



WASTED OPPORTUNITY: THE TECHNICAL REPORT



acknowledgements

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Second Harvest is Canada's largest food rescue organization and an expert in perishable food recovery. Every year we are expanding our network to include more farms, manufacturers, distributors and retailers. We work with hundreds of businesses across the food supply chain, reducing the amount of edible food going to waste, which in turn stops millions of pounds of greenhouse gases from damaging

our environment. The food Second Harvest recovers is redirected to social service organizations and schools, ensuring people have access to the good food they need to be healthy and strong. Second Harvest is a global leader in preventing food loss and waste, and continually innovates processes and shares methods to help create a better future for everyone.

www.SecondHarvest.ca



Value Chain Management International (VCM International) has authored/co-authored several publications on food loss and waste and is a leading public and industry voice in bringing awareness to the opportunities and solutions surrounding food waste reduction, traceability, and the environment. VCM International measures waste within the overall analysis of food systems to create pragmatic and sustainable solutions for businesses and

industry organizations along the value chain. VCM International applies specialized value chain diagnostic tools to detect where waste occurs and to determine how to eliminate it. VCM International then participates in the implementation of new practices to solve the issues and ensure successful outcomes.

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executive summary

Surplus edible food (SEF) is food that is 1) good to eat, though is surplus to industry requirements, or 2) not consumed for reasons such as nearing or reaching its best before date. SEF typically goes to waste or is diverted to another destination, such as animal feed. Both options represent an ineffective use of natural resources and unnecessary environmental emissions.

The food loss and waste (FLW) reduction hierarchy emphasizes that the economic and environmental importance of reducing FLW by redistributing SEF food to vulnerable populations is second only to preventing FLW at the source. Second Harvest has a social, environmental and economic triple bottom line that is unique in the charitable and non-profit sector. Through their fleet of trucks and the Second Harvest Food Rescue App, Second Harvest builds relationships by connecting non-profit organizations to their local food businesses, thereby enabling existing programming to be augmented with healthy food.

The Canadian food industry – excluding households – wastes 8.79 million tonnes of avoidable potentially edible food annually. An estimated 4.74 million tonnes of food is required to fully meet the needs of Canada's vulnerable populations. By food type, the greatest demand exists in protein (dairy, meat, seafood, and eggs), produce and grains.

The donation, rescue and redistribution of SEF is perceived to have logistical, food safety and legal challenges. The purpose and objective of this study was to verify the scale of opportunity that exists to reduce FLW by redistributing SEF to vulnerable populations who are food insecure, then propose solutions that would lead to a distinct increase in the volume of SEF rescued and redistributed.

The research commenced by collating data on businesses' names, locations, operational information, and general contact details. Data sourced from a wide array of electronic and printed mediums was categorized into food industry sectors and subsectors. The robustness and completeness of business data was verified



by employing statistical check and balance tests. This included using Statistics Canada data to hypothesize the number and types of organizations expected to exist in a given region, then inferring this against other verifiable databases to identify potential gaps or erroneous data. A total of 127,177 potential SEF donors were identified. Of these, 40,396 were prioritized as the most likely sources for enabling the effective rescuing of SEF.

The estimation of SEF volumes, types and regional location began with the design and dissemination of a national online survey. The survey asked businesses to provide details on the volumes and types of SEF that they experience, and the percentage of that which is currently donated. A second survey, circulated as part of a FLW study of Quebec, captured additional data that could be triangulated against national data provided by the Second Harvest survey. The analysis of survey data concluded with a statistical analysis of the comparative impact of specific factors on businesses' motivation and ability to donate SEF.

Of the 748 survey respondents, 45 percent (n=334) stated that they have SEF. Respondents represent all sectors of the food industry and all types of food. As the data was insufficiently granular to allow a rigorous analysis of individual food types, food was grouped into five categories: grain, dairy, protein, produce, and "all." The "all" category was applied to the analysis of HRI and retail responses, along with mainline distributors. Least likely to report experiencing SEF were respondents from the grains and protein sectors. Most likely to report experiencing SEF were respondents who handle "All" food types (retailers, HRI operators, mainline distributors), followed by the dairy and the produce sectors.

Of the 3.2 million metric tonnes of SEF estimated to exist nationally, respondents stated that just four percent is currently rescued. This leaves 3.1 million MT (6.8 billion lbs) available for rescue. Because many businesses are reluctant to acknowledge that they have SEF that could be donated, the true volume of SEF could, however, be considerably greater. Reasons why a fraction of available SEF is currently donated and businesses' reluctance to acknowledge the existence of SEF include: legal liability concerns, corporate policies, along with the perceived cost and complexity of donating. These and other factors discussed can be synthesized down to "ability to donate" and "willingness to donate."

The analysis of survey data, along with subsequent discussions with industry stakeholders, identified a number of immediate opportunities to markedly increase the volume of SEF that is donated, rescued and redistributed to vulnerable populations. Preferred immediate options are where the volume of available SEF is sufficient to ensure that rescue and redistribution processes are economical viable and therefore sustainable. The greatest opportunities appear to lie in the HRI, processing/manufacturing, and certain sectors of the farming industry.

In the retail sector there are fewer businesses who do not donate any SEF. However, the research identified that, principally due to the potential volumes that can be rescued from many retail stores, sizeable opportunities remain to increase the volume of food that can be rescued from this sector. This includes those foods that are in most demand among non-profit organizations.

The report concludes by presenting five solutions for increasing the volume of donated SEF. Nuances regarding how each of the solutions relate to the three categories of businesses identified during the research are presented. The research found that businesses can be categorized into those who:

1. Have edible surplus food, some of which is currently donated
2. Have edible surplus food, none of which is currently donated
3. Do not believe that they have edible surplus food (which could be donated)

Prior to any of the proposed solutions' wide-scale implementation, their design must be validated in practice and refined to suit specific situation(s). This would occur in the form of pilot initiatives. The report concludes by presenting three

proven tools for enabling the effective piloting and refinement of conceptual solutions in complex environments. The tools provide the ability to measure, control and continually improve the performance and effectiveness of each initiative on an ongoing basis. Concisely described with the aid of populated examples, the tools are:

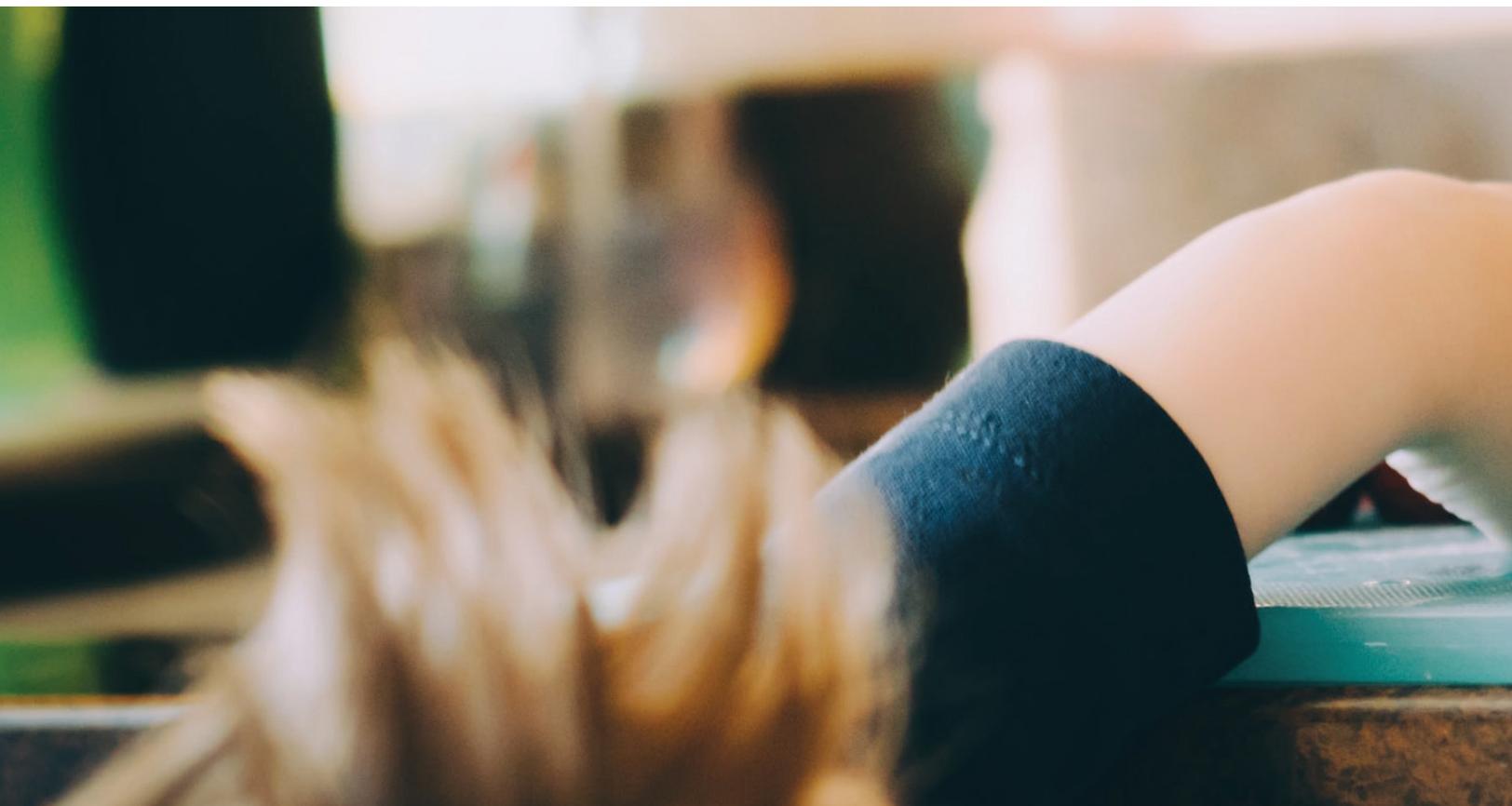
1. Critical to Quality Tree
2. Association Matrix
3. Risk Assessment and Mitigation Matrix



1. introduction

Surplus edible food (SEF) is food that is 1) good to eat though is surplus to industry requirements, or 2) not consumed for reasons such as nearing or reaching its best before date. It typically goes to waste or is diverted to another destination, such as animal feed. Both options represent an ineffective use of finite natural resources and unnecessary environmental emissions. The Avoidable Crisis of Food Waste (Gooch et al, 2019) estimated that the Canadian food industry – excluding households – wastes 8.79 million tonnes of avoidable potentially edible food annually.

Second Harvest has a social, environmental and economic triple bottom line that is unique in the charitable and non-profit sector. Through their fleet of trucks and the Second Harvest Food Rescue App, Second Harvest builds relationships by connecting non-profit organizations to their local food businesses, thereby enabling existing programming to be augmented with healthy food. In addition to addressing food insecurity, they play a vital environmental role in keeping edible food out of landfill, thus preventing millions of pounds of carbon dioxide and methane from entering our atmosphere and contributing to the negative impacts of human-made climate change.



1.1 purpose and objectives

The food loss and waste (FLW) reduction hierarchy (EPA, 2021) emphasizes that the economic and environmental importance of reducing FLW by redistributing SEF food to vulnerable populations is second only to preventing FLW at source. An analysis of the needs and shortfalls in supply experienced by the over 61,000 non-profit organizations serving food (Gooch et al, 2021) estimated that the food demands of Canada's vulnerable populations totals 4.74 million tonnes. By food type, the greatest demand exists in protein (dairy, meat, seafood, and eggs), produce and grains.

The donation of avoidable potentially edible FLW is fraught with perceived logistical, food safety and legal challenges. The purpose and objectives of this study was to verify the scale of opportunity that exists to reduce FLW by redistributing SEF to vulnerable populations, then propose solutions that would lead to a distinct increase in the volume of SEF rescued and redistributed. This report describes the research methodology and research findings. It concludes by presenting conceptual solutions for addressing vulnerable populations' needs by increasing the rescue and redistribution of SEF, and how solutions could be validated through a process of piloting and refinement prior to their wider rollout.



2. methodology

Given the complexity of the project, the continuing impact that the COVID-19 pandemic has had on the Canadian food industry's structure and operation, the need to establish a solid foundation upon which further activities can be based, and to ensure that all aspects of the project are knitted together as intended, the mapping process utilized the Plan-Do-Check-Act (PDCA) methodology. PDCA is a proven reiterative and disciplined process for conducting, evaluating and refining research. Toll gate reviews were performed prior to the completion of each phase of the project.

2.1 business identification, categorization and mapping of Canadian food businesses

At the commencement of the project, over 30 aggregated sources of electronic and printed information containing businesses' names, locations, operational information, and general contact details were identified and categorized into food industry sectors (e.g. seafood, fresh produce, retail, processing, and farming). This initial list was subsequently expanded upon, utilizing data from national and provincial electronic listings of farmers markets, fruit and vegetable farms certified as following Canada Gap protocols, as well as provincially and federally inspected food processors.

The robustness and completeness of business identification data was verified by employing statistical check and balance tests. This included hypothesizing the number and types of organizations expected to exist in a given region, then extrapolating the organizational data captured in relation to Statistics Canada and other verifiable databases to identify potential gaps or erroneous data. This process also enabled the prioritization of organizations based on the likelihood that they could donate SEF in sufficient volumes to enable its rescue and redistribution to be economically viable and therefore sustainable. The accuracy of information gleaned from the data was verified by cross-tabulating captured data against individual businesses' websites.

The mapping process identified a total of 127,177 potential SEF donors. Based on data sourced from Statistics Canada, industry and government websites, industry directories, local food initiatives, etc., 40,396 organizations were prioritized. For these locations – which included operations belonging to Canada’s top 100 restaurant chains, retailers, larger food processors, food distributors/wholesalers, and large to moderately-sized fruit and vegetable producers – additional information, such as CSR certification and charitable partnership information, was sought. Presented in Table 2-1 is the number and types of businesses identified during the mapping process.

Table 2-1: Summary of pipeline at September 17, 2021

SECTOR	Stats Can: Total # of businesses in each sector	Stats Can: Benchmark of medium + large businesses	VCMI: # ID'd potential donors	VCMI: # of priority donors re data capture
Farms/Food Producers/Farmers Markets	275,350	29,430	7,314	3,652
Processors & Manufacturers	6,088	642	3,462	1,829
Wholesalers (food & assoc. items)	8,328	393	4,901	1,296
Retailers (food & groceries, health and nutrition)	22,958	1,546	32,699	8,076
Hotels and Motels	7,575	391	9,304	1,013
Restaurants (QSR + dine in)	70,411	1,040	65,758	23,652
Institutions (education only)	4,299	929	442	418
Entertainment Facilities (catering/food services)	8,265	482	3,185	460
Other (SH contacts)			112	
TOTALS	403,274	34,853	127,177	40,396

2.2 design and population of a searchable database

A second consideration that guided the mining of organizational data was the development of a searchable database that will assist Second Harvest to match potential sources of SEF (by food type and location) with non-profit organizations serving food to their community. The creation of dynamic fields within the database will enable Second Harvest to cross-tabulate multiple fields simultaneously to create layered maps showing the location and suitability of potential donors for meeting the needs of individual recipients of SEF. The populated database provided to Second Harvest contains data (where available) associated with the 127,177 businesses identified in Table 2-1, including:

- Location (e.g. physical address, location name/number, latitude/longitude coordinates)
- Donor type (farm, food processor, distributor, restaurant, grocery store)
- Commodity (e.g. fruits and vegetables, fish and seafood, meat, eggs confectionary)
- Contact details (e.g. central phone number, website URL)
- Corporate structure (e.g. subsidiary, franchisee, corporate/franchisor)

2.3 identification and estimation of SEF volumes and types, nationally and by region

The identification and estimation of SEF volumes, types and location began with the design and dissemination of a national online survey. The survey asked businesses to provide details on the volumes and types of surplus edible food that they experience, and the percentage of that which is currently donated. Circulated by industry organizations, Second Harvest and VCMI, the survey captured quantitative data on SEF occurring at specific locations and qualitative data on factors previously identified as affecting the motivation and ability of food businesses to engage in the effective and efficient rescue/recovery and redistribution of SEF.

Additional data on SEF types and volumes occurring in Quebec specifically, including the percentage of SEF donated versus sent to other destinations, was sourced from surveys distributed in Quebec as part of a FLW study completed for RECYC-QUEBEC and the City of Montreal. While SEF formed a minor part of the Quebec study, the survey provided valuable data that could be triangulated against national data provided by the Second Harvest survey.

The analysis of survey data concluded with a statistical analysis of the comparative impact of specific factors on businesses' motivation and ability to donate SEF from food type, sector/sub-sector and geographic location.



2.4 development of solutions for increasing the rescue and redistribution of SEF

The final phase of the project involved using research outcomes to guide the design and development of conceptual solutions for optimizing the performance of food rescue/recovery and redistribution systems. Prior to their finalization, draft solutions were presented to members of the Food Rescue Canadian Alliance Private Sector Working Group (FRCA). This is an advisory group established by Second Harvest soon after the onset of the COVID-19 crisis to aid the rescue of surplus food for distribution to vulnerable populations.

Feedback received from the FRCA was incorporated into the proposed solutions' design. Their feedback also enabled an assessment to be made of which solutions held most promise for increasing the effectiveness and efficiency of rescue/recovery and redistribution practices. Means of validating the most promising conceptual solutions in practice prior to their large scale rollout, through a process of piloting and subsequent refinement, were devised. This would be achieved by the materials providing a means of measuring the comparative effectiveness of each solution in a specific situation and mitigating risks by establishing control mechanisms.

3 volumes, types, and location of SEF

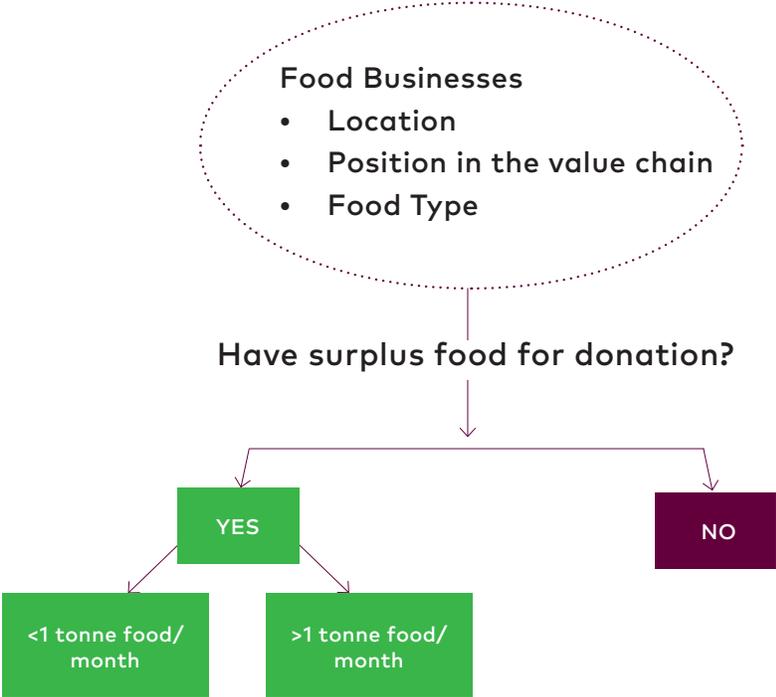
Section 3 presents the results of data analysis completed to estimate the volume and types of SEF that exist across Canada, along with the comparative volumes of what is presently rescued versus what could be rescued.

The surveys garnered a total of 748 useable responses: 320 and 428 responses from the Second Harvest and Quebec surveys, respectively. As there was significant variability in the data reported by respondents, the data was divided into two groups: 1) those who reported having less than one tonne of food per month, and 2) those who reported having more than one tonne of food per month. Within each group, the median volume by food and business type were calculated, then used to

infer volumes across the revised population of potential donors contained in the database. This process produced an estimate of the total quantity of SEF available for donation.

The analytical process enabled an estimate, from national and regional perspectives, of the volumes and types of SEF that are currently donated and the volumes and types of foods that are not (though could be) donated. This is presented graphically in Figure 3-1.

Figure 3-1: Process of analysis



Of the 748 respondents, 45 percent stated that they have SEF. The calculation of estimated volume and food types began by adjusting the total population of potential donors identified during the mapping process to reflect the proportion of businesses from each level of the value chain which indicated they had SEF. This enabled a more realistic estimate to be determined than if it had been assumed that all businesses have SEF. The estimation of food quantities, overall and by type, also took into account variations in seasonality and food availability that had been reported by respondents. Spatial and heat maps showing the concentration of food businesses likely to possess SEF form Appendix A.

3.1 whether respondents possess SEF

Presented in Table 3-1 is the geographic location of the 748 respondents to the national and Quebec centric surveys. Tables 3-2 and 3-3 provide details on the 334 respondents who stated that they have SEF versus the 414 respondents who stated that they did not. Estimated volumes were grouped into four regions: Atlantic, Quebec, Ontario, and West. This was due to the fact that 1) comparatively few responses were received for individual types of food types from provinces other than Ontario and Quebec, 2) no responses were received from businesses explicitly operating in the Territories, and 3) considerable differences existed in the types of food businesses operating in less populated versus more populated regions.

Table 3-1: Responses by region and business type (n=748)

ELEMENT OF CHAIN	Atlantic	Quebec		Ontario	West	Location not given	Total
		SH	QC*				
Farm/greenhouse	18	6	48	23	27	21	143
Processor/Manufacturer	4	1	44	16	10	6	81
Distributor/Wholesale	1	0	16	5	3	4	29
Retail	3	1	72	26	21	12	135
HRI	14	0	248	50	35	13	360
TOTAL	40	8	428	120	96	56	748

*Quebec survey data

As can be seen, the highest concentration of responses was from Quebec and Ontario. This reflects the density of the general population and the number of businesses operating in the food industry. Of total responses, 56 (8%) did not provide their geographic location.

By individual sector, the largest number of respondents are from foodservice (HRI = hotels, restaurants, institutions), followed by producers (incl. open field, livestock/poultry, greenhouse). The least number of respondents operate in the wholesale/distribution sector, though include a number of representatives from national operators serving retail and foodservice operators in specific regions. A number

of respondents from the food processing and manufacturing sector also include representatives from businesses with operations in specific regions across Canada.

As stated previously, 334 (45%) of all respondents stated that they have SEF. Presented in Table 3-2 is the regional location of those respondents as a percentage of total respondents in that same region. Of those respondents who provided their location, the highest proportion of respondents who possess SEF are in Quebec, followed by Ontario: 50 and 46 percent, respectively. In the Atlantic (NB, NS, NL, PE) and Western (MB, SK, AB, BC) regions, approximately a third of respondents stated that they have SEF.

Table 3-2: Do you have surplus edible food? (n=748)

REGION	Yes		No		Total
	Count	Row N %	Count	Row N %	Count
Atlantic	14	35.0%	26	65.0%	40
Ontario	55	45.8%	65	54.2%	120
Quebec	220	50.5%	216	49.5%	436
West	35	36.5%	61	63.5%	96
No Location	10	17.9%	46	82.1%	56
TOTAL	334		414		748

Compared to businesses operating in the Atlantic and Western regions, businesses operating in Quebec and Ontario appear more likely to have SEF. Further analysis identified that, in terms of industry sector, retailers are most likely to say that they have SEF (61% of retail respondents), followed by processors/ manufacturers and HRI (46% and 43% of respondents from each of these sectors, respectively). Approximately one third of farm/greenhouse and distributor/wholesale respondents have SEF.

As the data was insufficiently granular to allow a rigorous analysis of individual food types, food was grouped into five categories: grain, dairy, protein, produce, and "all." The "all" category was applied to the analysis of HRI and retail responses, along with mainline distributors. This is because these sectors and mainline

distributors handle all types of food. Even with this aggregation of food types into four broad commodity groupings and a catch-all fifth group, a correlation was identified as existing between food type(s) handled and respondents' likelihood to say that they have SEF that is, or could be, donated.

In terms of the number of responses and where they operate in the value chain, businesses operating in the produce (fruit and vegetable) industry or those which handle produce are more likely to say that they have SEF. This extends to retailers, HRI and mainline distributors for whom produce is among the products sold.

Table 3-3: Do you have surplus edible food? (n=748)

FOOD	Yes		No		Total
	Count	Row N %	Count	Row N %	Count
Dairy	13	44.8%	16	55.2%	29
Grains	11	29.7%	26	70.3%	37
Produce	38	42.2%	52	57.8%	90
Protein	18	31.0%	40	69.0%	58
ALL	250	48.1%	270	51.9%	520
N/A	4	28.6%	10	71.4%	14
TOTAL	334		414		748

Least likely to report having SEF are businesses operating in the grains and protein industries (30% and 31% of respondents from those industries, respectively). In the dairy, grains and protein industries, the potential to translate surplus commodities donated by farmers into food is impacted by the need for it to be processed into consumer goods.

Beyond legally-required processing requirements, including for liquid milk prior to consumption, a desire of farmers to donate surplus milk may be limited by the supply management system. While the supply management system also applies to some poultry, namely chicken and turkey, those sectors' regimes are arguably less restrictive than dairy.

3.2 potential availability versus current donations

The 334 respondents who identified that they experienced SEF were subsequently asked to estimate the volume of SEF that they typically experienced within a specific time frame. The national survey asked per month, the Quebec survey asked per year. The national survey also asked respondents to estimate the percentage of SEF that was currently donated. The process of analysis included normalizing all data to provide a snapshot of a typical one-month period. In Table 3-4 and 3-5 below, the results are grouped into those respondents who stated that they typically experienced less than one tonne of SEF per month versus those who stated that they typically experienced more than one tonne of SEF per month. Eighty-five percent of respondents estimated that their total SEF amounts to less than one tonne a month.

Table 3-4: Magnitude of monthly surplus edible food and % already donated (n=334)

REGION	<1 tonne/month			>1 tonne/month			Total
	N	Row N %	Median % donated	N	Row N %	Median % donated	N
Atlantic	13	92.9%	0.50%	1	7.1%	20.00%	14
Ontario	39	70.9%	50.00%	16	29.1%	0.75%	55
Quebec	201	91.4%	0.38%	19	8.6%	3.56%	220
West	22	62.9%	0.50%	13	37.1%	2.00%	35
No Location	9	90%	N/A	1	10%	N/A	10
TOTAL	284			50			334

As shown in Table 3-5, while the highest number of respondents possessing SEF are in HRI, this is also the sector where the highest proportion of respondents (94%) have less than one tonne of SEF per month. HRI is also the sector where the median percentage of available SEF that is currently donated is the lowest of all sectors. None of the HRI respondents who typically experience more than one tonne of SEF per month currently donate. Factors impacting the donation of SEF are described in Section 4.

Table 3-5: Magnitude of monthly surplus edible food and % already donated (n=334)

ELEMENT OF CHAIN	<1 tonne/month			>1 tonne/month			Total
	N	Row N %	Median % donated	N	Row N %	Median % donated	N
Farm/greenhouse	27	56.3%	4%	21	43.8%	3.56%	48
Processor/Manufacturer	31	83.8%	69%	6	16.2%	59%	37
Distributor/Wholesaler	4	36.4%	0.9%	7	63.4%	0.9%	11
Retail	76	92.7%	75%	6	7.3%	43%	82
HRI	146	93.6%	0.38%	10	6.4%	0%	156
TOTAL	284			50			334

Respondents from distribution/wholesale also said that the vast majority of SEF that they experience is not donated. At the third lowest level of donation, the opportunities that exist to rescue a higher proportion of SEF occurring on farms and in greenhouses is also considerable. Despite a comparatively higher percentage of SEF being donated in retail and processing/manufacturing than occurs in other sectors, there remains considerable room for improvement.

3.3 volume available and rescued versus community needs

Analysis of volume and availability data provided by the 334 survey responses who identified themselves as possessing SEF, and its inference against the adjusted number of businesses identified during the mapping process, enabled VCMI to estimate that 3.2 million metric tonnes (MT) of SEF exist nationally. This equates to 36 percent of the 8.79 million tonnes of avoidable and potentially edible FLW that Gooch et al (2019) estimated to occur annually within Canada’s food industry. Of the 3.2 million tonnes, respondents stated that just four percent is currently rescued. This leaves approximately 3.1 million MT (6.8 billion lbs) that is available to be rescued.

As shown in Table 3-6, the volume of SEF that is currently rescued equates to 1.4 percent of non-household avoidable and potentially edible FLW.

Table 3-6: Edible surplus food availability

Research Results (n=748)		Percent of 8.79 million MT of non-household avoidable potentially edible FLW reported in ACFW*
Volume of surplus edible food reported by respondents	3.2 million metric tonnes (7.1 billion lbs)	36%
Current volume of surplus edible food donated/rescued	120,000 metric tonnes (265 million lbs)	1.4%
Volume of surplus edible food not donated/rescued	3.1 million metric tonnes (6.8 billion lbs)	34.6%

* *The Avoidable Crisis of Food Waste (Gooch et al, 2019)*

Subsequent analysis identified that, for reasons which included food safety and public liability concerns, along with financial considerations, businesses are often conservative in terms of 1) their willingness to determine that surplus food is edible, and 2) the volume of SEF that they do possess which is donated. The above figures were derived from the percentage of surplus food that respondents believe is edible and that they would be inclined to donate, versus that which may actually be edible and they are not inclined to donate. Therefore the true volume of SEF that is currently lost and wasted could be considerably greater than 3.2 million tonnes.

This finding shows that all businesses can be grouped into one of three categories. Referred to in the proposed solutions that form Section 5, these three categories are:

1. Have edible surplus food, some of which is currently donated
2. Have edible surplus food, none of which is currently donated
3. Do not believe that they have edible surplus food (which could be donated)

The volume of food required to meet the needs of Canada’s charitable food network is 4.74 million tonnes (Gooch et al, 2021). Presented in Table 3-7 is the effect that the rescuing of 3.2 million tonnes (i.e., 68% of the aforementioned 4.74 million tonnes) of SEF identified by this study would have on 1) non-household avoidable and total FLW occurring annually in Canada, and 2) charitable organizations’ food needs. With just four percent of SEF currently being rescued and redistributed, the opportunities for improvement (and in-so-doing, reducing FLW while simultaneously meeting a large proportion of non-profit organizations’ overall demands for food) are enormous.

Table 3-7: Effect on FLW and addressing gaps between surplus food availability and demand

	Amount to rescue/reduce avoidable waste	Avoidable FLW (excluding HH)	Total FLW (excluding HH)	% Avoidable of total FLW (excluding HH)	% Reduction
	Million metric tonnes				
2019 estimate		8.79	29.74	30%	
Survey results	3.21	5.58	26.53	21%	-9%
If all demand met	4.74	4.05	25	16%	-13%*

*Percentage may not equate exactly due to rounding.

The rescue/recovery and redistribution of all the surplus food identified by respondents as known to exist would reduce avoidable non-household FLW from 8.79 million tonnes to 5.58 million tonnes. This would reduce total non-household FLW by 9 percent. Fully meeting the charitable sectors’ food demands would require the rescue/recovery of 4.74 million tonnes of surplus edible food. If achieved, this would reduce total non-household FLW by 13 percent to 25 million tonnes.

3.4 regional availability of SEF by type

Following the analysis of aggregated national data, the 334 responses from businesses who identified themselves as experiencing SEF were examined by region, by business type, and by food type. The regional availability of SEF by food type was estimated by applying survey data to the regional population of businesses identified in the pipeline.

¹The term “total FLW” encompasses both avoidable and unavoidable food loss and waste.

Grouped into five categories (grains, dairy, protein, produce, and all) presented in Table 3-8, by region and overall, is the number of businesses identified by the analysis as likely to possess SEF. The estimation of SEF availability by food type and geography was determined by applying results from the analysis of survey data to the Canadian food business information captured during the mapping and identification process. Also presented is the estimated volume of available excess edible food by region and overall. As mentioned previously, the businesses represented by "all" food types are retail and HRI operations (incl. restaurants, hotels, motels, institutions, and corporate caterers).

Table 3-8: Regional availability of excess edible food

	Number of businesses that may have food	Proportion of businesses identified in pipeline	Estimated total available food (MT/yr)	Estimated already donated	Estimated available for rescue
Atlantic					
Grains	65	0.11%	3,595	135	3,460
Dairy	11	0.02%	622	23	598
Protein	151	0.26%	8,400	315	8,085
Produce	174	0.30%	9,648	362	9,286
ALL	3,880	6.71%	215,218	8,078	207,140
Sub-total	4,281		237,483	8,913	228,569
Quebec					
Grains	286	0.49%	15,863	595	15,267
Dairy	23	0.04%	1,268	48	1,220
Protein	220	0.38%	12,204	458	11,746
Produce	379	0.66%	21,030	789	20,240
ALL	11,255	19.47%	624,267	23,430	600,837
Sub-total	12,163		674,632	25,320	649,310
Ontario					
Grains	426	0.74%	23,629	887	22,742
Dairy	39	0.07%	2,138	80	2,058

Protein	181	0.31%	10,052	377	9,675
Produce	404	0.70%	22,411	841	21,570
ALL	19,827	34.30%	1,099,688	41,274	1,058,414
Sub-total	20,877		1,157,918	43,459	1,114,459
West					
Grains	404	0.70%	22,409	841	21,568
Dairy	22	0.04%	1,193	45	1,149
Protein	253	0.44%	14,029	527	13,502
Produce	503	0.87%	27,915	1,048	26,867
ALL	19,298	33.39%	1,070,329	40,172	1,030,157
Sub-total	20,480		1,135,875	42,633	1,093,243
GRAND TOTAL	57,801	100%	3,205,908	20,324	3,085,584

In all regions of Canada, substantial opportunities exist to rescue considerably greater volumes of the foods that are in greatest demand among non-profit organizations. The overall volumes of each of the five categories of food are summarized in Table 3-9. The concentration of businesses by type, along with the type of specific or aggregated SEF associated with geographic regions, have been plotted on heat and spatial maps that form Appendix A.

Table 3-9: Available versus currently donated SEF

	Total available (MT*/year)	Currently donated (MT*/year)	Additional available for rescue (MT*/year)
Grains	65,496	2,458	63,037
Dairy	5,221	196	5,025
Protein	44,685	1,677	43,008
Produce	81,004	3,040	77,963
ALL	3,009,502	112,954	2,896,550
Total	3,205,908	120,325	3,085,583

* MT = metric tonnes

The results emphasize that just a fraction of SEF is currently rescued. The results also show that the source of the majority of available and currently donated foods is retail and HRI, both of which handle a wide variety of foods. Compared to retail, however, only a very small volume of available SEF is donated by (and rescued from) the HRI sector. Reasons behind this considerable discrepancy are explored in Section 4 of the report.

In terms of specific food types available prior to retail and HRI, the highest volumes of available SEF are produce, followed by grains and proteins. Here again, however, only a small percentage of available SEF is donated/rescued from the production, processing/manufacturing and distribution sectors. Dairy products represent a large proportion of total foods available in Canada. Compared to other foods, the estimated volume of dairy products that are both available and rescued are small. This suggests that this sector may be particularly reluctant to consider surplus foods to be edible and therefore donate them. Reasons for this potential reluctance are also explored in Section 4.

3.5 opportunities to improve the donation/ rescue of SEF

The analysis of survey data, along with subsequent discussions with industry stakeholders, identified a number of immediate opportunities that exist to markedly increase the volume of SEF that is donated, rescued and redistributed to vulnerable populations. Preferred options are where the volume of available SEF helps ensure that rescue and redistribution processes are economical viable and therefore sustainable.

In terms of targeting businesses that reported having SEF and either do not donate or are currently donating only a relatively small percentage of their potential volume, the greatest opportunities appear to lie in the HRI, processing/manufacturing, and certain sectors of the farming industry. The research identified that businesses operating in these sectors, particularly those which are larger and/or corporately owned, likely have environmental or CSR policies and commitments that they are seeking to fulfil. This may increase their motivation to begin donating SEF, or donate a larger volume of SEF.

Within agriculture, the fruit and vegetable sector represents arguable the best opportunity to markedly increase the donation and rescuing of SEF. While fruit and vegetable farms are more seasonal than the greenhouse industry, with the percentage of crop that does not match customer specifications commonly lying between 10 and 20 percent of harvested crop, the volumes that could be rescued from this sector are significant. The opportunities that exist in the fruit and vegetable industry extend to shipper/packers and distributors, both of which are often operated by farmers and farmer-owned cooperatives.

In the retail sector there are fewer businesses who do not donate any SEF. However, the research identified that, principally due to the potential volumes that can be rescued from many retail stores, sizeable opportunities remain to increase the volume of food that can be rescued from this sector. This includes those foods that are in most demand among non-profit organizations.



4 factors impacting the donation and rescuing of SEF

The sustainability of Canada's food industry relies on its ability to capture monetary value from the production and distribution of food. It is therefore natural that businesses would view the donation of surplus food as being of secondary importance to their commercial interests. This prompts the question of whether the evidence exists to support an assumption that this is the primary reason behind the small percentage of SEF that is presently donated or whether other factors are at play.

The national survey used a series of Likert scale questions to gauge respondents' perspectives on the level of impact that a selection of factors identified in prior research has on their organizations' willingness to donate SEF. A total of 320 respondents answered the question: "On a scale of 1 – 5 (where 1 = minimal, 3 = moderate, 5 = enormous), what impact do each of the factors listed below have on your organization's willingness to donate excess edible food?"

4.1 impact of possessing SEF versus not possessing SEF on respondents' perceptions

The Kruskal-Wallis H test (K-W test) was used to determine if there were statistical differences between responses. The K-W test is considered the non-parametric alternative to a one-way Analysis of Variance (ANOVA), and is particularly helpful in assessing ordinal data, such as that which is produced from responses given on a Likert scale. Responses were analyzed by business type, region and food type. More variability was found to exist in responses when analyzed by business type (the sector in which they operate) rather than by food type or by location.

The results of the statistical analysis are presented in Tables 4-1 and 4-2. In each table, the second column from the left indicates whether statistically significant differences exist between each sectors' responses. The median response to each question is also shown. A brief description of headline conclusions is then presented.

Table 4-1: Median response of all respondents (n=320)

	Sig Diff. Y/N	Producer	Processor/ Manufacturer	Distributor/ Wholesaler	Retail	HRI	Overall
Cost of donation vs alternative options	Yes	3.00	3.00	2.00	1.00	1.00	1.00
Lack of a tangible financial benefit, e.g. unable to claim tax rebates for donation	Yes	3.00	1.00	3.00	1.00	1.00	1.00
Perceived complexity of donating food for human consumption versus alternative disposal	No	3.00	3.00	1.00	2.00	3.00	3.00
Legal liability concerns should a food safety or other incident occur	No	3.00	3.00	3.00	2.00	3.00	3.00
Corporate policy limiting the donation of excess edible foods and beverages	Yes	1.00	1.00	1.00	1.00	2.00	1.00
Concerns surrounding brand image	No	1.00	2.00	2.00	1.00	1.00	1.00
Potentially detrimental to business relationships	No	1.00	1.00	1.00	1.00	1.00	1.00
Ineffective communication or coordination with a food rescue/ redistributor	No	2.00	1.00	1.00	2.00	3.00	2.00
Regulations discourage or prevent donation of edible food for redistribution	No	2.00	2.00	2.00	2.00	3.00	2.00

Across the 320 respondents, four factors were identified as having greatest impact on responding businesses' willingness to donate. They are:

1. Legal liability
2. Perceived complexity to donate
3. Ineffective communication or coordination with food rescue organizations
4. Regulations that discourage or prevent donation

Of the 320 respondents who answered the Likert questions pertaining to factors impacting their donation of SEF, 118 reported having SEF that could or is being donated. As can be seen in the differences that exist between the two tables, subtle differences

exist between responses provided by businesses who reported having SEF versus the wider population.

It is worth noting that no statistical differences were identified as existing between respondents that have SEF and donate versus respondents who have SEF and do not donate. It appears therefore that it is the acknowledgement of possessing SEF that leads to individuals' perceptions changing in relation to the surrounding environment. Whether individual businesses transition from acknowledging that they have SEF to actually donating SEF depends upon how they view these individual factors from business risk and cost perspectives.

Table 4-2: Median response from respondents reporting surplus food (N=118)

	Sig Diff. Y/N	Producer	Processor/ Manufacturer	Distributor/ Wholesaler	Retail	HRI	Overall
Cost of donation vs alternative options	Yes	3.00	3.00	2.00	1.00	1.00	2.00
Lack of a tangible financial benefit, e.g. unable to claim tax rebates for donation	Yes	3.00	3.00	3.00	1.00	1.00	1.00
Perceived complexity of donating food for human consumption versus alternative disposal	No	2.00	3.00	1.00	1.00	3.00	3.00
Legal liability concerns should a food safety or other incident occur	No	3.00	3.00	4.00	2.00	3.00	3.00
Corporate policy limiting the donation of excess edible foods and beverages	Yes	1.00	1.00	1.00	1.00	2.00	1.00
Concerns surrounding brand image	No	2.00	2.00	3.00	1.00	1.00	1.00
Potentially detrimental to business relationships	No	1.00	1.00	1.00	1.00	1.00	1.00
Ineffective communication or coordination with a food rescue/ redistributor	No	3.00	2.00	2.00	1.00	3.00	2.00
Regulations discourage or prevent donation of edible food for redistribution	No	2.00	2.00	2.00	2.00	3.00	2.00

Among respondents who reported having SEF, distributors/wholesalers' concerns regarding legal liability and brand image are particularly acute, as are processors/manufacturers' concerns regarding the lack of a tangible financial benefit for donation. The impact of ineffective communication or coordination by food rescue/redistributors is higher among those farmers, processors/manufacturers and distributors who reported having SEF than those who did not.

4.2 statistically significant differences in factors impacting donations of SEF

Three statistically significant differences were found to exist in the impact that certain factors have on particular sectors' willingness and/or ability to donate. They are:

- "Corporate policies limiting (or preventing) the donation of food"
 - This concern is more acute in HRI than other sectors, with the difference between HRI and other sectors being statistically significant when all HRI (donate or not) are included in the analysis. This concern appears linked to other factors, such as "legal liability" and "regulations that discourage or prevent donation."
- "Lack of tangible financial benefits" to encourage donation versus alternatives
 - This concern is most acute amongst producers and the fresh produce industry (incl. in distributors/wholesalers).
 - This concern is also more acute amongst those processors/manufacturers who have SEF versus the overall processor/manufacturer population.
- "Cost of donation vs. alternative options"
 - This concern is most acute amongst producers and processors/manufacturers.

With the exception of HRI, factors impacting the willingness of businesses to donate food are more acute upstream than downstream. Across all of the factors investigated, retailers' concerns are invariably amongst the lowest of any respondent group. Compared to other respondents, producers' and processors/manufacturers' concerns regarding the factors researched are amongst the highest.

4.3 impact of tangible benefits on willingness to donate

The analysis of upstream survey responses identified the extent to which the perceived “cost of donation” and the “lack of tangible financial benefits” impacts businesses’ willingness and motivation to donate. A produce industry respondent stated that they believe their cost of donation is three times that of alternative options, such as landfill. Interestingly, retailers – particularly those who are most likely to donate their SEF – see neither cost of donation nor lack of a tangible financial benefit as notable barriers to food donation.

The federal Canadian government’s 2020/21 Surplus Food Rescue Program (SFRP) \$50 million funding initiative provides distinct evidence of the extent to which the motivation of many food businesses to donate surplus edible food rests on the existence of monetary incentive. SFRP provided national non-profit organizations with the ability to purchase then distribute food at cost of production or below to regional charities supporting people with food. Most businesses’ interest and willingness to donate food ended immediately the program concluded. Reasons for this change included that, without a financial incentive to donate, businesses were typically more wary of factors that include potential legal or social liability concerns and the transactional costs associated with donation.

In the hope of “capturing cents on the dollar,” there is a greater tendency amongst businesses to retain SEF until it reaches or nears its best before date – then dispose of it at the cheapest possible cost. Without monetary value, surplus food is considered a budget item, and businesses assume that the donation of food will be more costly than its disposal at landfill. Capturing monetary value by selling surplus food for manufacture into animal feed or biofuel can take precedence over its donation for redistribution to vulnerable populations.

4.4 incorrect perceptions negatively impact willingness to donate

The research identified that, as described by Gooch et al (2019), many of the above-described attitudes which negatively impact businesses’ willingness to donate SEF – including corporate policies preventing the donation of SEF – are based on incorrect perceptions. These include:

4.4.1 legal liability

In Canada, while there is no documented case of a business who donated SEF being sued for negligence, many businesses remain concerned about legal liabilities surrounding the donation of food, particularly that which is perishable. Should an incident occur in relation to food that was donated in good faith and where the donor followed appropriate food safety protocols, Good Samaritan acts ensure that businesses who donate food are strongly defended against legal liability (Childs, 2019; NZWC, 2018).

The document entitled "Food Donation and Civil Liability in Canada" (NZWC, 2018) provides guidance on how businesses can ensure that they can donate SEF without fear of retribution, should a food safety incident occur.

4.4.2 opportunity cost

Businesses often view the donation of SEF in terms of opportunity cost. There could be an opportunity to capture some value, such as from selling SEF for manufacture into animal feed. On the other hand, the opportunity to donate SEF for redistribution comes with cost, but no immediate financial benefit.

This perspective possibly stems from businesses being unaware of the financial benefits that can accrue from donating SEF to non-profit organizations serving food to their communities and the costs associated with legal liability. Brand equity concerns may also factor into businesses' decisions on whether to donate SEF.

The Champions 12.3 document entitled "The Business Case for Reducing Food Loss and Waste" (Hanson & Mitchell, 2017) describes how and why businesses benefit from donating SEF. This includes how brand equity increases due to consumers and wider stakeholders viewing businesses as socially responsible.

See Section 5.2 for a discussion on the true cost/benefits of SEF donation.

5 solutions to increase the rescue and redistribution of SEF

The donation of avoidable potentially edible food loss and waste is fraught with perceived logistical, food safety and legal challenges. Without doubt, however, the volume of food donated to help address food access amongst vulnerable populations can be measurably increased.

5.1 aligning solutions to stakeholder nuances

Information described in prior sections of the report guided the development of five straw model solutions for increasing the volume of donated surplus edible food. Input from the FRCA assisted in the refinement of the solutions which are presented in the form of a matrix. The matrix encompasses the three distinct stakeholder groups identified by the analysis of survey data. These are:

1. Have edible surplus food, some of which is currently donated
2. Have edible surplus food, none of which is currently donated
3. Do not believe that they have edible surplus food (which could be donated)

Descriptions contained in the matrix illustrate the nuanced ways in which each of the solutions would lead to an increase in donated SEF. For current donors, the primary purpose of the solutions is to capture the SEF that is not donated by minimizing operational barriers. For non-donors, the primary purpose of the solutions is to address attitudinal factors that negatively impact their willingness to donate. This is because business managers will not invest resources required to apply the “how to” innovate – in this case donating SEF – until they have understood the “why” innovate (Gooch, 2012).

The first four solutions presented in Table 5-1 are enterprise level and could be applied immediately, particularly where strong relationships already exist between involved stakeholders and where some food donation already occurs. This is because an existing level of trust and familiarity provides a solid bedrock for testing new innovations and gaining candid insights that can be applied to implementing solutions in more challenging situations. This could be because inter-organizational relationships are still forming and more dynamic, or it is where SEF is known to exist – though it is not presently being

donated by the involved businesses. Section 6 presents proven methods for validating a systems' design and mitigating risks by tailoring its implementation to suit specific circumstances.

The fifth potential solution relates to government policies and, by definition, is therefore longer term. As mentioned previously, evidence captured during the research showed unequivocally the degree to which monetary incentives can impact businesses' willingness to donate SEF. The business case for donation, which forms section 5.2, illustrates why monetary considerations should be considered from enterprise and societal good perspectives

Table 5-1: Solutions for increasing SEF donations

Solution		How solution could result in increased donations		
		Have edible surplus food, some of which is currently donated	Have edible surplus food, none of which is currently donated	Do not believe that they have edible surplus food
		The primary focus of solutions is to increase <u>current</u> donors' capability to donate by having improved the efficiency of donation practices	The primary focus of solutions is to increase <u>potential</u> donors' willingness to donate, then improve the efficiency of donation practices	The primary focus of solutions is to cause <u>potential</u> donors to review their practices surrounding the management of unsold food
1	Common standardized food rescue and redistribution processes, procedures (possibly in conjunction with information, support and capacity-development services)	Encourage increased donation by optimizing food donation and redistribution practices.	Encourage donation by having addressed perceived complexities and cost concerns, and providing readily implementable processes and procedures – along with support.	Encourage businesses to quantify if food is edible and, if yes: <ul style="list-style-type: none"> • Ensure safe donation • Mitigate perceived complexities and cost concerns
		Informed perspectives towards date code* related challenges (whether because of public opinion or legal liability concerns) leads to increased willingness to donate.	Changed perspectives towards date code* related public opinion or legal liability concerns increase willingness to donate.	Changed perspectives towards date code* related public opinion or legal liability concerns increase willingness to explore whether they have edible surplus foods and consider donation.
		Assurance that food can be donated without the donor incurring legal liabilities by having infringed upon regulations that really do (or are perceived to) impact food donation efforts lead to increased donations.		Assurance that food can be donated without the donor incurring legal liabilities by having infringed upon regulations that really do (or are perceived to) impact food donation efforts lead to a willingness to consider the opportunity of donating surplus edible food.
		Changed perspectives lead to the relaxing of corporate policies that prevent the donation of certain forms of edible surplus foods, e.g. meat, seafood.	Changed perspectives lead to the relaxing of corporate policies that have previously prevented the donation of edible food.	Changed perspectives lead to the relaxing of corporate policies, leading to businesses redefining if they have surplus edible food that can be donated.

* Government intervention may be required to ensure standardized application and interpretation of best before dates. The starting point for intervention would be to determine for which foods best before dates are required, how they are established, and how they are communicated.

2	Valorize surplus edible food by establishing a business case for food donation	Perceiving the donation of food as a sound financial decision rather than a cost (budget item), plus a means to acquire social capital and increase employee engagement, would lead to increased willingness to donate foods that are not currently donated.	Perceiving the donation of food as beneficial to their business from financial, social and employee engagement perspectives would increase stakeholders' willingness to explore if they have edible surplus foods that are donateable.		
3	Formalized repurposing operations, such as the repackaging of bulk-sized foodservice packs and branded foods	Reduced brand-image related sensitives lead to increased willingness to donate foods not currently donated, possibly due to contractual reasons.			
4	Coordinated logistics (possibly in conjunction with information, support and capacity-development services)	Particularly amongst smaller donors, such as HRI, aggregated logistics facilitate increased donation by providing a localized safe food collection hub and service.	Particularly amongst smaller donors, such as HRI establishments operating within the radius of a few blocks or famers operating in a specific geography, aggregated logistics facilitate increased donation by reducing the need for additional storage, labour and transport costs.	The existence of a reliable, effective and efficient transportation solution would encourage businesses to review whether a proportion of what is incorrectly deemed organic waste could be donated and redistributed.	
		A proportion of unsold foods is returned to vendors or distributors. Due to short shelf-life, food safety concerns, and corporate policies that prevent the donation of such foods, their final destination is typically landfill. Interceding in this cycle would see returned foods rescued by their being transported directly to a rescue/redistribution center or non-profit organization.	This group of stakeholders may well include businesses (i.e. distributors) who receive returns from customers (i.e. retailers), though do not consider it edible and potentially donateable.		
		That not all available food is donated can be due to demand side issues, such as non-profit agencies lacking logistical capabilities and skills, or their reliance on unskilled volunteers. Increased logistical capacity, capabilities and skills would facilitate an increase in donations and redistribution.	Demand-related considerations may not be applicable to facilitating the donation of edible foods from this category of potential donors.		
5	Valorize donations through combination of corporate tax and carbon tax reductions/ rebates, along with increased landfill costs	Increase motivation to proactively donate food prior to it reaching or exceeding its date code, or food that which requires more resources to ensure its safe donation, by having given it a monetary value.	Establishing a monetary value for food will encourage businesses to no longer hold onto 'surplus' food in an effort to regain cents on the dollar, then landfill that food when it nears or exceeds its best before date and becomes unsaleable.	Establishing a monetary value for food will encourage businesses to re-examine whether food could be donated for human consumption rather than disposing of it at the least possible cost.	
		The ability to capture value from claiming tax credits and reducing disposal (landfill) costs requires effective measurement and reporting. The resulting insights is expected to lead to increased motivation to donate edible surplus food while simultaneously reducing FLW at source and addressing related inefficiencies.			

Research findings suggest that certain solutions may incentivize specific sectors of the food industry to commence or increase donations of SEF. The findings also suggest that certain solutions could be more applicable to certain types of food. The strength of association believed to exist between each conceptual solution and industry sector are colour coded.

Table 5-2: Association between proposed solutions, industry sectors and food types

	1. Common SEF rescue processes	2. Valorize SEF (business case)	3. Formalized repackaging	4. Coordinated logistics	5. Valorize SEF (policies/regulations)
Farm/greenhouse	Produce	Produce	Produce	Produce	Produce
Processor/Manufacturer			Grains, dairy, meat & poultry		
Distributor/Wholesaler			Grains, dairy, meat & poultry		
Retail					
HRI					

High	Impact of factor on incentive to increase or begin donation of SEF
Med	
Low	

Where no individual foods are mentioned in the above matrix, the proposed solution is anticipated to have equal bearing on all types of food within that specific sector of industry.

5.2 business case scenarios for donation versus disposal

On multiple occasions throughout the research, respondents noted the need for a business case that compared why businesses should donate SEF versus disposing of once edible food in other ways, such as sending to animal feed or landfill. economic cost/benefits of addressing FLW in Canada through the donation of SEF. This would require researchers to employ a methodology such as Social Return on Investment, which is beyond the scope of this project. This following business case should therefore be considered directional only.

The following business case for donation versus disposal uses data gathered during this research and the SFRP, the 2020/21 program that enabled non-profit organizations to procure SEF, then process and/or repackage that food (if required) prior to its redistribution. Two scenarios are presented: fresh produce and meat. Fresh produce generally does not need any repacking in order to be donated. Frozen meat, either due to branding and/or format size, often require some repackaging/processing in order for donation to occur.

Multiple projects completed by VCMi have found that much of the food industry view FLW as a cost of operating a business. Many of the operational costs are absorbed into a businesses' pricing structure, meaning that they are borne by the end customer (consumers). Any operational costs that are reduced by the donation of SEF benefits businesses financially. Costs that are not borne by businesses or consumers are the full array of economic externalities associated with FLW. These include the environmental costs of FLW and the social costs associated with food insecurity, both of which the donation of SEF can help address. Hence, eliminating FLW through the donation and redistribution of SEF provides a triple bottom line benefit. A financial value for FLW related externalities has not been established.

As shown in Table 5-3, an immediate financial benefit that businesses can gain when donating SEF versus sending it to landfill is the elimination of disposal fees. If landfill costs increase, so do the financial benefits associated with the donation. Businesses can also benefit from the implementation of common standardized processes for the rescuing of SEF leading to a reduction in transactional costs. Because SEF specific transaction costs are unknown and will differ across businesses, they have not been separated out.



² Social Return on Investment examines the extent of overall value of change achieved by investments made private and public sources in a given situation(s). It encompasses shareholder value, along with public good including environmental and social value, from a cost-benefit perspective.

Table 5-3: Business case for donation versus disposal

	Fresh Produce (1 Tonne of Food)		Frozen Meat (1 Tonne of Food)	
	Food Donation	Disposal (Landfill)	Food Donation	Disposal (Landfill)
Food Business Costs				
Cost of production*	\$1,429.19	\$1,429.19	\$7,726.97	\$7,726.97
Disposal		\$100.00		\$100.00
Total Business Cost	\$1,429.19	\$1,529.19	\$7,726.97	\$7,826.97
Rescue/Redistribution Costs				
Transportation cost for 100km	\$602.00		\$602.00	
Storage	\$480.00		\$480.00	
Repackaging	N/A		\$1,058.00	
Total Redistribution Cost	\$1,082.00		\$2,140.00	

* Includes transaction costs

The above budget illustrates the costs borne by SEF rescue and redistribution organizations. In the above scenarios, the rescue and redistribution of fresh produce and frozen meat are priced at \$1,082 and \$2,140, respectively. The cost of repackaging frozen meat is similar to the cost incurred from its rescue, storage and redistribution.

Businesses can benefit more from the donation of SEF than the above illustration suggests by capturing intangible returns on investment. Environmentally, the prevention of FLW by redistributing SEF improves food-related GHG emissions (reported in carbon dioxide equivalents: CO₂E) seven-fold compared to sending SEF to landfill (EPA, 2020). Similar gains are reported by WRAP in the UK (WRAP, 2015). These environmental improvements significantly impact corporate social responsibility commitment metrics, which are of increasing importance to institutional and private investors (Zhou, 2021; UNEP, 2021; Bisnoff, 2020). In turn, this impacts share prices and consumers' propensity to purchase a particular food item due to perceptions of added value (Danley, 2021; Parry, 2021; Hanson & Mitchell, 2017). Table 5-4 shows the average per tonne of GHG emissions that are avoided by the donation and redistribution of SEF, and the increase in emissions associated with the landfilling of FLW. For each tonne of food, compared to the landfilling of FLW, the rescue and redistribution of SEF equates to a 3.82 tonnes reduction in GHG emissions.

Table 5-4: GHG (CO₂E) emissions associated with SEF donation versus landfilling

	Emissions incurred (+) or avoided per tonne of food waste
Rescue and redistribution of food	-3.320 metric tonnes CO ₂ E
Landfill	+0.5 metric tonnes CO ₂ E
Total CO ₂ E emissions avoided by SEF redistribution	3.820 metric tonnes CO ₂ E

Source: EPA WARM model v15 (2020)

The donation of SEF is also socially responsible from the perspective of improving not only the health and well-being of the vulnerable population, but society as a whole. Based on literature review that included an extensive US study (Cook & Jeng, 2009) into the true costs of food insecurity, VCMI conservatively estimated that food insecurity costs the Canadian economy \$26 billion annually. Addressing food insecurity would significantly reduce this burden and create long-term economic growth.

In summation, the intangible benefits that businesses and broader society can gain from the rescue and redistribution of SEF are greater than inferred by a financial spreadsheet. Arguably, there is therefore a need to incentivize businesses to donate SEF because of the resulting public good. Options on how to achieve this through government policy include the granting of tax relief measures that are tied to food donation, as occurs in the US (ReFED, 2021; NRDC, 2021).



6 means to validate solutions' design and future rollout

Operational factors impact businesses' willingness and ability to donate SEF. Production lines are continuous, high volume and one-way. Lines cannot be reversed, interrupted for small runs, or have different products introduced part-way along. Operating on tight margins, business managers need to account for all costs, including process, labour, energy, and packaging materials. Regulatory compliance is critical. Storage capacity, particularly for frozen or refrigerated foods, is limited and costly. Less tangible factors, such as brand protection, are complex issues — particularly for co-packers. Concurrently, the charitable food sector has limited access to financial resources, and is often reliant on volunteers.

These limitations mean that, prior to any of the proposed solutions' wide-scale implementation, their design must be validated in practice and refined to suit specific situation(s). This would occur in the form of pilot initiatives. The following section summarizes three proven tools for enabling the effective piloting of conceptual solutions in complex environments. The tools provide the ability to measure, control and continually improve the performance and effectiveness of each initiative on an ongoing basis. Concisely described with the aid of populated examples the tools are:

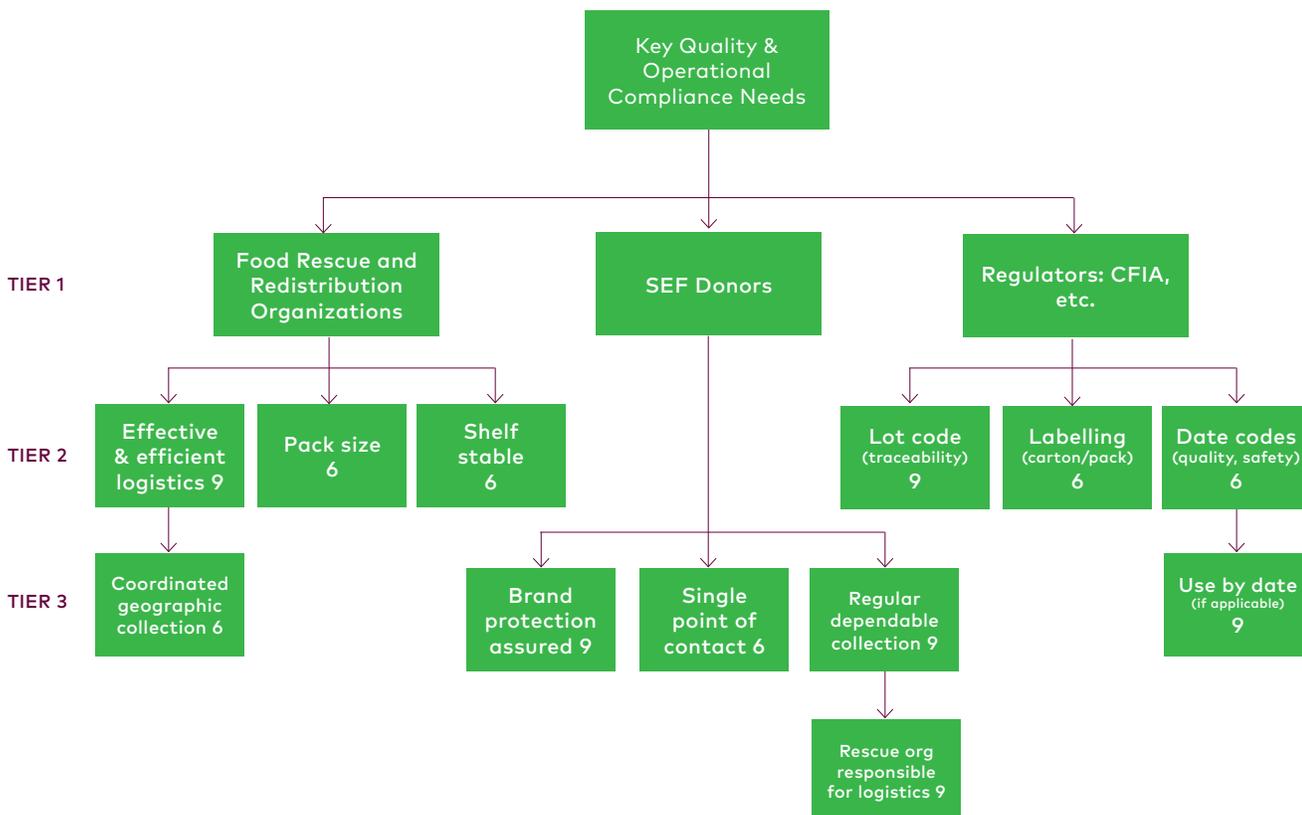
1. Critical to Quality Tree
2. Association Matrix
3. Risk Assessment and Mitigation Matrix

6.1 Critical to Quality (CTQ) Tree

The purpose of the CTQ Tree is to ensure that service providers understand the service attributes that are critical to each stakeholders' participation in the initiative. In so doing, those implementing an initiative are able to identify then manage the inputs and outputs that will determine the initiative's performance the most. Stakeholders can thereby be assured that their attention and finite resources are invested in managing those elements of the solution that have greatest impact on the initiative's success and long-term sustainability.

The first step to complete the CTQ Tree is to identify the process outputs that are critical to the customers of the initiative. Customers can be internal and external. In the example below (Figure 6-1), critical process outcome requirements have been summarized as "key quality and operational compliance needs." Below that in "Tier 1" are the three groups of stakeholders required to ensure that efficient operations comply with internal and external requirements. These groups are food rescue/redistribution organizations, donor businesses and regulators. Under each stakeholder group (Tier 2) are listed service attributes that are most pertinent to their long-term commitment to the initiative. Tier 3 drills down to show more detail about what each attribute looks like in practice. The importance of each attribute identified in Tiers 2 and 3 have then been rated in terms of critical (9), important (6), and nice to have (3). The inability of an initiative to meet a critical service attribute will be a deal breaker for one or more stakeholders. The inability of an initiative to meet an important service attribute will negatively impact the commitment of one or more stakeholders. Delivering on a nice to have service attribute will increase stakeholders' commitment to the initiative; it will also increase the likelihood of them encouraging others to participate.

Figure 6-1: Critical to quality (CTQ) tree



6.2 association matrix

The next step in preparing to pilot, validate and refine each of the chosen solutions is to identify the degree to which associations exist between each of the processes that must occur for the solution to operate as intended and the service attributes identified in the CTQ tree. In the populated example that forms Table 6-1, each service requirement and the corresponding criticality score (nice to have = 3; important = 6; critical = 9) have been listed along the top of the association matrix. Down the left-hand side of the matrix are listed the operational processes that the involved stakeholders believe must occur for the initiative to operate as intended.

Table 6-1: Association matrix

		Food Rescue /Redistribution Organizations				SEF Donors				Regulators (incl. CFIA) Compliance					
Attributes		Effective & efficient logistics	Coordinated geographic collection	Pack size (suits target client needs)	Self stable	Brand Protection assured	Single point of contact (btwn donor and food rescue org)	Regular dependable collection	Rescue org responsible for logistics	Lot code	Labelling	Date code	Use by date (where applicable)		
Critical to Quality (Low=3, Med=6, High=9)		9	6	6	6	6	6	9	6	9	6	6	9		
Organizational Processes													Score	% contribution	
Donor	Manufacture / production	3	0	3	6	0	0	3	0	3	3	3	3	198	3%
	Pack	6	6	9	9	3	0	6	0	9	9	9	9	540	7%
	QA / inspect	3	6	3	3	9	0	3	0	6	3	3	3	297	4%
	Store / inventory management	9	6	3	6	9	6	6	0	3	0	3	3	405	5%
	Stage	9	9	6	3	9	6	9	0	9	0	0	6	495	7%
	Dispatch	9	9	3	6	6	9	9	9	9	0	9	9	630	8%
SH / Rescue Organization	Confirm volume / specs	9	9	6	3	6	9	9	9	3	3	3	3	504	7%
	Procure	9	9	3	3	9	6	9	9	6	6	6	6	576	8%
	QA / inspect	6	0	3	6	9	0	6	3	9	6	9	6	459	6%
	Load	6	6	0	9	9	0	9	9	3	3	3	3	423	6%
	Transport	9	9	0	9	6	0	9	9	6	6	6	6	540	7%
	Unload	6	3	0	6	6	3	3	6	3	3	3	3	315	4%
Community Food Organization	Receive	6	3	3	6	6	0	3	9	6	6	6	6	423	6%
	Repack (if required)	6	3	9	9	9	0	0	0	9	9	9	9	504	7%
	Store / inventory management	6	3	3	9	9	0	3	3	9	3	3	3	387	5%
	Arrange for client to collect	6	3	6	3	3	0	3	3	9	3	6	6	378	5%
	Give to client	6	3	6	9	6	0	3	3	9	3	6	6	432	6%
TOTAL													7506	100%	

Where an association exists between each process and a specific service attribute (e.g. Process = Donor inventory management; CTQ = Effective & efficient logistics), a numerical score has been used to convey the strength of association that exists between the two parameters. One of four scores have been applied to each cell contained within the matrix: 0 = "no association," 3 = "low association," 6 = "moderate association," and 9 = "high association." The association between inventory management and logistics has been rated at 9 = "high," By having summated each association score and criticality score, the comparative impact that each operational process is anticipated to have on the overall initiative is reported numerically (colour coded) and in percentage terms in the far right-hand column. As can be seen in the example presented, donors' dispatch processes, followed by rescue organizations' procurement processes, are expected to have the greatest impact on the initiative's success. The effectiveness with which these processes can be performed relies on other key determinants of success. These determinants include staging, communication to confirm volume and specifications, and pack size/uniformity.

Once the comparative importance of operational processes in relation to service attributes and the initiative's overall performance have been identified, metrics can be established to assess how well each process meets stakeholders' expectations/needs during the pilot process. The performance of each operational process in relation to stakeholders' expectations/needs will determine the solutions' viability and the extent to which operational processes must be refined prior to further testing.

Armed with experience gained from having tested the solution in practice (if minimal or zero revisions are required to operational processes), the next stage is to expand the initiative from a pilot into a full-blown solution in stages. This requires the existence of appropriate governance and oversight. The third of the three tools helps ensure that stakeholders are fully prepared for the challenges and risks associated with implementation a large scale initiative.

6.3 risk assessment and mitigation matrix

The purpose of the risk assessment and mitigation matrix is to help ensure that stakeholders are able to mitigate potential risks, by having correctly identified each risk and rated both its probability of occurrence and the impact it will have

on the initiative if it occurs. This is achieved by having subject matter experts identify what could potentially go wrong with the new processes being implemented, and what actions are required to prevent the process from going wrong before it is implemented. An example of a populated risk matrix is shown in Table 6-2. Each of the numbered and summarized descriptions contained in the matrix is expanded upon in Table 6-3.

The process of completing the matrix and accompanying table begins by having subject matter experts from each of the stakeholder organizations identify risks that could negatively impact the initiative. The most appropriate box in which to place each risk is then determined. Each cell within the nine-box grid corresponds to the:

1. Impact that a risk's occurrence will have on operational processes or stakeholders' commitment (high/medium/low), and
2. Probability of a risk's occurrence (high/medium/low)

A numerical score is given for each risk's impact and probability. High = 9; medium = 6, low = 3.

Table 6-2: Risk management and mitigation matrix

RISK MANAGEMENT MATRIX		LOW - 3	MEDIUM - 6	HIGH - 9
RISK ITEM IMPACT AND RATING	HIGH - 9	#1 lack of coordination	#4 Donations cease #9 Regulations' Interpretation	#2 Corporate policies
	MEDIUM - 6	#5 Date coding	#3 Logistic costs	#6 Donation process
	LOW - 3		#7 Ineffective communications	#8 Budgetary constraints

The decision on which box to place a specific risk is aided by calculating the risk score. As shown in the Risk Reduction Plan that forms Table 6-3, this is achieved by multiplying the impact and probability score. Subject matter experts distill both the risk and its anticipated effect on the initiative into concise objective descriptions, then translate this shared understanding into a numerical score.

For risks placed in an orange box, a solution to manage or control the risk must be identified, documented and actioned before the process is implemented. For risks placed in a yellow box, a solution needs to be identified, documented and actioned as soon as possible. For risks placed in a green box, a documented solution may not be required, though robust management and monitoring processes must be in place. In all cases, the elimination of potential risks rests on regularly monitoring and proactively revising operational processes wherever required.



Table 6-3: Risk reduction plan

RISK REDUCTION PLAN									
ITEM	RISK DESCRIPTION	ANTICIPATED EFFECT	IMPACT	PROBABILITY	RISK SCORE	PROPOSED MITIGATION	ACTIONS TO IMPLEMENT	BY WHOM	DUE BY
1	Lack of coordination between donors and food rescue organizations leads to ineffective and inefficient logistics	Impacts: 1) businesses willingness to donate, and 2) the viability of SEF rescue/redistribution systems	9	3	27	Establish foundational standardized SEF donation and rescue/redistribution practices	1... 2... 3...	.....	.....
2	Corporate policies continue to prevent large volumes of SEF from being donated	Large volumes of SEF continue to be wasted due to corporations' reluctance to donate	9	9	81	Establish donation practices that address corporate concerns, and contractual arrangements that place appropriate areas of responsibility/accountability on donor, rescuer/redistributor, and community org	1... 2... 3...	.....	.....
3	Transport and logistics costs negatively impact the sustainability of SEF rescue and redistribution systems	The volume of SEF donations is below that which is possible	6	6	36	Establish and communicate standard operating procedures to donors, wider industry	1... 2... 3...	.....	.....
4	Quality or food safety complaint lead businesses to cease donating	Donations of SEF fall suddenly, potentially irreparably	9	6	54	All stakeholders have defined roles, responsibilities, accountabilities	1... 2... 3...	.....	.....
5	Processes followed to determine date code repackaged foods does not ensure 100% compliance with CFIA regulations	Best before dates do not relate to food safety. Processes need to simultaneously ensure that food is not disregarded unnecessarily nor that food safety is compromised	6	3	18	Implement auditable standard operating processes regarding the repackaging of food	1... 2... 3... 4...	.....	.....
6	Complexity of, and/or opportunity costs associated with, donation of SEF impacts willingness to donate	The volume of SEF donations remains below that which is possible	6	9	54	Establish and communicate standard operating procedures to donors, wider industry	1... 2... 3...	.....	.....
7	Ineffective communication between current/potential donors and food rescue organizations	Real or perceived complexity of donation process is exacerbated	3	6	18	Collaborate with respected industry leaders during the development, testing and refining of SEF rescue and redistribution systems	1... 2... 3...	.....	.....
8	Current rescue practices fail to address food businesses' operational and budgetary constraints	SEF donation impacted by potential and current donors always seeking cheapest and least riskiest option	3	9	27	Collaborate with respected industry leaders during the development, testing and refining of SEF rescue and redistribution systems	1... 2... 3...	.....	.....
9	Regulations incorrectly interpreted	Willingness and motivation to donate hampered by legal concerns	9	6	54	Listen to how businesses currently interpret regulations of concern, clarify those regulations and their enforcement with regulators, modify communication materials and practice accordingly	1... 2... 3... 4...	.....	.....

How the subject matter experts propose to mitigate the potential risk is summarized above. The individuals responsible for developing appropriate documentation (such as standard operating procedures for how to perform a particular operational process, and by when the documentation will be finalized and revised processes implemented) are identified. Often, the impact that the new management processes are anticipated to have on the likelihood of the risks' occurrence and the effect that the risks' occurrence would have on the initiative are then reassessed and monitored.

7 Conclusions

Surplus edible food (SEF) is food that is good to eat though is surplus to industry requirements, or food that is not consumed for reasons such as nearing or reaching its best before date. SEF typically goes to waste or is diverted to another destination, such as animal feed. As shown in the food waste hierarchy, both options represent an ineffective use of natural resources and unnecessary environmental emissions compared to the redistribution of SEF to relieve hunger among vulnerable populations.

The purpose and objective of this study was to verify the scale of opportunity that exists to reduce FLW by redistributing SEF to vulnerable populations who are food insecure, then propose solutions that would lead to a distinct increase in the volume of SEF rescued and redistributed. The economic and environmental benefits that could be achieved by addressing food insecurity by the donation, rescue and redistribution of SEF are enormous.

The estimated volume of avoidable potentially edible FLW – excluding households – that occurs annually in Canada is 8.79 million tonnes (Gooch et al, 2019). Meeting the needs of Canada's vulnerable populations would require an estimated 4.74 million tonnes of SEF (Gooch et al, 2021). The greatest demand among non-profit organizations serving Canada's vulnerable populations is protein (dairy, meat, seafood, and eggs), produce and grains.

7.1 key takeaways

7.1.1 surplus edible food (SEF)

- The study identified 127,177 potential donors of SEF across Canada.
 - Of this total number, 40,396 were prioritized as the most likely sources for enabling the effective rescuing of SEF in the short to medium term.
- A total of 748 businesses responded to surveys circulated across the Canadian food industry.
 - Of these, 45 percent (n=334) stated that they had SEF.
- By inferring survey results across the wider industry, it was estimated that 3.2 tonnes of SEF occurs annually across Canada.
 - Of this total volume, just four percent (0.1 million tonnes) of SEF is currently donated.
 - The volume of currently donated SEF equates to just 1.4 percent of non household avoidable and potentially edible FLW that occurs annually in Canada.
- The SEF that occurs annually across Canada is sufficient to address 68 percent of vulnerable populations' food needs, and the foods most in demand.
 - The rescue and redistribution of available SEF would reduce the volume of avoidable non-household FLW occurring annually in Canada by 36 percent.
 - Many businesses are reluctant to acknowledge that they have SEF; therefore, the true volume of available SEF could be higher than estimated by this research.

7.1.2 donors versus non-donors

- The research identified that businesses can be categorized into three groups:
 - Have edible surplus food, some of which is currently donated
 - Have edible surplus food, none of which is currently donated
 - Do not believe that they have edible surplus food (which could be donated)
- By sector, the highest concentration of businesses currently donating SEF is retail.
 - Not coincidentally, retail respondents were least likely to report that external or internal challenges significantly affect their willingness or ability to donate SEF.
- By sector, the lowest concentration of businesses currently donating SEF is HRI.
 - The HRI sector represents the largest source of SEF that is not presently donated.
 - Not coincidentally, compared to retail, HRI respondents are more likely to say that identified challenges significantly affect their willingness or ability to donate SEF.

- This difference is statistically significant.
- Primary reasons affecting HRI operators' willingness to donate are corporate policies.
 - These policies are linked to other factors, such as "legal liability" and "regulations that discourage or prevent donation."
- Perceived challenges also affect the willingness of farmers, food processors manufacturers and wholesalers/distributors to donate SEF, most notably:
 - A lack of tangible financial benefits versus costs has the greatest effect on the willingness of two particular respondent groups to donate SEF. They are:
 - Those operating in the fresh produce industry
 - The food processing/manufacturing sector
 - Legal liability concerns are highest among those wholesalers/distributors who already donate a proportion of the SEF that they experience.

7.1.3 solutions

- Research findings guided the development of five solutions to measurably increase the volume of SEF donated and redistributed to vulnerable populations.
 - Four of the solutions are enterprise level and could be piloted immediately.
 - This could most readily occur where strong relationships already exist among the involved stakeholders.
 - The fifth solution is longer term and relates to government policies.
 - As has occurred in the US, for example, tax incentives would incentivize businesses to donate SEF.
- The four proposed enterprise level solutions need to be validated in practice and tailored to individual stakeholders' need through a process of piloting and refinement.
 - Three proven tools would provide the ability to measure, control and continually improve the performance and effectiveness of each initiative on an ongoing basis.
 - Concisely described with the aid of populated examples, the tools are:
 - Critical to Quality Tree
 - Association Matrix
 - Risk Assessment and Mitigation Matrix

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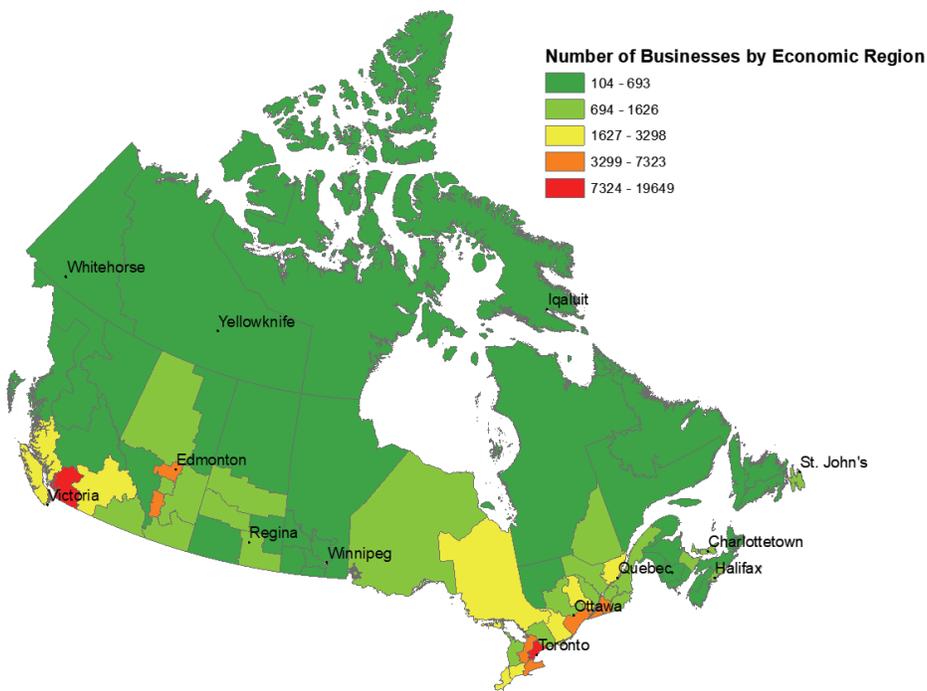
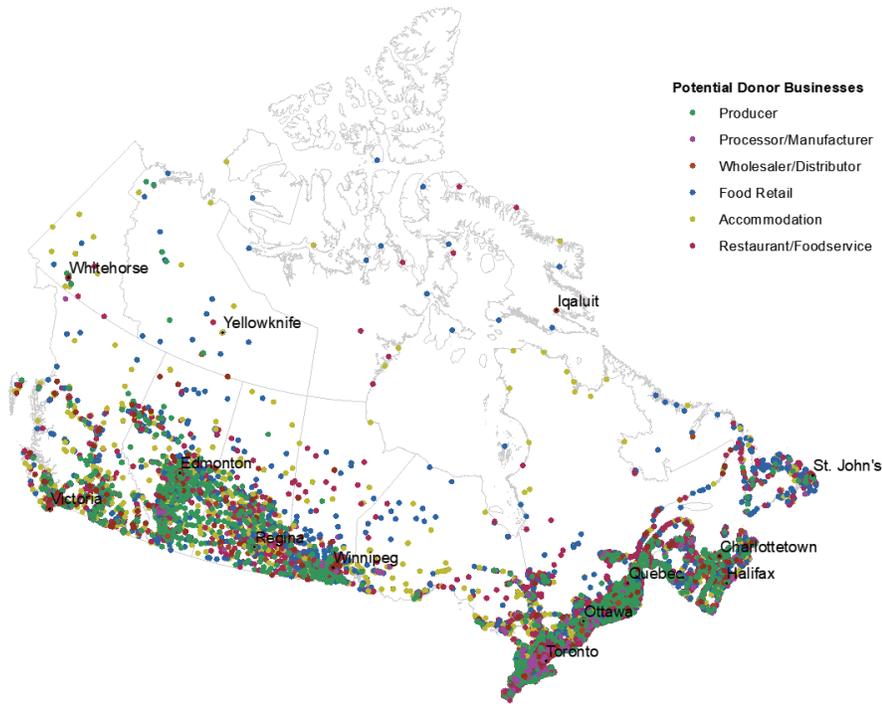
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9 appendix a: spatial and heat maps of potential donors' locations



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