in. This allows for the preservation of nutrient and carbon levels in the soil, regenerating it so that farming can continue sustainably. Across Canada, many organizations are using FLW to create agricultural inputs like soil amendments, compost and fertilizers. Some have also found a way to recover nutrients from agricultural wastewater and transform it into soil fertilizer.

## ReFeed Canada: Industrial Scale Nutrient Recovery

A Nutrient recovery company using circular economy principles to develop a closed-loop agricultural system.

**Founded by:** Stuart Lilley
**Established:** 2020
**Location:** Langley, British Columbia




**Driver:** Large volumes of FLW generated by pre-consumer food companies such as food graders and importers which due to limited manpower and storage are not fully captured by food banks and donation centres.

**Solution:** ReFeed is a first of its kind circular nutrition platform dedicated to using recovered produce and agri-food by-products to feed people, livestock and soil. The feedstock for its flagship facility at Langley is pre-consumer produce that comes primarily from food graders and food importers who pay ReFeed to collect and manage industrial quantities of unwanted food. Here it is used for various purposes, following a nutrient recovery hierarchy—resulting in a 99% rate of diversion from landfill and industrial composting. First, any food that is safe is redistributed back to people in need in partnership with the Greater Vancouver Food Bank. What cannot be used for human consumption, is redistributed to local farmers to help feed their livestock nutrient-rich produce. ReFeed also runs a commercial scale worm farm where recovered nutrients are turned into sustainable protein (worm protein) and organic microbial rich worm castings. ReFeed is also working with local dairy farms to develop manure management solutions that in the future will divert manure solids to its farm as feed for its worms. Worm castings combined with organic compost are used grow organic produce in local greenhouses and fields, thereby supporting organic regenerative agriculture. Refeeds' R&D arm is also in the process of developing an organic fertilizer from insect and livestock-based manures with a goal of eliminating 75% of chemical fertilizers used for food production within 50km of any ReFeed Farm.

The mission of this model is to address local food security, reduce GHG emissions, chemical use and phosphorous on farmland, produce sustainable protein and organic microbial rich growing mediums, and act as a community showcase to demonstrate what modern agriculture can look like. The system has intentionally been designed as a modular system that can be adapted to the needs of any food system in the hope that other areas can look to the ReFeed system as an example of what can be achieved and recognise elements that can be applied to improve the circularity of any food system.

In one year of operation, ReFeed has rescued over 2.7 million kg (6 million lbs) of food from ending up in the landfill or industrial compost facilities. Of the food recovered, nearly 1 million lbs went to feed people, largely to clients of the Greater Vancouver Food Bank, 4.4 million lbs went to feeding livestock, and 0.7 million was anaerobically digested. This amounts to the reduction of 5,416 Mt of $CO_2e$.

Find out more about this circular food solution here.

### *Biogas*

Finally, there are also several organizations in Canada that use FLW to produce biogas through anaerobic digestion. Biogas is often used for electricity or thermal energy and can either be used on-site to reduce the carbon footprint or sold externally. While biogas remains low on the food recovery hierarchy, even so, producing biogas from FLW can result in lower GHG emissions than using the same FLW for other purposes and for this reason may be preferred from a carbon mitigation perspective.

Research and development is a big component of all valorization solutions since these require developing new products. Many of the upcycling solutions in Canada rely on academic, government or self-conducted research to identify new avenues to utilize FLW. Once commercial products are developed such businesses usually set up operations close to the source of their feedstocks to reduce transportation costs. Despite this, some businesses face logistical issues to source feedstock especially as they scale up. Existing waste regulations that are not designed to accommodate and encourage valorization, may also present a challenge. To overcome these and other challenges, businesses have had to come up with innovative business models that rely on out of the box thinking. For instance, to capture waste from recreational fishing (which is not permitted to be sold), one business has developed a negative tipping fee system. Because they rely on others for consistent feedstock of waste, perhaps the biggest factor of success for these kinds of businesses are their partnerships and collaborations. Unsurprisingly, access to finance is the biggest barrier to scaling up such practices. This can be attributed to their lack of collateral, insufficient understanding among financial institutions of their novel business models, and a lack of time and manpower to apply for government support. However, demand for such products continues to grow as consumers become more environmentally conscious and seek out individual actions they can take to live a more low-carbon lifestyle.

### 3.3.2. Examples of Canadian food solutions

*Table 3: Inventory of Canadian circular food solutions to create new economic opportunities*

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| **Production Inputs** | | | | | | |
| Choice North Farms | Hay River, North West Territories | Business | A northern chicken farm that partnered with Ecology North to initiate the Hay River Poultry Manure Composting Project. They combine paper products and poultry manure, to produced safe and marketable compost. |  |  | Extending the Life of Resources |
| Nurture Growth Bio-Fertilizer Inc. | Mississauga, Ontario | Business | An agriculture input provider that rescues and upcycles food waste that is destined for landfills and transforms it into eco-friendly microbial fertilizer. The food waste feeds the beneficial microbes in our biofertilizer and, when applied to plants, it builds healthy soils which promotes vigorous plants. |  |  | Extending the Life of Resources |
| Ostara | Vancouver, British Columbia | Business | A water treatment technology corporation that uses proprietary pearl technology to recover nutrients from industrial, agricultural, and municipal water treatment streams and transforms them into granular fertilizers that improve crop yields and reduce runoff. This technology is transforming the commodity market value chain and closing the loop on phosphorus. |  |  | Extending the Life of Resources |
| Petawawa Renewable Power Corporation | Orangeville, Ontario | Business | A developer of clean and renewable energy projects that produces a CFIA-certified fertilizer with an associated Organic Input accreditation. They have recycled over 73,000 tonnes of food waste to sequestration carbon and supply fertilizers to farmers. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Rethink Resource | Toronto, Ontario | Business | A waste management company that collects used compostable packaging and food waste from clients and diverted this waste away from the landfill. The organics stream transforms this waste into compost and then supplies it to consumers to grow their own produce which keeps nutrients and resources within the soil. In addition, they collect brew grains from breweries and feed these waste by-products to cows. |  |  | Extending the Life of Resources |
| Salish Soils | Sechelt, British Columbia | Business | A waste solution provider that accepts fish waste from local fisheries, food waste from local municipalities, biosolid waste, and wood waste to create garden and soil amendment products such as compost, mulch, garden soil blends, and other soil-based aggregates. |  |  | Extending the Life of Resources |
| Synergie Haute-Yamaska | Granby, Quebec | Non-profit/ Community Initiative | A project carried out by MRC de La Haute-Yamaska in partnership with Granby Industrial and the Centre local de développement (CLD) Brome-Missisquoi. This regional initiative promotes a transition to a circular economy by optimizing the residues as well as the resources of the area's industries, businesses and institutions. |  |  | Extending the Life of Resources |
| **Animal and Fish Feed** | | | | | | |
| Catalyst Agri-Innovations | Abbotsford, British Columbia | Business | A circular manure management company that treats manure in anaerobic digesters to capture methane as biogas. They then use the remaining by-products to fertilize the production of aquatic grass which are harvested to create sugar and protein which are used in the production of livestock feed. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Darling Ingredients | Cambridge, Ontario | Business | A waste management company that collects materials such as, waste cooking oil and grease, as well as unwanted fat and bone from restaurants, butchers and other food service operators to create nutritional animal feed ingredients. Their products are compliant with safety regulations and fully traceable. |  |  | Extending the Life of Resources |
| PROREC | Saint-Hyacinthe, Quebec | Business | An alternative animal feed producer that specializes in recovery and recycling output gaps in bakeries, chocolate and candy makers, dairy farmers and processors, and also recovering used vegetable oil. Even once deemed no longer marketable, most food still retains its nutritional value. Instead of going to waste, the food is repurposed and converted into nutritional animal feed by-products. |  |  | Extending the Life of Resources |
| Subait | Dartmouth, Nova Scotia | Business | An organisation that is promoting the shift of bait used for local lobster fishing to a fish processing by-product rather than commercial lobster bait of wild-caught fish. This is more sustainable and adds value to fish processing by-product. They can reduce lobster fishermen's dependence on the commercial lobster bait like mackerel and herring. |  |  | Extending the Life of Resources |
| **Insect Protein** | | | | | | |
| Enterra Feed Corp | Maple Ridge, British Columbia | Business | A Black Soldier Fly company that uses pre-consumer waste food to feed the larvae. The recycled food is collected from local farms, grocery stores, and food production facilities and contains a mix of fruits, vegetables and grains. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Entosystem | Sherbrooke, Quebec | Business | A Black Soldier Fly company that uses insect farming technology in order to promote the agricultural circular economy. Entosystem produces entomological proteins and flour derived from insects with added value, by allowing the recuperation of the nutritional value from food waste and a higher quality control over food safety. |  |  | Extending the Life of Resources |
| Oberland Agriscience | Halifax, Nova Scotia | Business | A Black Soldier Fly company that upcycles waste to high-quality insect protein from gathered waste organics in Nova Scotia. Oberland creates insect feed from food waste through a waste stabilization process. They use this feed to raise black soldier fly larvae for pet food, aquaculture, and agriculture feed. |  |  | Extending the Life of Resources |
| TriCycle Inc. | Montreal, Quebec | Business | A mealworm producing company fighting against food waste, they feed the insects residues from the food production and processing sectors. TriCycle offers insect products and a certified organic fertilizer made from insect manure. Offers consulting services on insect production, R&D services, and support for the development of insect farms. |  |  | Extending the Life of Resources |
| **Upcycled Food & Beverage Products** | | | | | | |
| Abokichi Inc. | Hamilton, Ontario | Business | A company producing Japanese food which upcycles the by-product of sake production to create a line of instant miso soups. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Anew Upcycling | Calgary, Alberta | Non-profit/ Community Initiative | A food rescue charity that partners with food businesses to upcycle ingredients that cannot be distributed or donated. A portion of the proceeds of sales from those products is donated to the Leftovers Foundation. | |  | Extending the Life of Resources |
| Blanc de gris | Montreal, Quebec | Business | A gourmet mushroom producer that uses spent brewers grain as a substrate for the cultivation. |  |  | Extending the Life of Resources |
| Boomerang | Montreal, Quebec | Business | A flour manufacturer that creates enhanced flour from brewing residues. The resulting product is high in fiber, protein, and minerals. Boomerang partners with local brewers and offers agile pickup services for spent grains. |  |  | Extending the Life of Resources |
| Bruized | Toronto, Ontario | Business | A food upcycling business that specializes in turning imperfect produce into healthy food to reduce food waste. Their product line includes granola, made with juice pulp, and cookies, made with fruit, that would otherwise have been wasted. |  |  | Extending the Life of Resources |
| Deep Roots Distillery | Warren Grove, P.E.I. | Business | A small-batch craft distillery in Prince Edward Island that uses apples that would have otherwise been wasted due to falling. |  |  | Extending the Life of Resources |
| Goodly Foods | Vancouver, British Columbia | Business | A soup manufacture that makes tasty and healthy food using surplus produce that would have otherwise gone to waste. This includes slightly unaesthetic tomatoes, excess squash, oversupply of potatoes, beets and other hearty vegetables to make soups, stews and nourishing meals. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| La Transformerie | Montreal, Quebec | Business | A non-profit organization working to reduce food waste, as well as raising awareness on this issue, by implementing solutions to the problem of unsold food in grocery stores and green grocers. They collect food that retail stores are disposing of and then process the food in their kitchen to create canned goods and spreads. |  |  | Extending the Life of Resources |
| LOOP Mission | Montreal, Quebec | Business | A juice business that saves fruits and veggies rejected because they don't have the proper shape, size, or shelf-life necessary to survive distribution. LOOP makes these into cold-pressed juices. In addition, they have beers brewed with day-old bread, a gin distilled from potato cuttings from a potato chip factory, and hand-crafted soaps made with rejected cooking oil. |  |  | Extending the Life of Resources |
| Still Good Inc. | Montreal, Quebec | Business | A snack food-producing company that features upcycled ingredients, including fruit pulp, overripe bananas, and spent brewer's yeast. Their featured product line is a cookie. |  |  | Extending the Life of Resources |
| Susgrainable | Vancouver, B.C. | Business | A flour manufacturer that creates upcycled barley flour from brewer grain. They also have developed an array of baked goods using this flour. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Vodkow | Almonte, Ontario | Business | A vodka distillery that makes vodka using milk permeate, not starch from grains or potatoes like traditional vodka. Milk permeate is a lactose (milk sugar) rich by-product of ultrafiltered milk production. They ferment the lactose in the milk permeate to make alcohol. A bottle of Vodkow weighs on average 50% less than other glass vodka bottles, making their carbon footprint smaller than other vodkas. |  |  | Extending the Life of Resources |
| Wisely Foods Inc. | Montreal, Quebec | Business | A pizza crust processer that reduces food waste by using perfectly good unaesthetic sweet potatoes to produce delicious and nutritious pizza crusts. This decreases the amount of waste and creates new value from it. |  |  | Extending the Life of Resources |
| **Other Bio-based Products** | | | | | | |
| Aruna Revolution | Vancouver, British Columbia | Business | A hygiene company that makes menstrual pads from food and crop waste. These pads are compostable. In comparison, conventional plastic-based pads take up to 800 years to decompose. |  |  | Extending the Life of Resources |
| Genecis | Scarborough, Ontario | Business | A bioplastic manufacturer that converts food waste into biodegradable plastics and other high-value materials. Their biological process converts food waste destined for landfill into valuable materials. Genecis aims to help build a circular economy, where major brands utilize eco-friendly PHA plastics in plastic products. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Goodwood Plastic | Stewiacke, Nova Scotia | Business | A plastic upcycler that recycles rope, net, and other end-of-life fishing and aquaculture industry plastics, as well as general plastic waste and bags into plastic lumber. |  |  | Extending the Life of Resources |
| 7Leagues | Vancouver, British Columbia | Business | A tannery that is creating a unisex ankle boot created from waste in the fishing industry and tanned with waste from the forestry sector. Fish leather requires less energy than other types of leather and it does not require petroleum products. This circular solution uses existing waste from food fisheries to create a durable finished good. |  |  | Extending the Life of Resources |
| **Multiple-Uses** | | | | | | |
| CometBio | London, Ontario | Business | An upcycling company that focuses on agriculture by-products and food leftovers, such as straw, leaves, and shells, into sustainable and healthy ingredients. They reclaim and purify lost nutrients and make them readily available for use in their supplements, food, and beverages. Their products include Sweeterra, Arrabina, animal nutrition and biomaterials. |  |  | Extending the Life of Resources |
| Sanimax | Montreal, Quebec | Business | An industrial ingredients manufacturer that reclaims agri-food industry by-products and transforms them into industrial inputs that are used to create everyday items. The value-added goods manufactured by Sanimax are returned to companies that, in turn, use them to make everyday items. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| West Coast Reduction Ltd. | Vancouver, British Columbia | Business | A waste management company that collects food waste and by-products from food producers like farms, restaurants, and supermarkets, transforming them into ingredients used in renewable energy, animal feed, and thousands of other products used every day. West Coast Reduction focuses their efforts based on a food waste hierarchy to reduce and redirect food resources. |  |  | Extending the Life of Resources |
| Cavendish Farms | New Annan, Prince Edward Island | Business | A large food processor located in PEI, that has created a project to convert food waste into biogas. Potato scraps from the french-fry plant are used at the nearby biogas facility to fuel the fry factory they came from, allowing them to reduce GHG emissions by 60 per cent. |  |  | Extending the Life of Resources |
| CCi Bioenergy | Newcastle, Ontario | Business | A bioenergy corporation whose unique solution for organic waste allows waste to be converted to bioenergy which can be used on-site. They can transform 200 to 1,000 tonnes of organics on-site into energy for internal use or external sale. |  |  | Extending the Life of Resources |
| Sustane Tech | Chester, Nova Scotia | Business | A cleantech innovator that receives fishing gear collected from the ocean by Coastal Action in Mahone Bay, NS for conversion to diesel fuel. This fuel can be used to power vehicles and boats or the Sustanetec plant which also creates bioenergy pellets from organic waste. |  |  | Extending the Life of Resources |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| ZooShare Biogas Co-operative | Toronto, Ontario | Non-profit/ Community Initiative | A community-owned biogas plant project across from the Toronto Zoo. Every year, 2,000 tonnes of manure from the Zoo and 15,000 tonnes of inedible local food waste is converted into renewable energy and fertilizer, leading to the reduction of 20,000 tonnes of GHGs. Annually, the plant produces enough power for 250 homes while generating a by-product of fertilizer to build up the soil of nearby farm fields. |  |  | Extending the Life of Resources |

‡‡Legend

‡‡

| | | | | |
|---|---|---|---|---|
| Focus Area |  Terrestrial Food Production |  Aquatic Food Production |  Processing and Manufacturing |  Northern, rural, and Indigenous communities |
| Lens |  Climate Action |  Business Innovation |  Technology Innovation |  Social Capital |

## 3.4. Motivating Cultural and Behavior Shifts

The global food system in which Canada participates is a highly complex and interlinked system of many actors including farmers and fishers, businesses that process, manufacture, package and sell food, technology and logistic providers, consumers and citizens, governments, NGOs and civil society. The food system is also linked to other systems such as water, energy, health, waste management, trade etc. With so many parts to the food system, making the transition to a more circular one is a wide-ranging task that cannot be planned and executed in a static, deterministic way. It instead requires a design-thinking approach bringing together actors from across the system to collaborate, prototype, learn, refine, and scale what works.[30]

Fostering circular design and systems thinking ultimately requires a cultural and behavioural shift away from linear thinking, among producers, consumers, governments, and financial institutions. Recognising the historical environmental and social damage caused by existing systems, a cultural reckoning has already begun in Canada. This can be seen in changing growing and harvesting practices, business commitments to reduce FLW, changing diets towards plant-based proteins and organic produce, and government policies. However long-term behaviour changes will depend on a sustained effort by all actors to apply creative and innovative thinking to create new technologies, processes, products, services, policies and business models that can deliver a truly sustainable food system that works for the collective good of society.

In addition to applying circular strategies and practices, circular food solutions also include initiatives that educate and spread awareness to motivate the cultural and behaviours shifts that are required for a systemic transition to a circular food economy.

### 3.4.1. Canadian food solutions

#### *Alternative Production Training and Awareness*

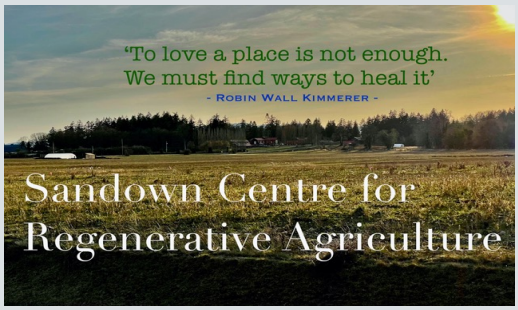
As described in section 3.1.1, alternative production practices like local, sustainable, and regenerative farming are picking up in Canada. Many of these are promoted by educational farms, associations and networks, training workshops, online programs and schools across Canada. Since many circular production practices are unfamiliar to those who have relied on traditional practices all their life, these initiatives play a big role in introducing proven new production techniques to both traditional and urban food producers and in providing the support to implement these with confidence.

Importantly, some of these initiatives are being undertaken by or in schools to instill sustainable and circular values amongst the next generation of food producers. In Canada, the average age of farmers has recently increased to 55 years. However, the number of farmers under the age of 35 increased by 3.0% from 2011 to 2016.[31] Hence, to continue meeting Canada's food requirements for domestic consumption and exports, there is a need to encourage young people to take up farming. This presents an opportunity to instill circular values and principles in individuals who will take the sector forward.

## Sandown Centre: Regenerative Agriculture Hub

A Educational centre that demonstrates regenerative agriculture practices to showcase what ecologically, culturally and economically sustainable food production looks like.

**Founded & Managed by:** Lindsey Boyle & Jen Rashleigh (Circular Farm and Food Society
**Established:** 2019
**Location:** North Saanich, British Columbia




**Driver:** Dwindling farmer population (due to low-profit margins and high land costs), increasing impacts of climate change and early insight into the promise of regenerative agriculture.

**Solution:** The Sandown Centre was formed on Agricultural Land Reserve land that was previously used as a horse racetrack. When the land came up for sale the leadership of the District of North Saanich struck an unconventional deal with its owner. They allowed some of the land to be converted into industrial land that could be sold for a higher price and in return asked that 83 acres be gifted to the municipality, so it could be used to promote local food production as part of the District's Agricultural Strategy. The Centre was developed through community consultation and input called *Vision Sandown* and is partly funded by the taxes generated by the retail store that now sits on the industrial portion of the land. It aims to serve as a destination centre for visitors, the local community and food growers to witness regenerative agriculture in action. Its philosophy is to help birth a regional food system that produces nutritious and delicious produce, ensures a good livelihood for local food growers, and protects and enhances its surrounding ecosystems.

The Sandown Centres offerings include:

- Showcasing soil regeneration practices and ecological stewardship, using managed intensive rotational pasture grazing
- A part-time Farmpreneur program, which provides education and mentorship to young individuals who are drawn to regenerative agriculture from other careers. This is conducted on student incubator plots using shared amenities during the program with the option for short-term leases after.
- Public education programs that utilize community gardens, workshops, food festivals etc.
- Local wetland regeneration, through regenerative land management techniques, in collaboration with the University of Victoria's Ecological Restoration Program.
- Creation of a living laboratory, by building collaborations that span institutions, disciplines and practices to contribute to a growing body of best practices and examples in regenerative agriculture.

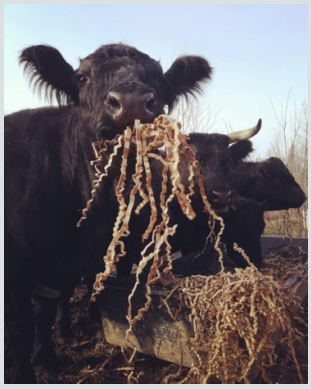
While the Sandown Centre is still in its early stage of development, by 2029 it aims to train 148 farmers and food entrepreneurs, teach 72 community members how to grow their own food, create 29 student jobs and 6 full time jobs and build a more resilient community with increased connection and collaboration with the Tseycum First Nation.

Find out more about this circular food solution here.

## The Northern Farm Training Institute: Northern Food Production Training

Experiential farm school that provides immersive training in regenerative agriculture to help build productive local farms and thriving resilient communities.

**Founded by:** Jackie Milne
**Established:** 2013
**Location:** Hay River, Northwest Territories



**Driver:** Deficit of skilled food producers and teachers in isolated and Indigenous communities in Northern Canada.

**Solution:** The Northern Farm Training Institute (NFTI) operates on a 260-acre campus to provide immersive farm training to anyone committed to improving their local food systems to address northern and Indigenous food security issues.

NFTI conducts research, provides consulting services, designs custom courses as well as delivers scheduled classes. These cover topics like building healthy soil, building greenhouses, northern garden design, garden harvest and preservation, permaculture, northern animal husbandry, marketing and small business development, waste reduction for communities and farmers, etc.

Some of the innovative circular practices developed and propagated by NFTI include:

- Growing food in gardens where soil is amended with manure, biochar, and compost.
- Creating animal feed from FLW (diverted from a local grocery store) waste vegetable oil and locally sourced hay, which is much more fibrous than industrial feed
- Creating animal feed and bedding from shredded waste cardboard. This is also used as a biodegradable garden mulch which is very effective at absorbing water
- Creating forest paddocks and grazing animals in forested pastures so that their manure regenerates the land.

Since 2013, NFTI has trained with over 300 people: over 50% First Nations / Metis / Inuvialuit from 30 different communities, helping to restore independent food systems and shift the culture around food production and resource use. Its practices have enabled the growing of fresh produce and successfully wintering over all their animals (250+) for 5 winters in -40c with very low losses. In 2018, it was the runner-up in the Artic Inspiration Prize.

Find out more about this circular food solution here.

A key factor of success for agricultural training and educational initiatives in Canada is taking a bottom-up approach that has local community support and engagement. This is important as the promotion of alternative production practices can sometimes face resistance from traditional producers who see these as competition rather than a means to improve their own sustainability and productivity. Further, for actual uptake and proliferation, such initiatives must be able to showcase and demonstrate best practices that can be replicated.

### *Reviving Indigenous Production Techniques*

Some initiatives in Canada are also attempting to revive Indigenous growing techniques. This is largely done using community gardens where knowledge can be passed down through storytelling and hands-on learning. These programs play a role in rebuilding a relationship with the land, developing skilled food producers, and empowering local people through capacity building. Importantly, these programs could present an opportunity for reconciliation in alignment with the Truth and Reconciliation Commission's Calls to Action.

### *Sustainable Consumption Training and Awareness*

To increase the demand for sustainably grown food and reduce the amount of FLW generated at the consumption stage, many organizations also run workshops, communication campaigns, and coaching classes that aim to change consumer behaviour patterns. In many cases, these are run by organizations that focus solely on food-related issues. However, in some cases, food programs are run as one component of a larger sustainability focus.

## The Charlton Sustainability Hub: Sustainable Rural Lifestyle Teaching Hub

Experiential teaching hub that supports the sharing of Indigenous Traditional Knowledge and contemporary knowledge to promote the socio-economic sustainability of rural and remote communities through low-carbon living, resource diversification and circular economies.

**Founded by:** Ambrose Raftis & Martha McSherry
**Established:** 2018
**Location:** Charlton, Ontario


**Driver:** Adverse infrastructure issues faced by Northern, rural, and Indigenous communities impacting their social and economic development.

**Solution:** The Charlton Sustainability Hub (CSH) was initiated as a part of the Northern Ontario Centre for Sustainable Development Co-Op Inc. (NOCSDC). It takes inspiration from The Nordic Follkcenter in Denmark, and other sustainability hubs in Europe which have proven to nearly reverse youth out-migration and economic decline in rural areas there.

The CSH operates out of a closed public school facility which is to be retrofitted into a sustainably run building that is energy and food secure. The property will be farmed, used as an affordable low-carbon-living research and testing site, and fitted with living accommodations for 30 people as the Hub will also run as an educational facility with hands-on and theoretical programs offered. A Virtual Hub is also planned to enable convening despite the large distances between populations in the region, as well as the inability to travel as efficiently in winter in the North. The NOCSDS has also partnered with Keepers of the Circle, an Indigenous urban hub with experience running educational hubs and gardens. By integrating Traditional Ecological Knowledge (TEK) and contemporary Western practices, the goal is for the CSH to be an inter-cultural learning facility that teaches, practices, as well as research and tests, affordable, low-carbon, sustainable rural living techniques for the region, creating energy and food security for everyone. While open to various demographics, the CSH will focus on promoting its resources and programs to First Nation and Metis Communities, local students and Amish and Mennonite farmers.

Given the high level of food insecurity in the region, developing local and sustainable food systems is an important aspect of the CSH. The CSH will work towards this by:

- Building a community garden that will share harvested food with the community through the local food bank, community food events, and a computerized Food Hub system
- Building a renewable energy powered greenhouse
- Building an industrial community kitchen that will prepare and preserve food harvested from the garden and greenhouse

- Developing workshops that create an understanding of food storage and the value of quality food for health. Topics will include:
    - Permaculture, planning, planting and soil regeneration
    - Garden, greenhouse and four-season growing techniques
    - Bee and animal husbandry and forest harvesting
    - Food preparation, drying, canning and preserving
    - Aquaponics, growing food and fish

By providing the tools, skills, and resources to harness regenerative agriculture practices, the CSH hopes to empower rural communities with the ability to serve their own food needs by increasing access to nutritious and affordable food and create stronger local investment in infrastructure and equipment for food production

The Hub currently has partnerships with five surrounding townships and seven First Nations.

Find out more about this circular food solution here.

### 3.4.2. Examples of Canadian food solutions

*Table 4: Inventory of Canadian circular food solutions to motivate cultural and behavioral shifts*

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| **Alternative Food Production Education & Awareness** | | | | | | |
| Clear Water Farms | Willow Beach, Ontario | Business | An education farm that provides place-based education using experiences that will lead to a regenerative farming system. They also assist with adapting to climate change through preparing for droughts and extreme weather events. |  |  | Rethinking Production and Resource Consumption |
| Food Eco District | Victoria, British Columbia | Non-profit/ Community Initiative | A district in the heart of downtown Victoria that is becoming the first sustainable dining district in Canada. There are fourteen restaurant and café members which are focused on eco-friendly practices, and including a growing number of edible gardens around town. They have partnered with LifeCycles Project Society to create an Urban Learning Garden in the courtyard of the downtown library, people can learn more about growing in urban spaces. |  |  | Rethinking Production and Resource Consumption |
| Food First Foundation | Yellowknife, NWT | Non-profit/ Community Initiative | A registered charity which supports food and nutrition education programs in schools with the goal of encouraging a healthy population of children and youth for future generations. They purchase indoor gardens, soil, and seeds for schools in the Northwest Territories who want to partake in the program. The program was intended to showcase how food can be grown and the healthy options that growing your own food can create. |  |  | Rethinking Production and Resource Consumption |
| James Bay Eeyou School Greenhouse | Chisasibi, Quebec | Institutional | This greenhouse was launched by the local high school as a way to teach students about gardening, health and food security in the North. The JBES Greenhouse was supported by the Cree School Board, the local band office, and the Chisasibi Business Service |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | Centre. The service centre has plans to build a year-round commercial greenhouse, which is challenging due to the high heating costs associated with the short growing season in the North. | | | |
| Rencontre East | Rencontre East, Newfoundland and Labrador | Non-profit Organization | A small community that set out to increase its food supply chain and become more resilient. There, the Food Security Committee settled on launching three programs: a backyard gardening and composting program, a food education and skills program, and a fruit mapping program. |  |  | Rethinking Production and Resource Consumption |
| SucSeed | St Johns, Newfoundland and Labrador | Business | An organization that is improving food security in Labrador through education, micro gardens, and are encouraging people to live more sustainably. SucSeed employs at-risk youth to build small-scale hydroponic systems (a soilless, nutrient-filled plant incubator) to help communities tackle their own food security issues. Proceeds from sales are used to support food sharing initiatives across Canada and the North. |  |  | Rethinking Production and Resource Consumption |
| The Market Gardener | St-Armand, Quebec | Business | Aids the creation of new small regenerative farms and promotes an ecological agricultural transition around the world. They offer online programs to farmers from 56 countries, in-person workshops and training, produce and distribute digital media content, develop television and publishing projects, and are establishing a team of consultants to work on landmark projects all over the world. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Young Agrarians | Nanaimo, British Columbia | Non-profit/ Community Initiative | A farmer-to-farmer educational resource network for new and young ecological, organic and regenerative farmers in Canada. The network is volunteer-based, with farmers across the country organizing on-farm events and building community to create spaces for knowledge sharing and growth. Their focus demographic is 20-40. |  |  | Rethinking Production and Resource Consumption |
| **Traditional Knowledge Sharing** | | | | | | |
| Klinic Garden | Winnipeg, Manitoba | Indigenous Community Initiative | Regenerative community garden teaching Traditional Ecological Knowledge (TEK). A growing space using ancestral growing techniques/stories and hands on learning through oral teachings. |  |  | Rethinking Production and Resource Consumption |
| Three Sisters Teaching and Knowledge Garden | Valleyfield, Prince Edward Island | Indigenous Community Initiative | A garden hosted by the Sweet Clover Farm. Three Sisters (Milpa farming) is a traditional practice that uses corn, beans, and squash these three crops all have different symbiotic characteristics that encourage the growth of the others. The farm is focused on reviving Indigenous farming techniques and education. |  |  | Rethinking Production and Resource Consumption |
| **Sustainable Consumption Behavior Awareness** | | | | | | |
| Lifecycles Project | Victoria, British Columbia | Non-profit/ Community Initiative | The founder of several community food initiatives in the Greater Victoria area. Their mission is to build the relationship between healthy food, healthy communities, and a healthy planet. Through sustainable projects and volunteer opportunities, they empower people by sharing food knowledge and practices in the community. Examples of projects undertaken by the lifecycles project include a fruit tree project, community orchard, school workshops, and community food justice. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Love Food Hate Waste-Canada | National | Government | A behaviour change campaign that is helping Canadians reduce FLW through food planning, storage, and consumption habits. By working with businesses, governments and community groups across Canada, they are working to inspire and empower people to make their food go further and waste less. | |  | Rethinking Production and Resource Consumption |
| Sauve ta bouffe | Quebec, Quebec | Business | Leads a coaching style food loss and waste prevention program for households. They promote individual practices that households can do to reuse waste. | |  | Rethinking Production and Resource Consumption |
| **Circular Business Education** | | | | | | |
| Food Venture Program | Guelph, Ontario | Business | A 4-day online program which provides entrepreneurship education to new food and beverage business owners across Canada looking to increase their focus on sustainability. They offer courses that provide opportunities for businesses to circularize their businesses in multiple ways such as farm to retail programs, restaurant recovery, and uncovering hidden value. A key topic covered in their program is 'discovering already-exisiting value and creating new value'. | |  | Extending the Life of Resources |

[§§]Legend

[§§]

| | | | | |
|---|---|---|---|---|
| Focus Area | Terrestrial Food Production | Aquatic Food Production | Processing and Manufacturing | Northern, rural, and Indigenous communities |
| Lens | Climate Action | Business Innovation | Technology Innovation | Social Capital |

## 3.5. Building Local Economies and Social Connections

The Canadian agriculture and food economy is highly industrialized, with increasing centralization in production and processing operations resulting in larger corporate control over the food system and reducing profit margins for farmers. This has not only resulted in deteriorating environmental outcomes but also impacted rural communities socially and economically. Consumers have also lost knowledge about where their food comes from and their connection to food. As described in previous sections, many remote, northern, and Indigenous communities are particularly impacted.

Further, the current industrial food system is underpinned by highly globalised supply chains. Canada is both the 5$^{th}$ largest food exporter in the world and the 6$^{th}$ largest food importer. As the COVID-19 pandemic has highlighted, these supply chains are complex and vulnerable to external shock. The severe disruptions experienced during the pandemic have amplified the call for greater localization of food supply, and the demand for community-supported agriculture and direct-to consumer food marketing modes which can reduce transaction and transportation costs for farmers and fishers.[32]

Many circular food solutions --like local and regenerative food production; increasing resource intensity by sharing land, equipment, and surplus food; finding synergies between producers and consumers of 'waste' resources that can be reused for new value-added products--help to build back social food connections and revitalize local economies. This is in turn creates a more connected system to food, to local area, to the producers of food, and other people in the community. A more connected, circular food system has the ability to regenerate natural systems, increase farmer incomes, and build food security as well as to improve community self-reliance.

### 3.5.1. Canadian food solutions

#### *Local Food Production*

The local food movement has been growing in Canada since the 2000's as consumers are increasingly interested in where their food is coming from.[33] As noted in section 4.1, local production and consequently shorter supply chains reduce transport-associated GHG emissions. This practice is especially observed among remote, northern, and Indigenous communities for whom local food production is not only a cultural practice but also in many cases the only way to secure their food supply. As a result, these communities are increasingly adopting community gardens, community fridges and freezers, greenhouses and hydroponic/aquaponic systems. In keeping with cultural values of maintaining environmental health, most of these communities also practice composting. In some cases, communities have gone beyond local production practices and have also built community kitchens, local processing units, traditional food knowledge sharing programs, etc.

## Fort Chipewyan Sustainable Food Production Centre: Local Food Production

An Indigenous community-led food hub that combines high tech growing systems with honouring and continuing traditional Indigenous practices.

**Founded by:** Three Nations Energy GP Inc
**Established:** Currently in Planning Stage
**Location:** Fort Chipewyan, Alberta

**Driver:** High cost and GHG emissions of food imports along with strong community interest in reviving traditional food harvesting and processing practices.

**Solution:** Three Nations Energy (3NE), jointly owned by the Athabasca Chipewyan First Nation, the Mikisew Cree First Nation, and the Fort Chipewyan Metis Association was created in 2018 to bring clean, low carbon, affordable and reliable electricity to the community of Fort Chipewyan. In 2020, they set up Canada's largest solar PV system in a remote community. 3NE now aims to continue serving as a vehicle for the Nations to work together on delivering indigenous-owned clean energy, healthy food and local economic development.

Based on extensive consultation with leaders of the Nations, a local fisherman association, elders and community members and academics working on northern local food production practices, 3NE is in the planning stage of developing a Sustainable Food Production Centre (SFPC). The SFPC will be based on community owned land and is being designed to create a sustainable integrated food solution package that will use best available production technologies, support traditional food practices education and offer the community desirable flexible employment opportunities.

Planned components of the SFPC include:

- Indoor farming using state of the art hydroponics system using modular vertical towers.
- A seasonal greenhouse that can utilize waste heat from the indoor growing lights, pumps, and wood boiler in the shoulder season, allowing for a longer growing season (April to October)
- Outdoor garden plots for commercial use as well as individual gardens
- Indoor fish farming tanks and aquaponic systems to harvest Tilapia (a warm water whitefish)
- Facilities for cleaning and processing of fresh or preserved wild foods (from the SFPC as well as fish catch/ game from community elder harvests, wild berries, family garden produce)
- A composting facility that will compost organic waste from commercial, institutional, and residential sources

- An education centre focussed on teaching and passing along traditional skills and culture to the youth

Another innovative aspect of the SFPC is its energy use plan. In the summer months it will rely largely on electricity generated through an onsite dedicated solar array which will also have the capacity to sell surplus electricity to the local grid for credits. In the winter months it will generate heat using a commercial wood-fired outside boiler which will create local jobs for salvage and sustainably harvest timber.

Find out more about this circular food solution here.

Some communities have developed their own 'food hubs' that take a holistic approach to improving their local food system, including sustainable production, processing, distribution, recovery and reuse practices. However, examples of such hubs are as of yet scarce in Canada.

## Yellowknife Farmers Market:
## Farmers Market for Locally Grown Food and Products

Not-for-profit society that promotes the growth of local food systems.

**Founded by:** Local volunteers
**Established:** 2013
**Location:** Yellowknife, Northwest Territories

**Driver:** Vulnerable food supply chains and that disrupt the access to fresh nutritious food in the North.

**Solution:** The Yellowknife Farmers Market (YKFM) is a weekly summer farmers market that provides a venue where Yellowknifers can purchase locally baked, cooked, processed and harvested goods. It also provides a space where communities can gather together and support local growers, harvesters, bakers, cooks and artists. This helps share critical knowledge and create conversations required to initiate progress towards sustainability.

However, it is much more than a marketplace and is guided by the objectives of supporting food based economic development and the growth of the local food system, and aims to play a central role in fostering an economically, ecologically, culturally, and socially sustainable community. To do this, it has several programs in place including:

- Landshare program: that connects landowners to growers to encourage the development of food production in under-utilized spaces in Yellowknife.
- Harvesters' table: where local producers can sell or donate their excess to prevent food waste and gain experience in how to market themselves and their produce.
- Lunch and learn program: that holds workshops on food production so Northern growers can make the most of their limited growing season and share their experiences
- Waste reduction and compost program: that requires all vendors to use compostable disposal items and has set up 10 compostable bins on site. These bins are staffed by volunteers that educate patrons about proper disposal and vendors about using compostable packaging alternatives. YKFM also runs a loyalty card program that encourages patrons to bring their own dinnerware by giving them a $15 market voucher for every 5 times they bring their own containers/cutlery.

The YKFM has grown from 10 vendors in 2013 to an average turnout of approximately 30 vendors per summer, for a total of approximately 70 businesses. Through its waste diversion program, it diverts between 85%-95% of its waste to compost each week. YKFM has an economic impact to the local economy of close to $1 million annually.

Find out more about this circular food solution here.

### *Production Equipment Sharing*

Another circular principle seen applied by some community initiatives is the sharing of resources, that allow for more intensive use, thereby increasing their utility and reducing the use of virgin resources. This not only includes sharing of food through food trading, meal swap programs, etc. but also the initiatives that support the sharing, swapping, renting etc. of agricultural tools and equipment. These practices increase the usage intensity of existing resources and thereby reduce the GHG emissions associated with the production of virgin resources. Such examples are also rare, and where found are mostly from Quebec. These initiatives are highly dependent on mutual trust and community connections for success.

## CUMA de l'Érables: Farm Equipment Sharing

Co-op developed to enable the practice of sharing farm equipment locally.

**Established:** 2002
**Location:** l'Erable, Quebec

**Driver:** Financial strain of self-purchasing capital intensive farming equipment as well as lower than optimal usage of the equipment over its lifetime.

**Solution:** CUMAs (Coopérative d'utilisation de matériel Agricole) is an equipment sharing co-op that was established in France after World War II to increase agricultural productivity. In 1992 the first CUMA was established in Quebec, which grew quickly but later stagnated. More recently, these have once again become prevalent in Quebec due to the high costs of machinery and a new generation of farmers entering the industry who are seeking cost effective solutions. The CUMA de L'Érables is one such organisation operating in the Érables region of Quebec and is one of the 61 CUMAs listed in the Quebec Governments directory.

Local farmers who are interested in equipment sharing can register with the co-op and become members. The co-op then prioritizes what equipment is to be purchased and finances it. Twenty percent of the capital cost is borne by the co-op members while the remaining is sourced from financial institutions. Members then sign up to use the machine and pay according to their usage.

By joining a co-op, members can access more efficient farming equipment than they would otherwise be able to afford. It also reduces their burden of equipment upkeep and maintenance. In addition, the co-op encourages and supports new farmers by removing the barriers of having to individually purchase capital intensive farming equipment.

The CUMA de l'Érables has 16 members as well as 16 pieces of equipment in the Co-op.

Find out more about this circular food solution here.

### *Industrial Symbiosis*

Finally, there are some examples of platforms supporting industrial symbiosis in the agri-food sector in Canada. Industrial symbiosis is a form of brokering which brings companies together to find synergic solutions to use waste from one company as raw materials for another. Such platforms create connections required to support the creation of new value-added products from FLW. However, most of these symbiotic platforms are operating on a small scale and with limited uptake in Canada. They are largely seen in Quebec, and especially prevalent in the areas surrounding Montreal. This is likely due to the large number of food-processing companies in the area, which offers increased opportunities for symbiotic platforms to be successful. Further, since these are located in close proximity to each other, it allows for lower transportation costs and reduces transport associated GHG emissions.

## Symbiose Agroalimentaire Montérégie: Industrial Symbiosis

Regional project that applies the principles of industrial symbiosis in Montérégie's agri-food sector to support the development of a circular economy in the region.

**Founded by:** Regional Environmental Council of Montérégie
**Established:** 2019
**Location:** Longueuil, Quebec

**Driver:** Limited resources among agriculture and agri-food companies to divert unused materials and by-products, resulting high waste-disposal costs and untapped potential for new business opportunities.

in

**Solution:** The Symbiose agroalimentaire Montérégie is an agri-food industrial symbiosis initiative coordinated by the Montérégie Regional Environmental Council. It has created a local network of organizations linked together by exchanges of residual materials and other undervalued resources. This includes both organic and inorganic resources. It supports businesses who are interested in joining this network by first characterizing their resources using techniques such as surveys, workshops etc. It then identifies potential synergies with businesses that can utilize the resource. Based on this it then creates the connections between the two businesses. To aid efforts to increase industrial symbiosis in the region, Symbiose agroalimentaire Montérégie partners with organizations like Municipalite regionale de conte (MRC) who provides financial support as well as with agri-food research centers who help them identify news avenues to utilize the waste generated by their network.

Symbiose agroalimentaire Montérégie has reached over 100 businesses in the region so far, with hundreds more having expressed an interest in becoming involved.

Find out more about this circular food solution here.

### 3.5.2. Examples of Canadian food solutions

*Table 5: Inventory of Canadian circular food solutions to build local economies and social connections*

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| **Local Food Production** | | | | | | |
| Churchill Northern Studies Centre | Churchill, Manitoba | Indigenous Community Initiative | The Centre started a hydroponic garden which aids in supplying local fresh produce to the community in an area where fresh produce is limited and expensive. Now the garden supplies the subscription box, grocery store, and restaurant. |  |  | Rethinking Production and Resource Consumption |
| Eabameetong (Fort Hope) Community Garden | Fort Hope, Ontario | Indigenous Community Initiative | A successful community garden project and five-acre farm that has been growing fresh food for the community, offering jobs, training and creating a local farm business for learning from the traditional wisdom of Elders. The operational support for the Eabametoong Farm is supplied by Covenant North Incorporated Consultants. |  |  | Rethinking Production and Resource Consumption |
| Fort Severn First Nation | Fort Severn, Ontario | Indigenous Community Initiative | Has several greenhouses and has been growing different fruits and vegetables. Each year, one or two new greenhouses have been erected in a new yard. The greenhouses are made entirely by community members using recycled materials. Plants are grown out of the ground or in raised beds, old tires, and storage bins. |  |  | Rethinking Production and Resource Consumption |
| Inuvik Community Greenhouse | Inuvik, Northwest Territories | Indigenous Community Initiative | Started in 1998 when volunteers transformed an old arena into a fully functioning greenhouse. This space is used by locals who pay a small fee and volunteer to garden here. They also have a commercial space where they sell plants to cover operation costs. They have over 170 beds in the greenhouse for members to |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| | | | use. They also have dedicated plots for elders, group homes, children's groups, the local food banks, and more. | | | |
| Kitasoo First Nation | Klemtu, British Columbia | Indigenous Community Initiative | Partnered with the Nutrition through Engagement and Agricultural Technologies Project to develop local food production, create sustainable business models and engage the community including its youth. The project aims to improve health and well-being and cultivate resilience in the face of climate change, the COVID-19 pandemic and other disruptions. The goal is to provide their own food system and create a circular economy. |  |  | Rethinking Production and Resource Consumption |
| Kuujjuaq Greenhouse | Kuujjuaq, Quebec | Indigenous Community Initiative | The community's two greenhouses are divided by plots which are offered to all residents of Kuujjuaq for one season. Some plot users join their efforts together to make a collective garden and users who have too much harvest distribute it to the community. A composting project has also been built and been put in place to produce compost that is used in the greenhouse. The feedstock is collected from nearby institutions such as grocery stores and other major vegetable waste producers. |  |  | Rethinking Production and Resource Consumption |
| Local Food Manitoulin | Manitoulin Island, Ontario | Indigenous Community Initiative | Supports a combination of eleven community gardens in First Nations on Manitoulin Island, as well as food-sharing platforms such as a mobile market, food box program, and harvest to share program. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| NiKigijavut Nunatsiavutinni (Our Food in Nunatsiavut) Project | Nunatsiavut, Newfoundland and Labrador | Indigenous Community Initiative | An ongoing project that uses a CLFA Model as a tool for increasing access to healthy food, improving health, and achieving healthier weights in other Inuit communities in Nunatsiavut and across Canada. This approach has led to a community freezer expansion program, a community gardening program, a community kitchens program focused on traditional food education, and a good food box program. |  |  | Rethinking Production and Resource Consumption |
| Nishnawbe Aski Nation | Thunder Bay, Ontario | Indigenous Community Initiative | Working with its First Nation communities to restore locally produced food that is integral to resilient ecosystems and the development of sustainable economies. They have a Food Strategy, advisory council, and website that lists community stores and other educational promotions. |  |  | Rethinking Production and Resource Consumption |
| Northern Manitoba First Nations Food Sovereignty Project | Northern Manitoba | Indigenous Community Initiative | Provides shipping equipment and supplies to support community garden and greenhouse development and home gardening pilot projects. They build essential food-producing infrastructure such as greenhouses, cold-frames, and soil from waste diverted from landfills. They also create and manage local food systems and provide information sharing from southern experts, within and between communities, and from Elders and youth. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Norway House Cree Nation | Norway House Cree Nation, Manitoba | Indigenous Community Initiative | Has been able to implement two container box hydroponic growers to supply the community with fresh and healthy leafy greens and herbs. This project was made possible with the help of the Churchill Region Economic Development Fund. |  |  | Rethinking Production and Resource Consumption |
| Opaskwayak First Nation | near The Pas, Manitoba | Indigenous Community Initiative | Year-round gardens provide free fresh vegetables to hundreds of community members. One pilot project kicked off in 2016 with seven plants grown under LED lighting in hydroponic Styrofoam planters. The indoor growing facility in the community hall now has more than 75 plants that supply free, fresh produce to 125 families on a regular basis. Some of the vegetables grown from this project are also donated to other local facilities which provide programs that provide social assistance and teach how to cook healthy meals. |  |  | Rethinking Production and Resource Consumption |
| Pool's Cove | Pool's Cove, British Columbia | Indigenous Community Initiative | An isolated small coastal community whose food security is dependent on a ferry crossing for delivery to a town that is located 55km away. When 98% of residents reported wanting access to healthier food, the community responded by building a community garden. The garden is built around recycling, using old highway guard rails to make raised planters and old buoys for pots. The community also has a community food freezer that is stocked by donations from local hunters, fishers, and gatherers. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Sioux Valley Dakota Nation | Sioux Valley Dakota Nation | Indigenous Community Initiative | Formed a partnership with regional organizations to implement sustainable practices and environmental stewardship through innovative waste management or recycling/upcycling projects. They identified community gardening, composting, and building a greenhouse as the methods to provide sustainable economic benefits and local food production. |  |  | Rethinking Production and Resource Consumption |
| Waywayseecappo First Nation | Waywayseecappo, Manitoba | Indigenous Community Initiative | Has established three community gardens as projects under the Feed the Children project. These gardens provide fresh food to an area where food security and healthy food access is otherwise difficult to establish. |  |  | Rethinking Production and Resource Consumption |
| **Food Hubs** | | | | | | |
| Gitmaxmak'ay Nisga'a Society | Prince Rupert, British Columbia | Indigenous Community Initiative | The project explored ways to coordinate the assets owned by the society to create a "food hub" that could address food insecurity in a holistic way. Activities included in the project were processing seafood, the use of traditional medicine, community-led workshops, gardening, and greenhouse education along with hydroponic food production. |  |  | Rethinking Production and Resource Consumption |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| The Station Food Company Ltd. | Newport Station, Nova Scotia | Non-profit Organization | A food hub in rural Nova Scotia that acts as a community kitchen, food business incubator, and local food processing company. One of the in-house projects is the upcycling of unharvested produce into frozen vegetables and fruit puree scoops they also run a school snack and food literacy program, a seniors food box program, and services for food business start-ups. |  |  | Rethinking Production and Resource Consumption |
| **Community Composting Initiatives** | | | | | | |
| Bella Bella Compost Program | Bella Bella, British Columbia | Non-profit/ Community Initiative | Initiated in 2012 by the local Solid Waste Working Group and Heiltsuk Tribal Council representatives, the project was inspired by existing community gardens and composting at the Elders Centre and the School. Community leaders hope to reduce the volume of waste sent to landfill and to improve health by expanding composting and growing food locally. |  |  | Giving Resources New Life |
| Community Compost Exchange Program | Toronto, Ontario | Non-profit/ Community Initiative | An exchange system incentivizing the resource collection of organics. Community members bring their kitchen waste to an urban farm and, in return, are given “market dollars” to purchase organically grown produce at weekly farm markets. The collected kitchen waste is then processed onsite into high-quality compost for use on the farm, in turn building a circular economy and closing the food waste loop. |  |  | Giving Resources New Life |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Glooscap Organic Compost Shed Community Event | Glooscap First Nation, Nova Scotia | Non-profit/ Community Initiative | Created to divert organic waste while providing an educational tool for the community youth program, as well as creating nutrient-rich compost to be used within the Community. The construction event provided an opportunity for community members to practice their trade skills and assist in the construction process from start to finish. |  |  | Giving Resources New Life |
| Neighbourhood Composting Program | Victoria, British Columbia | Non-profit/ Community Initiative | A neighbourhood composting pilot program with a small community garden site and 30 households (mostly apartments) that do not have access to land to do their own composting. The pilot project has been successful and is looking to expand to other parts of the Capital Region District (Victoria). This initiative has given people living in apartments a way to be a part of a more local, circular food system and increased the affordability of growing their own food by avoiding the need to purchase fertilizer. |  |  | Giving Resources New Life |
| **Resource Sharing** | | | | | | |
| Alveoli Resource Sharing | Gatineau, Quebec | Non-profit/ Community Initiative | Links businesses, organizations, and self-employed workers within the agri-food and related sectors to enable them to co-develop by swapping, renting, ceding, selling, sharing, or grouping. They do this for greater environmental, economic and social profitability. | |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Junction Food Network | Guelph, Ontario | Non-profit/ Community Initiative | A collaborative community project that reduces food waste, increases the resiliency of local food, and builds community connections by facilitating food trading, donation, and sales between residents of the neighbourhood. |  |  | Maximizing Resource Utilization |
| **Industrial Symbiosis** | | | | | | |
| Merinov | Gaspé, Quebec | Business | Uses fish co-products generated in Quebec to create new avenues of recovery adapted to the economic market. A system for connecting processors with potential users of co-products will also be developed to foster the creation of a circular economy. |  |  | Maximizing Resource Utilization |
| Resetfoods | Toronto, Ontario | Business | Working towards a disruptive multiprotocol plug-in that connects commercial Suppliers to Buyers of FLW at all points along the food supply chain. The resulting innovative value creation complements a FLW Blockchain, thereby improving profits and establishing trust, traceability, optimization, confidence, and transparency. |  |  | Maximizing Resource Utilization |
| ReSource Exchange | Guelph, Ontario | Non-profit/ Community Initiative | A free business-to-business marketplace that enables companies to post their food waste, by-products and coproducts that would normally be thrown away for other businesses to use. Businesses can generate new revenue and reduce potential costs by posting excess space, tools and equipment, and donate a particular food product to local food-relief organizations through the platform. |  |  | Maximizing Resource Utilization |

| Name | Location | Type | Description | Focus Area | Lens | CE Objective |
|---|---|---|---|---|---|---|
| Synergie Bellechasse-Etchemins | Saint-Lazare-de-Bellechase, Quebec | Indigenous Community Initiative | By mobilizing the business community and organizations, they aim to optimize the use of materials in a circular economy perspective. They find synergy within the community including industry, farms, and other organizations to rethink, reduce, reuse, recycle, and recover materials and products. |  |  | Maximizing Resource Utilization |

***Legend

***

| | | | | |
|---|---|---|---|---|
| Focus Area |  Terrestrial Food Production |  Aquatic Food Production |  Processing and Manufacturing |  Northern, rural, and Indigenous communities |
| Lens |  Climate Action |  Business Innovation |  Technology Innovation |  Social Capital |

# 4.0 KEY FINDINGS & OBSERVATIONS

## 4.1. Geographical Distribution

Circular food solutions are found across Canada, as depicted by the geographical spread of the close to 200 initiatives identified in this report (Figure 5).

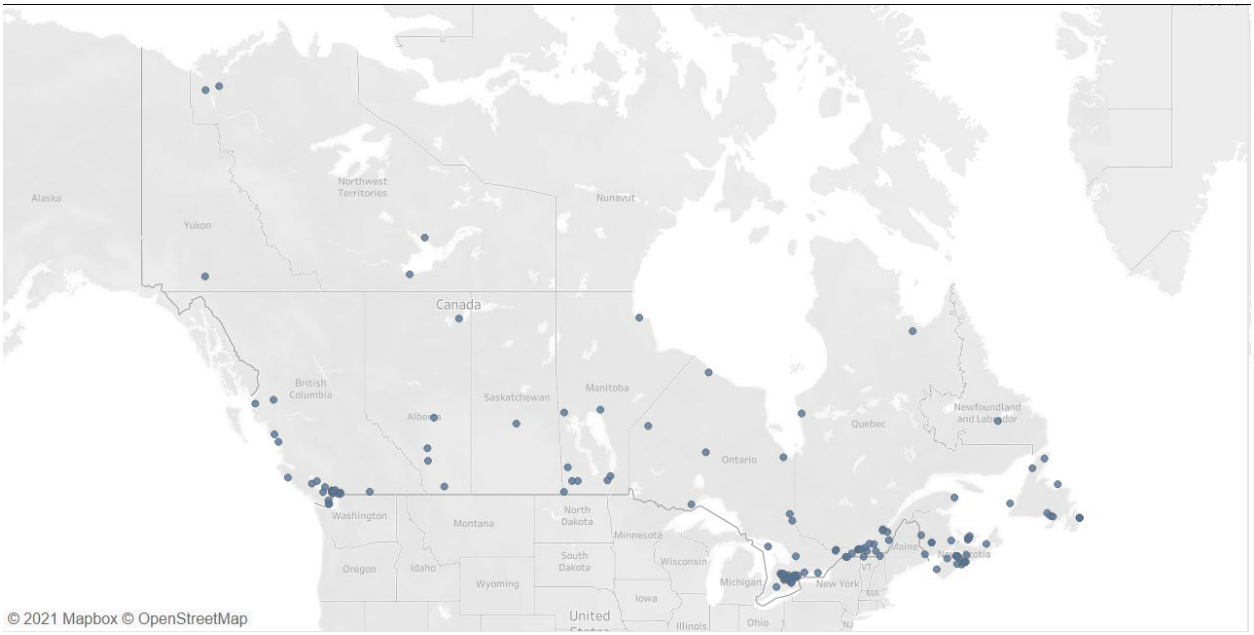



*Figure 4: Geographic Spread of Identified Circular Food Solutions Across Canada*

The initiatives identified are concentrated in Ontario, Quebec, and British Columbia, with these provinces making up over half of the examples found (Figure 5). This likely reflects the population size of these provinces.

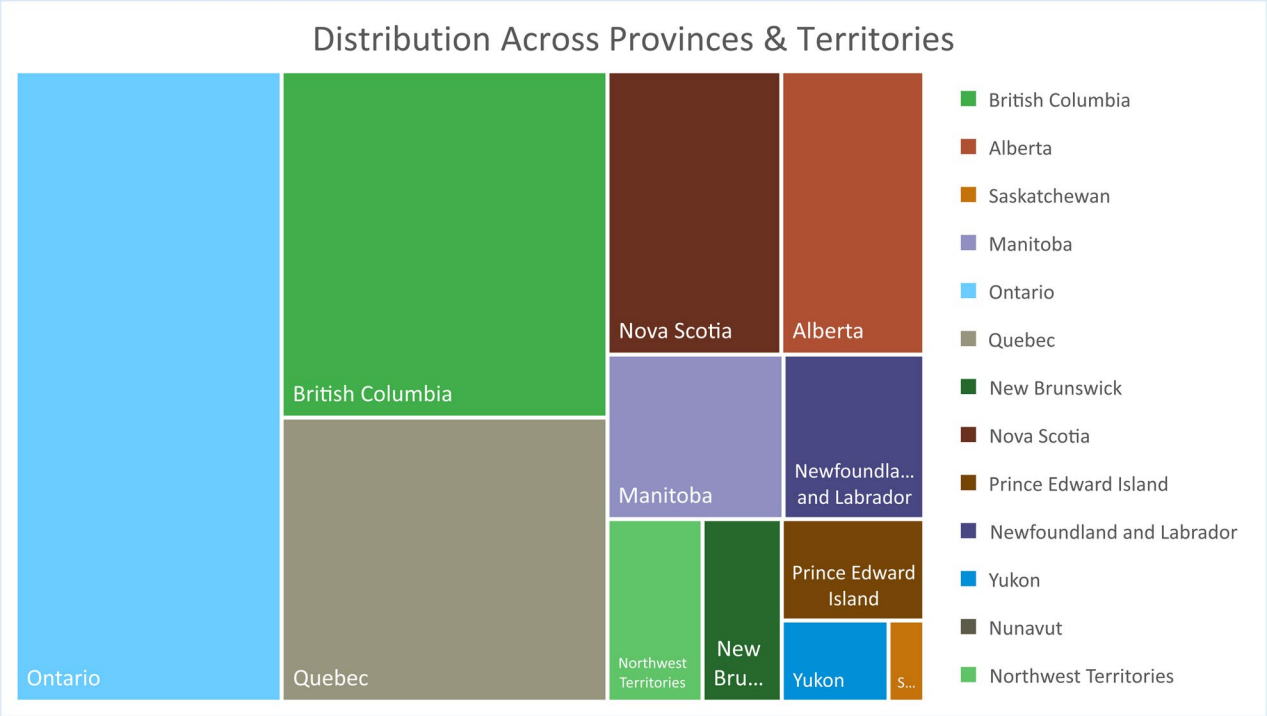



*Figure 5: Distribution of Identified Circular Food Solutions Across Provinces & Territories*

Despite the project's emphasis on identifying solutions from rural, northern, and Indigenous communities, over half the initiatives identified are found in urban centres such as Toronto, Vancouver, Halifax, Calgary, Montréal, and their surrounding peri-urban areas (Figure 6). With over 80% of Canada's population now residing in cities,[34] this is likely due to the large market opportunities that urban areas represent as well as the space they offer for new and innovative enterprises to exist without market saturation. This is also consistent with literature findings. For instance, the Ellen MacArthur Foundation has studied circular food solutions across cities globally and has concluded that cities have a unique opportunity to spark a transformation towards a circular economy for food. This is based on the ability of urban food actors to catalyse this change by getting more value out of their food and to substantially influence what food is produced and how.[35]

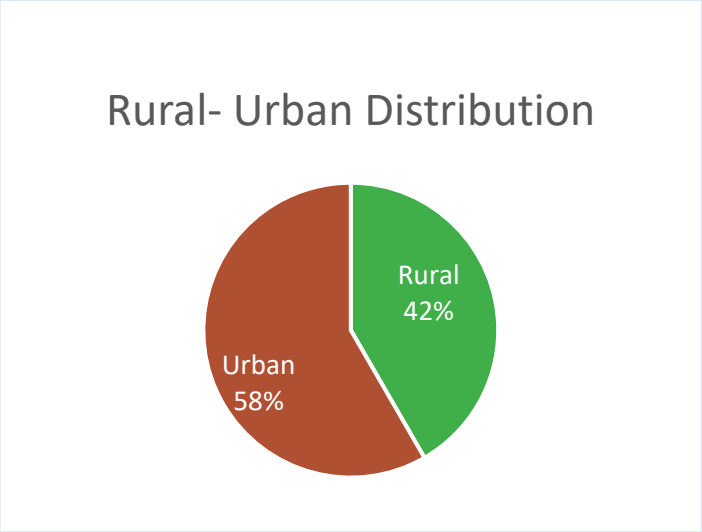



*Figure 6: Rural- Urban Distribution of Identified Circular Food Solutions*

Approximately 20 initiatives were identified in the Vancouver area alone. This could be credited to the influence of prominent local government-led initiatives and the prevailing culture of sustainability on the West Coast leading to greater demand and opportunities for circular business solutions.

## 4.2. Supply Chain Distribution

While the project actively searched for initiatives taking a systemic approach to addressing the challenges faced by Canada's food system and operate across the food supply chain, such solutions proved rare. Nearly all the solutions found tended to operate at an isolated stage of the supply chain. Unsurprisingly, solutions in rural areas focus on agriculture and early-stages of the food supply chain, while most of the solutions in urban centers address the latter parts of a typical food supply chain including processing, distribution, and retail. Food production systems built around underutilized urban spaces, such as rooftop farms and vertical agriculture solutions, were an exception. Urban areas also furnished numerous examples of teaching gardens where communities are learning how to grow their own food and create their own compost.

## 4.3. Organization Type

Over 60% of the examples of the initiatives identified are for-profit (Figure 7), operated by terrestrial and aquatic farmers, food processing and manufacturing firms, technology solution providers, and service providers such as consulting and waste management companies. Since large and already well-documented initiatives were not the focus of this project, these were largely SMEs.

The remaining examples are not-for-profit initiatives, including institutions such as schools and universities, and community-driven organizations. Indigenous circular food solutions make up about 15% of the examples found.

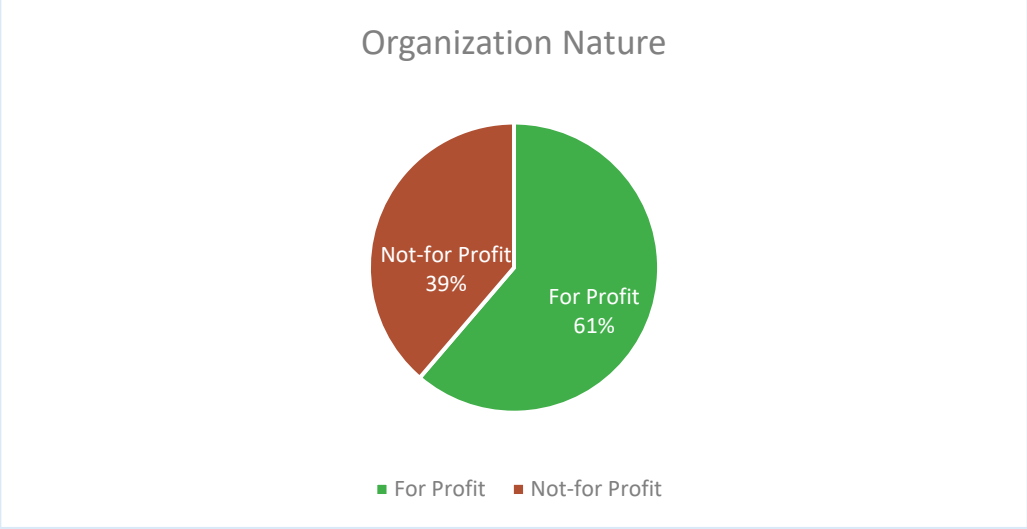



*Figure 7: Organizational Type of Identified Circular Food Solutions*

## 4.4. Drivers for existing circular food solutions

Many food producers cite their first-hand witnessing of negative environmental impacts of conventional agriculture and aquaculture and ensuing desire to preserve the natural resources they depend on for coming generations as their driver to exploring and adopting more regenerative production practices. This inter-generational motivation is of special note since regenerative practices can take some time to deliver economic and environmental results, hence are more attractive to forward-thinking producers who have an appetite for some risk.

Among rural, northern, and Indigenous communities in particular, high levels of food insecurity are cited as a key motivator. Geographically remote locations make food supply chains lengthier for these communities, resulting in periodic and irregular shipments, raised food prices among communities that on average also have lower income levels, and stocks of nutritionally depleted food products.

Extremely low profit margins in agricultural production (among other factors) have resulted in a dwindling farmer population across Canada. In addition, the lack of attractive job opportunities is causing the youth to migrate towards urban centers to pursue education and jobs, As a result, while organizations that promote regenerative and local production practices hope to influence current production practices, they focus more on attracting and training the next generation of producers, a generation perceived to be more open to new production techniques and technologies as well as more conscious of the environmental impacts of their actions.

Further down the food supply chain, reducing FLW is cited as a key driver for developing and implementing circular food solutions. Businesses operating at the processing, manufacturing, distribution, retail and consumption stages of the supply chain are acutely aware of the large volumes of FLW being generated by their industry. Managing and disposing of this FLW costs money and impacts their bottom line. While this is a motivation for them to seek FLW reduction solutions, it is often not strong enough given the relatively low cost of waste disposal in Canada. As a result most businesses only adopt FLW reduction technologies that have a short payback period and FLW reduction processes which can be adopted with minimal disturbance to their existing operations. In Canada, most agri-food businesses are SMEs. Due to their scale, these businesses often lack the bandwidth to identify innovative market solutions to their FLW challenges or the capital to invest in the infrastructure and upfront cost to adopt solutions.

## 4.5. Link to Climate Action

Circular food solutions are deeply connected to climate action. Many regenerative production practices help adaptation to changing climatic conditions as well as enhance the soil's carbon sequestration capacity. Increasing local food production in urban centers and remote communities reduces food miles, significantly reducing the food system's carbon footprint. Finally, any solution that reduces FLW generation contributes to GHG mitigation by curbing methane emissions from landfills, and embedded carbon in the production and processing of food items. While some GHGs are emitted when valorizing FLW into new products and energy, circular food solutions generally deliver a net reduction in GHG emissions.

While many circular food initiatives recognize the climate action benefits of their solution, in most cases this is not quantified, tending to be advertised as a co-benefit of their work rather than a key driver. In other cases, however, the climate connection is the emphasis because it is felt that the circular economy is a novel and more academic concept that does not yet resonate with funders and customers.

## 4.6. Factors for Success

Many of the individuals leading the initiatives identified have worked in the conventional food system or have experience in developing technology solutions that could be adapted and applied to the agri-food sector. Questioning of the status quo food system led them to seek more sustainable production techniques, profitable waste reduction avenues, and ways to serve their communities' food requirements. Going against the norm, these individuals have faced an uphill battle to achieve success and have shown grit and determination along with outstanding leadership qualities. Their success is also credited to skilled and passionate employees or volunteers.

In the highly connected and interdependent food system, the success of these initiatives is underpinned by robust collaborations and partnerships. These include academic collaborations to develop cutting-edge technologies and techniques; partnerships with other players across the food chain to share resources and secure feedstocks for valorization; and--most importantly-- community linkages without which these solutions would have limited uptake. Indigenous community partnerships bring new opportunities to learn from traditional knowledge and principles. Since food culture is context-specific and food has a short lifespan, making any intervention highly time-sensitive, these collaborations and partnerships tend to be very localized.

Research plays a large role in establishing many kinds of circular food initiatives. These include solutions that involve new production techniques, technologies, and inputs; technology solutions for reducing FLW; and the development of new value-added products. In some cases, the circular food initiatives profiled have leaned on existing research undertaken by Canadian and international universities. In most cases, however, this research has been funded and conducted privately and represents a big proportion of start-up costs.

Availability and access to capital is vital for success. Community-based initiatives largely depend on local government funding, while business start-ups tap government programs designed to support start-ups. More systemic circular food solutions with multiple interventions and objectives have been more successful in attracting funding as they have been able to diversify their funding sources. In addition, initiatives led by individuals with prior grant writing experience and stronger business acumen have more success with attracting both public and private financing.

## 4.7. Barriers to Scale

The initiatives identified are operating on a relatively small scale compared to their conventional counterparts. A key barrier to scaling these, as well as incentivizing the establishment of similar initiatives, is funding. Experience with private and institutional investors has been that they are hesitant to invest in these ventures due to limited understanding of the novel solutions developed, and how these will generate returns. Food producers especially face this challenge as they operate on extremely low profit margins.

Another big barrier is the inherent tilt of the playing fields towards conventional food systems. Those working on regenerative production and FLW reduction solutions find that the market does not recognize the social and environmental benefits delivered by circular solutions. In addition, the low cost of FLW disposal at landfills is a big disincentive to developing solutions to mitigate FLW. Government regulations designed for a conventional production process and a linear food economy may unintentionally impede efforts for more circular practices, and are also sometimes seen as a barrier to growth.

The biggest hurdle to transitioning to a more circular food system, however, is seen as existing cultural and behavioural patterns. While many communities in Canada are facing food-related challenges, not many are aware, open, or organized enough to implement the available solutions. Food producers who have operated for generations according to established practices tend to be risk averse to trying alternatives. Large processors, manufacturers, distributors, and retailers who have profited from the status quo are also averse to a disruption of regular operations. Food recovery practices sometimes face the stigma associated with offering people perfectly edible food that has been labelled ‘waste’. Finally, those offering upcycled products face some demand creation challenges as markets for their products are not fully developed, and understanding of their sustainability commitments and willingness to pay higher prices for these products is limited to a niche customer base.

## 4.8. Circular Food Solutions Uptake

While not an exhaustive inventory, this report has identified and profiled many innovative Canadian circular food solutions. With no formal platform tracking Canada's transition to a circular economy in general and to a circular food economy more specifically, it is not known how pervasive these solutions are and to what extent they influence the system as a whole. However, the examples of solutions documented in this report are thought to be exceptions rather than the rule in a still dominantly linear food system.

For instance, Regeneration Canada's map of regenerative agricultural farms has documented less than 100 farms, while close to 200,000 farms were in operation in Canada in 2016.[36] Similarly, only 37 aquaculture farms have to date been certified as sustainable by the Aquaculture Stewardship Council, and the examples of Integrated Multi-Trophic Aquaculture identified in this report are still in the pilot stage. While community-managed indoor growing systems like hydroponic, aquaponic, and greenhouses are on the rise in Canada, these are still few in number and remain out of reach for many communities due to their high upfront and operating costs on the one hand and low revenues from sales on the other.

At the food processing and manufacturing stage, only a handful of examples were found of SMEs taking steps to reduce their FLW. While this may be because FLW reduction is considered an operational issue and as such not publicized, anecdotal evidence confirms that FLW has been normalized in the industry and only a small proportion of the food processing and manufacturing firms are engaged in seeking solutions for this issue.

While numerous food recovery organizations and food banks are found across Canada, persisting high levels of food insecurity amongst certain communities indicates strong room for the growth of these food recovery operations. Similarly, despite the high volumes of FLW prevalent in the system today, only a few businesses are converting this 'waste' into value-added products thereby creating new economic opportunities, and even these businesses are only able to valorize a small fraction of the FLW that is available to them.

Initiatives like training programs, behaviour change campaigns and industrial symbiosis platforms are instrumental to supporting systemic change such as that entailed for a more circular food system. While some examples of these are found in Canada, these also remain limited and not consistently present across the provinces and territories.

Finally, despite communities being disproportionately impacted by food access and availability issues, very few circular food solutions were identified that are either led by northern and/or Indigenous communities or that support them. Those identified focus on local food production and lack the inclusion of other aspects of circularity.

## 4.9. Systemic solutions

Most of the initiatives found focus on improving specific aspects of the food system, not the transformation across the full food system that is also required. This may reflect the smaller scale of the initiatives identified. Those working on similar issues also lack a means to effectively connect with one another and share best practices to leverage each other's successes. This is a key challenge to the growth of Canada's circular food movement.

### Our Food Future: Building Canada's first data and technology-enabled circular food economy

Regional initiative to create a sustainable, inclusive food system for residents and business.

**Founded by:** City of Guelph and County of Wellington
**Established:** 2019
**Location:** Guelph and Wellington County, Ontario


**Driver:** The current food system is broken—people are food insecure, don't have access to healthy, nutritious food and food is wasted throughout the food system.

**Solution:** Businesses, organizations, academics, governments, and community members are using Our Food Future as the catalyst for change within the regional food system. Through new and existing collaborations, Guelph-Wellington is creating a circular food system that responds to and addresses the needs of the entire community. This whole-system change is being fueled by people, data, and technology.

Our Food Future is focused on nine key pathfinder projects that cut across three areas of focus:

- increasing access to a diversity of affordable, nutritious, and culturally relevant foods
- inspiring and creating a thriving, circular and regenerative economy through the support and development of circular businesses and business practices
- respecting planetary and environmental boundaries by recognizing the impact and value of wasted resources

These nine pathfinder projects range from assessing the local food environment to creating tools, resources, and funding channels for businesses, to educating the community on the value of waste and increasing the circularity of carbon credits in the food system. They all address components of a circular food economy.

A key focus of Our Food Future has been to establish a funding ecosystem that will support businesses as they transition to or enhance circularity in their business practices. Through its Harvest Impact Fund and the Circular Food Economy iHub, change-makers are matched with investors to bring circular ideas, data, and technology to food problems. And through programs such as the Urban Agriculture Challenge and the

Circulate CoLab, organizations and community groups are able to test and scale innovative circular food economy ideas.

Since 2019, Our Food Future has:

- increased access to food for more than 2,600 individuals
- leveraged more than $11 million in new funding
- coordinated more than $1 million in supports for businesses and social enterprises
- diverted more than 2,700 tonnes of food from the landfill
- prevented more than 4,500 tonnes of GHG emissions

Our Food Future recognizes that change needs to occur at all points throughout the food system and requires the participation of everyone—individuals, businesses, and government.

Find out more about this circular food solution here.

# 5.0 CONCLUSION

Across the world, the circular economy is emerging as a way of building a more sustainable economy. In the context of food systems, circularity promotes regenerating the natural systems that support agriculture and fishing/aquaculture, designing out food waste and pollution, and keeping food and the infrastructure used to produce that food in their highest and best use. These principles can be applied through practices across the entire food supply chain, encompassing agricultural production, processing, distribution, consumption, and waste recovery.

This report is intended to be a foundational piece to stimulate conversation and engage a broad set of stakeholders across Canada's agri-food ecosystem. The findings in this report are intended to help stakeholders explore how we can (re)design our agricultural supply chain and food systems with circularity in mind to enhance productivity, spur innovation, eliminate waste, reduce GHG emissions, and restore damaged soil and ecosystems.

A growing number of individuals, communities, organizations and institutions are responding to failures in Canada's linear food system – and are pioneering innovative solutions. These early movers provide both specific examples to emulate, and insights on barriers, challenges, drivers and enablers to transitioning to a more circular Canadian food economy. The report identifies close to 200 examples of such solutions across Canada, with particular attention to previously under-documented initiatives found in rural, northern and Indigenous communities. It profiles 21 of these to better understand their practices, drivers and hindering factors.

Scaling and accelerating this transition to a circular food system will require coordinated and collective action. The Government of Canada's commitment to rebuilding the economy post-pandemic, joined with aggressive growth targets for agri-food exports and ambition for net-zero emissions by 2050 along with overall improvements in environmental quality indicators, provide a critical moment in time to address issues in Canada's food system.

# APPENDIX 1: LIST OF INTERVIEWEES

| S.No. | Name | Designation | Organization |
|---|---|---|---|
| 1. | Ambrose Raftis | Project Chair | Charlton Sustainability Hub |
| 2. | Ben Wiper | Founder | 3F Waste Recovery |
| 3. | Bruno Guérard | Secretary | CUMA de l'Erables |
| 4. | Claire Li | Sustainability Director | Golden Eagle Sablefish |
| 5. | Craig McIntosh | Co-Founder | Trendi Tech Inc. |
| 6. | Dihan Chandra | Founder | The Spent Goods Company |
| 7. | Harjeet Bajaj | Founder | Savormetrics Inc |
| 8. | Iván Wadgymar | Co-Founder | Maizal Tortillieria |
| 9. | Jackie Milne | Founder | Northern Farm Training Institute |
| 10. | Jen Rashleigh & Lindsey Boyle | Co-Founder | Sandown Centre |
| 11. | Jessica Regan | Co-Founder | FoodMesh |
| 12. | Karen Schuett | Co-Founder | Livestock Water Recycling |
| 13. | Stuart Lilley | Founder | Refeed Canada |
| 14. | Tarek Bos-Jabbar | Co-Founder | ColdAcre |
| 15. | D. Thierry Chopin | Co-Founder | Turquoise Revolution |
| 16. | TJ Galiardi | Co-Founder | Outcast Foods |
| 17. | Ugo Forcier | Project Manager | Symbiose Agrolimentaire Montérégi |
| 18. | France Benoit & Lise Picard | Volunteers | Yellowknife Farmers Market |
| 19. | Josh Oulton | President | TapRoot Farms |
| 20. | Rob Macintosh | Project Manager | Three Nations Energy |

# REFERENCES


[1] Agriculture and Agri-Food Canada (2020) "Overview of the Canadian agriculture and agri-food sector 2018" *Government of Canada.*

[2] Nikkel, L., Maguire, M., Gooch, M., Bucknell, D., LaPlain, D., Dent, B., Whitehead, P., Felfel, A. (2019) "The Avoidable Crisis of Food Waste: Roadmap". *Second Harvest and Value Chain Management International*.

[3] Agriculture and Agri-Food Canada (2018) *op. cit.*

[4] Library of Parliament (2020) "Statistics for Canada's 2018 Commercial Fisheries". *Government of Canada.*

[5] Library of Parliament (2021) "Executive Summary- Canada's Aquaculture Industry" *Government of Canada.*

[6] Nikkel (2019) *op. cit.*

[7] Salimi N. (2021) "Circular Economy in Agri-food Systems. " In: Rezaei J. (eds) Strategic Decision Making for Sustainable Management of Industrial Networks. Greening of Industry Networks Studies, vol 8. Springer, Cham.

[8] Environmental and Climate Change Canada (2021) "Greenhouse gas sources and sinks: executive summary 2021" *Government of Canada*.

[9] Farmers for Climate Solutions (n.d.) "About"

[10] National Zero Waste Council (2016) "Reducing Food Waste & Cutting Canada's Carbon Emissions : Policies for Reaping the Environmental, Economic and Social Benefits. "

[11] Farmers for Climate Solutions (n.d.) *op. cit.*

[12] RECYC-Quebec (2018) "Schéma de l'économie circulaire dans la filière alimentaire". *Government of Quebec*.

[13] The United Nations General Assembly (1966). "International Covenant on Economic, Social, and Cultural Rights" Treaty Series, 999, 171.

[14] Food Insecurity Policy Research (2020) "More Canadians are Food Insecure Than Every Before- and the Problem is Only Getting Worse" *University of Toronto.*

[15] *Ibid.*

[16] Food Secure Canada (n.d.) "Affordable Food in the North" *Food Secure Canada.*

[17] Food Insecurity Policy Research (n.d.) "Household Food Insecurity in Canada" *University of Toronto.*

[18] Food Secure Canada (n.d.) *op. cit.*

[19] Food Policy for Canada (n.d.) "Lack of Resilience" *York University.*

[20] Fisheries and Oceans Canada (2021) "Minister Jordan launches engagement on Canada's new Blue Economy Strategy" *Government of Canada*.

[21] Pulidindi, K. & Prakash, A. (2021) "Commercial Seaweed Market Size, By Product (Brown, Red, Green), By Form (Dry, Wet), By End User (Animal Feed, Food, Biofuels, Pharma & Personal Care), Industry Analysis Report, Regional Outlook, Covid-19 Impact Analysis, Price Trends, Competitive Landscape, Application Growth Potential & Forecast, 2021 – 2027" *Global Market Insights*.

[22] Nikkel (2019) *op. cit.*

[23] *Ibid.*

[24] *Ibid.*

[25] Environment and Climate Change Canada (2019) "Taking Stock: Reducing Food Loss and Waste Canada" *Government of Canada*.

[26] Nikkel (2019) *op. cit.*.

[27] Bedford, E. (2019) "Value of Meat Processing Industry in Canada 2010-2016" *Statista.*

[28] Teigiserova, D. A., Hamelin, L. & Thomsen, M. (2020) "Towards Transparent Valorization of Food Surplus, Waste and Loss: Clarifying Definitions, Food Waste Hierarchy, and Role in the Circular Economy". *Science of The Total Environment,* 706:136033.

[29] Ibid.

[30] Ellen MacArthur Foundation (2019) "Cities and Circular Economy for Food" *Ellen MacArthur Foundation*.

[31] Statistics Canada (2017) "A Portrait of a 21st Century Agricultural Operation" *Government of Canada.*

[32] Olsen,S., Lozano,A., Wang,K., Hearn,B., Ropp,C., Tung,R. (2020) "The Circular Economy Action Agenda for Food" *Platform for Accelerating the Circular Economy (PACE).*

[33] Reynolds, J. (2016) "What Is Behind the Trend of Local Food?" Food Secure Canada.
[34] Statistics Canada (2019) "Canada's population estimates: Subprovincial areas, July 1, 2018". *Government of Canada.*
[35] Ellen MacArthur Foundation (2019) *op. cit.*
[36] Statistics Canada (2017) "Total number of farms and Farm Operators" Government of Canada.