Canadian Food Studies / La Revue canadienne des études sur l'alimentation

Original Research Article

Critical food guidance for tackling food waste in Canada: A closed-loop food system alternative to the food recovery hierarchy approach

Tammara Soma*

Simon Fraser University

Abstract

Food waste is a complex problem with far reaching negative environmental, social, and economic impacts. To identify appropriate solutions to address food waste, the food recovery hierarchy developed by the Environmental Protection Agency is currently the most popular guiding framework in food waste prevention and reduction. However, this paper found that the application and the interpretation of the guide is quite problematic due to its lack of consideration of scale in efforts to prevent and reduce food loss and waste. Furthermore, the food recovery hierarchy is premised on a linear food supply chain instead of a circular approach. Although the hierarchy recommends prevention as the most preferred approach, it still provides the option (albeit less preferred) to landfill food waste. Based on values and worldviews that potentially serve as better tools for food waste prevention and reduction, this paper explores the tensions within the food recovery hierarchy framework and identifies alternative critical food guidance developed in a Canadian social innovation lab.

Keywords: Food waste; food recovery hierarchy; social innovation; closed loop; Canada

Editor's note: This PDF was revised in May 2025 to correct for missing references. Folio markers after page 264 now include alphabetical suffixes to adjust for the supplemental pages.

*Corresponding author: tammara_soma@sfu.ca
DOI: 10.15353/cfs-rcea.v9i1.490
ISSN: 2292-3071

Introduction

An estimated 35.5 million metric tonnes of food is wasted annually in Canada, with avoidable food loss and waste costing Canada $49.5 billion per year (Gooch et al., 2019). Scholars and policy makers are generally in agreement that the amount of food wasted in Canada is detrimental to environmental sustainability and contributes to climate change, economic inefficiencies, and social inequality (MacRae et al., 2016; Parizeau et al., 2015; Soma et al., 2020; Urrutia et al., 2019; van der Werf, 2017;). The problem of food waste is also a logical consequence of an industrial food system predicated on overproduction (Gille, 2012), corporate subsidies (Patel, 2007) urbanization, dietary transition (Parfitt et al., 2010) and a linear food chain that does not encourage waste prevention or the return of nutrients from organic waste back into production (Ontario, 2017). While this study is primarily focused on Canada, it is important to note that demands by Canadian consumers impact global agriculture. As Stuart (2009, p. xv) noted, demand for food in one part of the world "indirectly stimulates the creation of fields thousands of miles away." In fact, the dominant food system "has left many stuffed and many starved" (Patel, 2007, p. 18). This paradox identified by Patel is particularly relevant in the contexts of agri-food systems, waste systems, and health systems that take place on land, and within the colonial context of Canada. For example, when speaking of the issue of plastics waste and landfilling, Liboiron (2021) noted the intimate relationship between plastics pollution and colonialism. Liboiron argues that this waste issue is due to "assumed access by settler and colonial projects to Indigenous lands for settler and colonial goals" (2021, p. 5), which in this case is based on excessive consumption and resource extraction. Similarly, in a food system where Indigenous peoples are disproportionately impacted by food insecurity and food-related non-communicable diseases such as diabetes, food has historically been weaponized to harm children in residential schools through poor nutrition and insufficient foods (Mosby &Galloway, 2017), as well as through forced farm labour (Giancarlo, 2020). The colonial framework is also entrenched in an agricultural system that has in some cases profited from the exploitation of migrant farm workers (Reid-Musson, 2017). The foregoing examples illustrate the adverse consequences that arise when food is treated as a commodity (Soma et al., 2020), and how the food supply chain is embedded within a linear system as opposed to a more preferable circular system.

Recognizing the detrimental impact of food waste, a flurry of activities and solutions to address the issue have emerged. These solutions have ranged from educational approaches to food waste prevention such as the *Love Food Hate Waste Canada*[1] awareness campaign, policy strategies such as *Ontario's Food and Organic Waste Framework Action Plan* (Ontario, 2017), the growth of food waste reduction apps such as FlashFood and Feedback, as well as popular charity-based solutions focused on *food rescue* such as Second Harvest, Food Share Network B.C, and Leftovers Calgary.

[1] Lovefoodhatewaste.ca

On the waste management and diversion side, there are also calls to encourage the management of food waste in a more sustainable manner. For example, large retailers such as Walmart have committed 244 of their Canadian stores to send organic waste to anaerobic digestion facilities instead of landfills (Walmart Canada, 2018). Smaller-scale solutions include vermicomposting (worm composting) enterprises such as Waste Not Farms[2], a green bin office pick-up service where organic waste from green bins is picked up and composted in a local worm farm with the resulting soil amendments given back to the clients. All of these diverse food waste solutions can be represented at various levels of the Food Recovery Hierarchy Framework (hereinafter Framework) made popular by the Environmental Protection Agency in the United States (Figure 1).

This paper will critically analyze and unpack the hierarchies of solutions promoted by the Framework, especially as the Framework is increasingly viewed as an authoritative guide on how to best address the issue of food waste (CEC, 2017; Eriksson et al., 2015; Papargyropoulou et al., 2014). This paper argues that this Framework is premised upon a paradigm that perpetuates and does not challenge, the dominant linear, industrial food supply chain. Moreover, the Framework does not address the issue of "competing solutions" from diverse stakeholders (Mourad, 2016). As Mourad (2016) argues, actors who have diverse interests and agendas in the food commodity chains actually develop competing solutions, many of which can be categorized as "weak sustainability" instead of holistic solutions defined as "strong sustainability."

As an alternative paradigm, this paper explores a conceptual framework for critical food guidance that would potentially create a better tool for food waste prevention and reduction. Using a case study of the Food Systems Lab for social innovation in Toronto, we showcase an alternative framework based on the principles of justice, reconciliation, and innovation. This framework was developed through a social innovation workshop with diverse attendees including farmers, retailers, restaurateurs, Indigenous community members, migrant farm worker, faith organizations and more. Findings from the lab demonstrate the need to explore the *values* that will feed into a closed-loop food system. One of the values embraced was the Indigenous principles based on All My Relations" and the importance of Reconciliation (TRC, 2015). Considering an Indigenous person in Canada is 28.2% more likely than non-Indigenous peoples to be food insecure (Tarasuk et al., 2016), an approach based on decolonization and reconciliation may serve as an alternative paradigm to challenge the commodification of food and the injustice prevalent in the dominant food system, and correspondingly contribute to tackling the issue of food waste in a systemic manner. This framework, we suggest, can provide critical guidance in the vital area of food waste reduction and prevention

[2] wastenotfarms.com

Hierarchy of food waste solutions: The food recovery hierarchy framework

Figure 1:

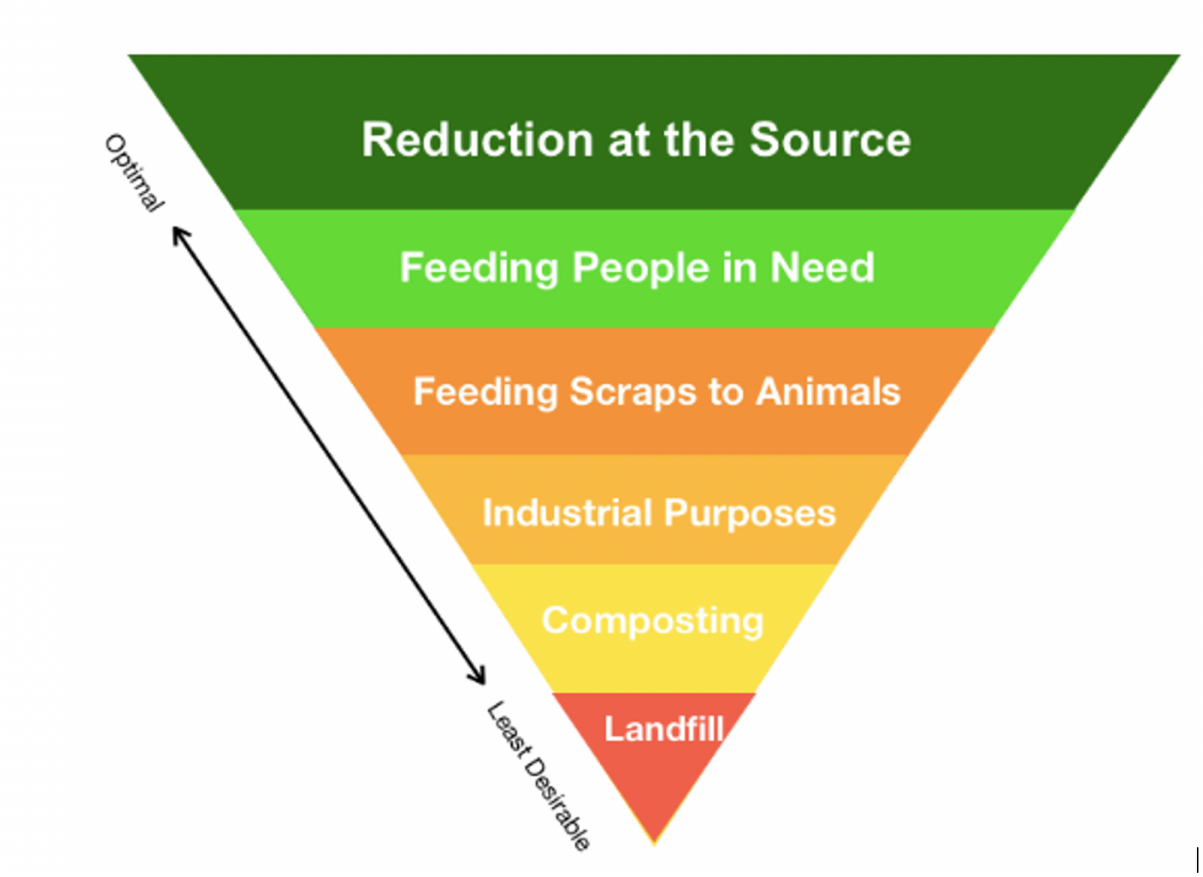

Diagram adapted from the EPA Food Recovery Hierarchy <https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>

The Food Recovery Hierarchy Framework provides guidance for food waste prevention, reduction, and recovery in the shape of an upside-down pyramid. The genesis of the framework is a "Waste Ladder" with five rungs, developed in 1979 by Ad Lansink and also known as the "Lansink Ladder" (Hendriks et al., 2003). The ladder includes: 1) prevention; 2) reuse; 3) recycling; 4) recovery; and 5) disposal. The model visually illustrated by the Environmental Protection Agency is currently the most dominant guide in food waste prevention, reduction, and recovery and is cited in various food waste reports, albeit often slightly modified or adapted (CEC, 2017; Garrone et al., 2014). Waste management guidelines often frame waste as a resource exemplified by the 3R principles of Reduce, Re-use and Recycle (Papargyropoulou et

al., 2014). In Europe, the 3R hierarchy of Reduce, Reuse and Recycle was enacted into law in 1975 (European Commission, 2009).

According to Papargyropoulou et al. (2014), the food waste hierarchy has the potential to deliver substantial environmental, social, and economic benefits. However, this paper argues that the ways in which the hierarchy categorizes the recovery of food waste may potentially limit innovation. This is due to its lack of consideration of scale where the food waste occurs, and the fact that it does not distinguish the types of food waste in determining desirable and least desirable practices/options. The levels of the hierarchy also appear to be arbitrary, especially when considering the different types, definitions, scales, and categories of food waste. The limitations of these hierarchies will be analyzed by looking at the levels of food management options from the most desirable (source reduction/prevention) to the least desirable option (landfill/disposal).

Prior to critically analyzing the hierarchies, it is important to understand that there are many definitions and diverse conceptualizations around 'food waste' which highlight the tensions and issues within the practices promoted by the Framework. A systematic review by Roodhuyzen et al. (2017) found that scholars in the field use various angles and terminologies to define food loss and waste, and while there is no consensus, there are generally two terms commonly used to describe food that is wasted: *food loss* and *food waste*. The term food loss is primarily used to define food that is wasted at the agricultural/production stage due to spoilage, lack of farm infrastructure, harvesting, and processing issues (Gustavsson et al., 2011). Meanwhile, food waste is the term that is often used to define food wasted at the consumer or retail stages and is mainly linked with behavioural issues rather than infrastructural issues.

According to the Food and Agriculture Organization (FAO) (2019), food waste is any edible material that was produced for human consumption that instead of being eaten, is discarded, lost, degraded or consumed by pests. Lee and Soma (2016) define food waste as any discarded organic matter that was intended for consumption by humans, regardless of its ultimate fate. Scholars such as Smil (2004) include overnutrition within the definition of food waste, and Stuart (2009) includes the diversion of edible food from the human food chain to animal feed as food waste. O'Brien, on the other hand, argues that food waste is the natural logic of capitalist surplus and, as such, 'waste' is an imaginary construct (2012). In a study conducted in Indonesia, it was noted that income, cultural preferences, and class, influence who is able to determine what is 'food' and what is considered 'waste' (Soma, 2017a).

In addition to the diverse interpretations of what is meant by 'food waste', there are further categories and distinctions. For example, the U.K organization Waste and Resources Action Program (WRAP)(2009) has categorized food and drink waste by how avoidable the waste was prior to being disposed.

a. **Avoidable food waste**: food that was at some point edible prior to disposal, e.g. food that was overpurchased or spoiled (meat, apples, cooked/prepared foods).

b. **Potentially avoidable food waste**: food consumed by some people but not by others. Examples include carrot skins, potato skins, bread crusts, broccoli stalks.
c. **Non-avoidable food waste**: food waste that under normal circumstances would not be edible (usually the result of food preparation), e.g.avocado skin and seed, eggshells, bones from meat, pineapple skin.

It is important to note that the terminologies and categories used in the food recovery hierarchy framework are often used interchangeably, which can also lead to confusion (Teigiserova et al., 2020). For example, feeding food to animals can be considered both reuse and recycling, while anaerobic digestion has been included in both recovery (as part of energy recovery) and recycling (Teigiserova et al., 2020). Giordano et al. (2020) also argue that despite the hierarchy focusing on source reduction, most of the research is focused downstream. While there are different versions of the food recovery hierarchy (see Teigiserova et al., 2020 on a Best Environmental Option-Waste Hierarchy), thus far, none have adequately addressed the issue of justice, and within the context of Canada, the colonial structure that has resulted in a regime of extraction.

Tensions within the food recovery hierarchy framework

Source reduction

The first level of the Food Recovery Hierarchy promotes source reduction**,** based on the goals of preventing food waste at the source. While other aspects of the Framework are easier to quantify, Mourad (2016) noted that prevention or source reduction is the least measurable category within the hierarchy. In a study analyzing the implementation of the waste recovery hierarchy in Europe, Giordano et al. (2020) found that despite clear recommendations to address source reduction, interventions based on the implementation of the waste recovery hierarchy in Europe (France and Italy) are focused on weaker interventions such as energy recovery or food donations.

For some, the objective of food waste prevention and source reduction would imply pushing towards systemic solutions to address the root problem of agricultural overproduction. Papargyropoulou et al. (2014) noted that food waste prevention would include practices such as producing only the necessary amount of food that would both cover global needs as well as safeguard food security. Despite scholars such as Godfray et al. (2010) and institutions such as the World Bank (2008) arguing that we need to produce anywhere between 70 to 100% more food by 2050 to address the challenge of feeding 9 billion people, we currently produce more food than is needed by the current population (Elinder, 2005; Holt-Gimenez et al., 2012). As Elinder (2005) argues, it is important to address the oversupply/overproduction of food driven by

agricultural subsidies and trade-distorting measures, which undermine agricultural sectors in the Global South (Organization for Economic and Cooperative Development, 2004).

Overconsumption is also another pressing issue. For example, between 1999 and 2000, per capita calories per person per day in the United States reached 3900 calories (Putnam et al., 2002), far beyond what is needed for a person with an active lifestyle (USDA, 2002). Prevention would entail challenging the global food supply chain and targeting certain agricultural subsidies on commodity crops such as corn and soy (Carolan, 2011), which have contributed to the prevalence of 'cheap food'. As Carolan (2011, p. 2) noted, the term cheap food refers to the "de-contextualization of food in its broadest sense" which includes collaterals such as pollution and resources extracted to grow the food. In the United Sates, on average, a decreasing amount of annual income is spent on food, with the percentage of disposable income spent on food dropping from 13.9 to 9.8 percent between 1970 and 2005 (Carolan, 2011). Cheap food enables overconsumption and is deceptive as it does not take fully into account the true cost of food production.

As noted by various scholars, the lack of clarity on what is meant by food waste prevention results from the fact that 'prevention' indicators are challenging to measure and are considered the least tangible (Gentil et al., 2011; Mourad, 2016). Thus far, food waste prevention studies have generally focused on raising awareness and encouraging individual behavioural changes, rather than structural changes in agricultural production (Mourad, 2016) or actual source reduction (Joshi & Visvanathan, 2019). The terms *food waste prevention* and *source reduction* have also been used to identify practices such as retail food donation (Schneider, 2013), which technically fit within the second level of the Framework's hierarchy (i.e., feeding people in need). From the household waste prevention scale, authors such as Cox et al. (2010) have used the example of home composting as a form of source reduction and prevention (which may understandably refer to source reduction of waste from landfills). Yet according to the Framework, this strategy is second to last in terms of desirability and is only one level above landfilling.

There is a dearth of efforts to address the complex problem of oversupply at the production stages within the context of source reduction/food waste prevention discussions and literature. Agricultural-level studies on food loss have focused on quantifying losses (Beretta et al., 2013; Ridoutt et al., 2010) or minimizing losses due to damage caused by pests during harvest (Treeamnuk et al., 2010). Few studies have explored the correlation between crop overproduction and food waste (Gille, 2012). However, studies focusing on individual and household food waste prevention such as meal planning, behavioural interventions, a grocery list, and portion planning are plentiful (Graham-Rowe et al., 2014; Quested et al., 2013; Stefan et al., 2013;van der Werf et al., 2018) This supports the assertion of Welch et al. (2018) and Swaffield et al.(2018) that the overall focus on consumers' role in food waste reduction reflects a neoliberal environmentalism paradigm, which focuses on turning to consumption (e.g., sustainable consumption) to solve the problems that are caused by consumption itself. This approach has been interpreted by scholars such as Maniates (2001) as allowing governments and

institutions to abdicate their responsibilities in changing the system. A deeper engagement with source reduction and systemic solutions would require addressing questions of land distribution, access to food, discriminatory agricultural practices, farm labour, the type of food being produced and commoditized, and speculation, as well as unjust trade distortion or subsidies (Soma et al., 2021).

Feeding people in need/ feed hungry people

The second most desirable option to manage food from becoming waste on the Framework is 'Feeding People in Need' or 'Feed Hungry People.' This solution is promoted to ensure that edible surplus food (i.e., food that is fit for human consumption) is donated or shared with people to alleviate hunger rather than having it wasted. At a glance, this solution has been promoted by proponents as a win-win solution (Macleod, 2015), as not only is food waste prevented, but those who are hungry benefit from the donated foods. In the effort to push retailers to donate food instead of discarding it, images of mountains of edible food wasted by corporate retailers have sparked an outcry and garnered significant media attention. For example, after the CBC (Canadian Broadcasting Corporation) investigated the contents of Walmart garbage bins, they found large amounts of discarded food well before the best-before date, most of which was still in its packaging (Mancini &Vellani, 2016).

Concerns over perfectly edible food going to waste have resulted in calls to improve processes for donating, and proposals to develop a food waste tax incentive (National Zero Waste Council, 2016). However, this seemingly desirable solution has also been criticized from a social justice angle and by anti-poverty activists (Patel and Saul, 2017). Caplan (2017) argues that these types of food 'solutions' to hunger contribute to hunger's normalization as well as the idea of people as 'waste' infrastructure (Soma, 2017b; Yates, 2011). There are numerous limitations with respect to using wasted food to feed hungry people (Millar et al., 2020). When this approach is scaled up or replicated, it absorbs infrastructural investments that would be better used to develop long-term solutions to better wages, or to invest in closed-loop systems. As Fisher (2017) noted:

> Donors want free waste removal, convenience, a tax deduction, and the halo effect that accompanies hunger relief efforts. Donors do not want to be judged about the quality of the food they provide. Food bankers fear that if they decline a product the donor will not deliver other desirable items. (p. 53)

There is stigma (Riches, 2002) in offering people foods that corporations have deemed as 'waste'. There are also concerns that the food charity approach has been promoted to invest in practices and infrastructures that divert attention away from the need to focus on food waste prevention or source reduction, as well as that free surplus food distribution may be used to scale up programs such as food banks that have limited use for long-term impacts for food security

(Riches, 2018; Tarasuk et al., 2014). As Giles (2015) argues, under the current economic and industrial food system, "the work of making waste itself becomes a source of economic value" (p. 82). In summary, the work of waste-making is reflected in the logistics around corporate surplus food, that is then categorized as 'waste', which in turn becomes a source of economic value for hunger-relief organizations and a source of corporate social responsibility.

There are other approaches to food accessibility that are not predicated on a two-tiered food system where one group has the privilege of choice, and the other group relies on whatever food is provided to them. Food sharing (Lazell, 2016; Lazell et al., 2018) via apps such as OLIO to support community-based sharing practices is another example where food can be redistributed. While food sharing between residents, neighbours and households may not have the stigma associated with food banks, there are still limitations due to issues of trust and concerns for food safety (Lazell, 2016). Scale matters when taking into account the prescription to feed hungry people. When it comes to efficiency and equity of common resource use, addressing the issue of scale is particularly relevant (Giordano, 2008). While encouraging individuals to share extra food is commendable and distributing surplus food to individuals in need is preferable to disposing of it in the landfill, if the issue of scale is not addressed, neither of these interventions will result in efficient waste reduction or effectively address the issue of food insecurity. Moreover, without considering scale, this intervention level may conflict with the priority of food waste prevention.

Feeding animals

Third from the top of the Food Recovery Hierarchy is feeding animals. In general, according to Leib et al. (2016), food that is still edible for humans should continue to be consumed by humans. However, when food is no longer edible for humans but is safe for animal consumption, the next best option according to the hierarchy is to feed it to animals.

In his seminal book *Waste: Uncovering the Global Food Scandal,* Tristram Stuart, a farmer, activist, and freelance writer noted how the massive supply of free excess food from bakeries and markets were a boon for pig farmers due to the expensive cost of pig feed. When he reflected upon the fact that most of the food he collected was actually fit for human consumption, he recognized that feeding food waste to animals did not address the root cause of the problem (Stuart, 2009). While the pre-industrial or agroecological practice of feeding food scraps to animals is an important part of a closed-loop food system, the scale of industrial agriculture and the industrial food system has made what may be a simple practice more complicated for food-safety purposes. In the current industrial context, food scraps are not necessarily scraps from derived farm produce such as corn husks or vegetables trimmings. In Las Vegas, food scraps used for animal feed might include massive amounts of uneaten meat, bread, vegetables and desserts sourced from all you can eat buffets at restaurants and hotels, 22 million pounds of which are sent for pig feeds each year (Spector, 2012). Food scraps in the context of animal agriculture could also entail the feeding of processed animal by-products, such as ground

up cattle from the remnants of industrial scale slaughterhouses, to animals that are naturally herbivores (Alali & Ricke, 2012). Thankfully, this practice has declined since the 1980s due to disease outbreaks such as foot-and-mouth disease and mad cow disease connected to leftovers or by-products containing untreated infected meat being used for animal feed (Canadian Food Inspection Agency [CFIA], 2015; DEFRA, 2002; Leib et al., 2016). It was not until 1997 that mammalian proteins consisting of skulls, brains, eyes, tonsils, spinal cords, dorsal root ganglia, trigeminal ganglia were prohibited for animal feed (CFIA, 2015).

Feeding food scraps to animals can save farmers and businesses money as well as divert a significant amount of food waste from landfills (Leib et al., 2016). However, there is very little research that evaluates or audits whether or not the food given to animals is actually still fit for human consumption and if so, how scholars and policy makers can provide better recommendations to reduce and prevent avoidable food waste at the source. Secondly, there are also health consequences for animals due to the prevalence of rapidly digestible baked goods and carbohydrate overload in the feed, causing a type of illness called acidosis in ruminants consuming high levels of carbohydrates (Morgante, 2002).

Beyond cattle, there is also the potential to reduce livestock waste or divert scraps to feed black soldier flies, which in turn can be fed to chickens and to fish in aquaculture, (St-Hilaire et al., 2007). It is argued that feeding black soldier fly larvae to fish can improve the sustainability of aquaculture (Diener et al., 2009), which at the industrial scale is extremely wasteful due to its practice of feeding wild fish to farmed fish, the destruction of mangrove forests to make way for shrimp and tilapia farms, heavy use of antibiotics, and even violence between corporations and the poor living in coastal communities (Islam, 2014). To reiterate, while feeding animals food scraps is a critical component of a circular economy and a closed-loop food system, concerns around animal health, the industrial scale of animal feed operations, and animals' natural diet should also be addressed. Attempts to prop up an animal agriculture system (e.g. intensive livestock operations and industrial slaughterhouses) by feeding food waste to animals are tenuous, often contributing to unnecessary and unwanted consequences such as antibiotic resistance and pathogens, poor animal welfare and labour, and massive environmental pollutants (Weis, 2013), all of which are not conducive to long-term sustainability or a just closed loop food system.

Industrial purposes (biogas, rendering)

Fourth from the top of the Food Recovery Hierarchy, only two steps above landfilling, is recovering food waste through industrial purposes. In this case, the EPA Food Recovery Hierarchy identifies the rendering of waste oils for fuel conversion and the use of food scraps as feedstock for digestion as legitimate ways to recover energy so that it is not 'wasted'(EPA, nd). Industrial agriculture and animal farming in particular, result in substantial waste throughout the supply chain, starting from animal rearing and feeding, slaughtering and processing (Mekonnen et al., 2016). As Mekonnen et al. (2014) argue, the scale of modern industrial animal agriculture

produces a significant amount of by-products via slaughter, which are considered by the industry as non-edible portions. The rendering industry collects and processes these by-products such as hide, skin, fats, oil, blood, and feathers, which are then transformed into ingredients for the cosmetic industry, feed additives, industrial commodity chemicals, biofuel, and pharmaceuticals (Mekonnen et al., 2014). In 2013 alone, the North American rendering industry recycled 27.8 million tonnes of perishable by-products from the beef, pig, and poultry industries as well as supermarkets, food processing facilities and restaurants (Mekonnen et al., 2014). Protein by-products such as feather meal, bone meal, meat and blood meal are utilized in pet food, aquaculture, and industrial livestock feed.

Without the rendering industry, there would be a massive waste crisis in the industrial animal agriculture sector as it would be impossible to manage the disposal of by-products from industrial-scale slaughter. While the process of rendering may kill various forms of bacteria such as *Salmonella, Listeria monocytogenes*, etc. (Troutt et al., 2001), it does not inactivate the transmission of bovine spongiform encephalopathy (BSE) or mad cow disease (Meeker &Hamilton, 2006). At the scale at which industrial animal agriculture operates, the restriction and limitations on certain cattle tissues have resulted in a significant loss of economic value. Due to Canada's limitations on Specified Risk Materials (SRM) from ruminants, it is estimated that more than three hundred thousand tonnes of rendered SRM materials that were once sold as meat or bone meal are now landfilled (Mekonnen et al., 2014).

Food waste can also be used to generate biogas through anaerobic digestion. While industrial uses such as biogas are seen as less preferable than feeding food waste to animals, depending on the characteristic of the food product (specifically water and energy content), anaerobic digestion may result in lower greenhouse gas (GHG) emissions than using the food for animal feed (Eriksson et al., 2015). Biogas is used for electricity and as thermal energy (Gilroyed et al., 2010). The conversion of waste protein to energy destroys BSE-causing prions and pathogens; the final product may take the form of pellets, liquid fertilizers, inedible tallow, and biogas (Somerville et al., 2009; Mekonnen et al., 2014).

Currently, the growth of the biogas industry is served by the growth of food waste produced by hotels, restaurants, and companies, as well as population growth (Zhang et al., 2014). The process of anaerobic digestion uses anaerobic bacteria to break down food waste and convert the organic materials into biogas (methane). Regulations such as landfill bans on organic waste and climate change mitigation policies may help support the growth and investment in biogas industries (Levis et al., 2010). For example, the province of Nova Scotia has enacted a landfill ban on organic waste, which has been in place since 1998 (Friesen, 2000). MacRae et al. (2016) noted that despite the landfill ban, Nova Scotia is facing challenges in sending food waste to biogas facilities as there is a lack of infrastructure to absorb the materials. It is important to note that biogas companies face steep competition from other sectors competing for the product. MacRae et al. (2016) noted that it would cost a major Canadian retailer $2385 to divert food waste to an anaerobic digestion facility, compared to $1323 for animal feed, $897 for on-site composting, and $0 for donations. Eriksson et al. (2015) concluded that the properties of

individual food products (e.g., whether they have a higher water or energy content) influence which waste management option is more favourable. Scale matters with respect to the use of food waste for industrial purposes, as the scaling up of this energy source might contribute to a deviation from food waste prevention. Source reduction of food waste would result in the collapse or scaling down of industries reliant on food waste as a source of wealth generation and growth for their industry. Anaerobic digestion, therefore, should be focused on processing non-avoidable food waste (or food scraps) rather than avoidable food waste.

Composting

Just above landfill and incineration in terms of desirability in the Food Recovery Hierarchy Framework is composting. Composting turns organic waste into a resource for food production in the form of a soil amendment (Sidder, 2016). Composting and in turn compost itself is a vital component of an integrated, sustainable waste management program and sustainable agriculture. In fact, composting has been promoted as one of the most feasible tools to address the management of organic waste since it reduces the waste that would otherwise go in landfills (Hoornweg et al., 1999).

Composting has the potential to provide numerous benefits: serving as a natural soil amendment for agriculture; creating employment opportunities; generating additional income for municipalities/communities that run composting programs; diverting waste from landfills; and providing a relatively inexpensive process to manage organic waste, especially at the smaller scale (Hoornweg et al., 1999; Nunan, 2000). However, the efficacy and success of composting initiatives hinge on successful waste segregation (i.e., source separation of organic waste from other waste), especially at the municipal level where household waste is often mixed. Composting, depending on its scale and approach/methodology (e.g., windrow versus worm composting, industrial composting versus home composting) can look very different.

Community-based composting is a decentralized approach to waste management that is diverse in its scale and involves various stakeholders. In decentralized composting projects, government authorities take a hands-off approach and require the community to manage its own waste collection. With the increase in the types and complexity of waste, it has become more difficult for modern residents to practice composting. For example, in Indonesia residents noted that with the rise of modern packaging, their traditional practice of composting organic waste or burying organic waste has become difficult (Soma, 2017a). In addition, farmers' willingness to pay may be reduced, as those wishing to use compost have to compete with subsidized chemical fertilizers (Rouse et al., 2008).

In the case of Ontario, Canada, there are many barriers to developing a community-based composting program. Even at a small to medium-scale, compost operators would need to go through very costly approval processes. In Ontario, the Environmental Protection Act categorizes compost feedstock as waste product rather than as a 'resource', which then requires those interested in managing compost to obtain an Environmental Compliance Approval (ECA) for a

waste disposal site prior to handling or processing waste (Vidoni, 2011). While it is unlikely that a community garden managing its own organic waste and then composting on site would need the ECA, should they bring in any outside materials (for example, coffee grounds from a corner café or food scraps from a neighbour), they would be prohibited from doing so.

In an ideal context, community-based composting will result in a reduction of energy required to transport waste long distance. However, the current policy landscape poses regulatory and financial barriers for interested small to medium-scale entrepreneurs. A study by Adhikari et al. (2010) found that if urban organic wastes are treated via home/community composting, waste management costs could be reduced by 34% for Canada. In comparison to centralized composting, on-site composting can reduce GHG emissions by 40% for Canada (Adhikari et al., 2010).

While centralized composting may result in more residents/households participating, the actual quality of the compost feedstock might be compromised due to improper source segregation. In fact, studies have shown the impact of various contaminants in the content of compost. As Zhou et al. (2013) noted, contaminants in compost feedstock from centralized facilities include alkaline batteries, galvanized nails, zinc-plated screws, copper wires, and cables. At the most basic level, composting is a simple, low-cost option to turn nutrients from food scraps into a soil amendment that can then be used to improve soil and consequently food production. However, there are numerous regulatory and financial barriers that would negatively impact the quality of the compost or the long-term financial feasibility of smaller-scale enterprise. Most importantly, the role of food packaging, as it contributes to a waste crisis and changes the regimes of urban waste management (Hawkins, 2012), makes the practice of composting difficult due to contamination of feedstock (composting materials) and an added layer of complexity for waste segregation. It is also important to ensure that industrial-scale composting does not encourage the wasting of food (i.e., a licensing effect). For example, one study by Qi and Roe (2017) found that when consumers are informed that food waste will be composted, the food waste generated is significantly greater, which undermines food waste reduction efforts. Therefore, a critical food guidance should recognize the important role of composting as part of a regenerative food system, while acknowledging the context of scale and the type of materials being composted to ensure that this intervention does not impinge upon efforts to reduce food waste.

Landfill/ incineration

The last resort and the least desirable option in the Food Recovery Hierarchy is landfill and/or incineration. Despite being the least preferable option, it is telling that landfilling and incineration are normalized as an option in the management of food waste. While some scholars might assume the Framework is circular, the inclusion of the landfilling is inconsistent with the

concept of circularity. A circular food system or a circular economy designs waste out of the system; landfilling is reflective of linearity. Although food is biodegradable, when thrown in the landfill it is often placed in plastic garbage bags, generating the greenhouse gas methane as it degrades in an environment without oxygen (anaerobic). Methane gas is more potent than carbon dioxide in contributing to climate change, and it is estimated that a head of lettuce discarded in the landfill would take approximately 25 years to decompose (Rathje and Murphy, 2002; Rothman, 2014). Food waste in the landfill also contributes to toxic leachate. Canada has primarily relied on landfills to deal with the management of solid waste, which also includes food waste (Taylor, 2009). Landfilling is an unacceptable approach to deal with modern wastes, many of which are no longer biodegradable, are toxic, and have long lifecycles (for example, plastic). Moreover, borrowing Liboiron's discourse on plastics waste whereby "disposable plastics are simply not possible without colonizer access to land" (2018, np), disposability of food in landfills is also based on colonizer access to land.

Landfill siting is problematic as it often reflects "environmental racism" (Agyeman et al., 2016, p. 323). For example, in the United States, there is considerable evidence that toxic waste facilities or landfills are often located in predominantly black and low-income communities (Agyeman et al., 2016). In Canada, this is also the case with waste and pollution disproportionately impacting Indigenous communities (Mascarenhas, 2007). While landfilling is the predominant method to manage food waste in most municipalities, especially smaller municipalities with a lack of centralized composting or food waste diversion option, this will increasingly change with the growth of diversion programs as well as organic waste bans in landfills such as in British Columbia (City of Vancouver, 2015).

Although Canada's commitment to reduce the amount of waste landfilled in Canada is commendable, the impact of distancing, as in the separation of primary resource extraction from final consumption decisions (Princen, 2002), means that most of the public do not understand or will not experience the direct consequences of their consumption decisions. Another important fact is that Canada's waste does not necessarily stay in Canada. It has been well documented that countries of the Global North, including Canada, ship their waste internationally and often to countries in the Global South (Clapp, 2002).

This particular issue of shipping waste to the Global South created an international scandal when Prime Minister Trudeau was confronted on his official visit to the Philippines with the call to 'repatriate' 103 shipping containers full of Canada's rotting waste that were sent to the Philippines. The Philippine case is an example of the impact and consequences of waste distancing, as the Canadian waste was shipped to the Philippines under the guise of 'recyclable goods' (which is permitted under the Basel Convention) when it was actually household trash and landfill materials (Blatchford, 2017). In essence, the Food Recovery Hierarchy Framework should not be including landfilling as an option when the objective of the hierarchy is to better manage or reduce food waste. As the food recovery hierarchy does not address context, scale, or values, I will demonstrate an alternative food guidance towards re-valuing food and preventing food waste.

Case study in critical food guidance: food systems lab

An alternative approach to the dominant Food Recovery Hierarchy Framework is provided by the case study of the Food Systems Lab social innovation pilot project in Toronto. This alternative framework to address the issue of food waste is centered on the values of reconciliation and justice in the food system. Concepts such as food justice (Alkon and Agyeman, 2011), Indigenous food sovereignty (Kepkiewicz and Rotz, 2018; Morrison, 2011) and just sustainability (Agyeman & Evans, 2004) inform this approach to addressing food waste that seeks to re-frame how people value food, animals, the land, and each other. Developed after the social innovation process, the framework also seeks to better ensure the inclusion of diverse voices in developing food waste prevention and reduction policies and moves beyond the concept of a circular economy to emphasize the social justice component. Some of the quotes shared in this paper are included in the Food Systems Lab Design Brief (Food Systems Lab, 2016).

The Food Systems Lab was launched in 2016 as the first food-waste-focused social innovation lab in the Greater Toronto Area (GTA), Canada. Social innovation was selected as a methodology as it promotes deep engagement rather than one-way consultation. As Westley and Antadze (2010) identified:

> Social innovation is a complex process of introducing new products, processes or programs that profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which the innovation occurs. Such successful social innovations have durability and broad impact (p. 2).

Social innovation was selected as a methodology and a tool for engaging stakeholders as it offers an innovative way to deal with complex challenges (Rittel and Webber, 1973). The lab started in September 2016 and was completed in June of 2017. It commenced with 47 key informant interviews to better understand the food landscape in the City of Toronto, and three social innovation workshops with a total of 92 stakeholders across the food system. The stakeholders consisted of both urban and rural farmers; a migrant farm worker; food bank recipients; representatives of various not-for-profit organizations; Indigenous members/elders; policy makers at the provincial and municipal levels; small to large-scale businesses in the retail, food processing and restaurant sector; academics; and members of faith communities.

Three workshops were held: *Seeing the System* in November 2016; *Designing Solutions* in March 2017; and *Prototyping* in June 2017. The workshops included traditional Indigenous teachings, learning circles with Indigenous leaders and Elders, and participation in smudging, all centered around the All My Relations teaching. The first workshop aimed to better understand the root causes of the food waste problem and the various political, economic, and regulatory

forces that have led us to the current problem. The convening question -a question posed in a social innovation lab to gather stakeholders together to address a problem- was "How can we reduce food waste while ensuring that food is accessible, affordable and that we support a vibrant food sector?" (Food System Lab, 2016). Several stakeholders found this question problematic. For example, one stakeholder noted:

> The key isn't that food is unaffordable, but that people's other expenses are so high and non-variable. You can't skip out on paying rent. People often sacrifice food in favour of fixed expenses like rent, heat, or electricity. (Food Bank representative)

The quote above from a food bank representative clearly identifies the need to disrupt the two-tiered food system. Accordingly, when addressing the paradox of food waste and food insecurity in Canada, the solution is therefore not to simply move unwanted foods to 'feed hungry people' as identified by the food recovery hierarchy, but rather, to address root causes such as economic injustice. In envisioning solutions to reduce and prevent wasted food in a way that is dignified, collaborative and just, the key is to create a new relationship based on respect and reciprocity of peoples, beliefs, and cultures, as one Indigenous Elder noted:

> I look forward to the day that I can sit in the circle with our brothers and sisters from Europe and they will say, hey, this is our ceremony, this is how we did food work. I look forward to that day because it will be reciprocal.

Another stakeholder, a chef for a community organization, also noted the importance of health in transforming surplus food for community members as well as the need to preserve an individual's dignity:

> ….I believe in the dignity of people and the respect for a human being. Serving garbage, highly processed food, and rotten food for anybody is disrespectful. I do not serve any food here that I wouldn't give to my son. I serve everybody here like I serve the person who I love the most in the world. (Chef)

The final workshop culminated with connecting all of the learnings in the lab through the All My Relations principle. This teaching promotes respect for all beings and views plants and animals as relations and not as commodities. Moreover, the principle challenges the structural and systemic weaponization of food against marginalized and particularly Indigenous peoples. The Special Advisor to the Lab Melanie Goodchild (Anishinaabe from the Biigtigoong Nichanaabeg First Nation) taught everyone in the Lab to reflect on food as medicine:

> Food is nurturing, and in our traditional teachings, food is also medicine, it's one of the medicines. And food sources are our relatives. So you

> don't hunt elk, deer and bison, they give their life to you, to give you life and that's a reciprocal relationship. And when you die, you're put back in the ground because you are giving life to them as well….the relationship and the value of food as a relative might hold some insights for people who are working to reduce food waste.

As the Lab was embedded in a process of decolonization and reconciliation through the integration of Indigenous ceremony, the voices of Indigenous special advisors, elders, Indigenous foods (catered), and an Indigenous expert who assessed the solution pitches, it became evident that the options offered by the Food Recovery Hierarchy framework are insufficient. The Framework offers very little in terms of the relationality, interconnectivity, dignity, and the circularity that is offered by the All My Relations principle. While one participant did not find any issue with the Framework, in general, the long-term relationship building and educational approach of the workshops helped to bring diverse peoples toward common ground. The lessons learned from the Lab made it impossible to continue viewing the issue of food waste through a linear framework that neither accounts for, nor challenges the systemic and structural injustices existent within the current industrial food system. At the final Lab workshop, through various iterations, and having discussed the findings from the workshop, it became clear that it is imperative to take a holistic approach to analyzing the food system. Therefore, the Lab research team developed a diagram representing the values that are needed and the elements that should be considered to address the issue of food waste in a systemic, just, and decolonizing approach. Rather than hierarchies, this alternative diagram is based on the values that can assist in shaping a more just and closed loop food system. Each value is interconnected (hence loops to the centre, rather than disparate levels). The definition of a closed loop food system based on the social innovation lab is the following:

> We define a closed-loop food system as a system that generates no waste and is governed with the commitment to food as a right, acknowledging the interconnectedness of all parts of the ecosystem and inculcating respect for all of its inhabitants.

As identified above by the participants and food leaders, central to the removal of waste and injustice from the food system is the resolution of economic issues endemic in the food system. Further, it is necessary that the harm of colonization is acknowledged and addressed through decolonization and reconciliation based on respectful relationships. The correlation between community health and the provisioning of nutritious food is also an integral part of a just and vibrant food system. Other values identified include systems thinking to understand connectivity (plant, animals, human, land, environmental relations, impact of solutions), and the need to reconnect/relearn the knowledge and food literacy that has been disrupted by colonization. Through the teachings of the Indigenous Elders and leaders, many of the non-Indigenous participants including the Lab team members had the opportunity to learn critical principles and

values needed to transform the food system. In comparison to the hierarchy, the closed loop food system diagram is based on the recognition that all the elements of the values need to work together and be treated holistically to achieve the objective, as opposed to being viewed within silos.

Figure 2: Values that feed into a closed-loop food system

(diagram developed by Kelsey Carriere)

The first value of *resilient and just economies* is based on the need to support financial and infrastructural investments for small- and medium-scale growers, fishers, ranchers, food processors, distributors, retailers, entrepreneurs, and those who employ fair and just labour practices to operate within the principles of a sustainable circular economy. Simply diverting food waste from one preferred level to another level without addressing the root causes of an unjust food system is problematic, resulting in the marginalization of some groups.

The next step in the process of *reconciliation* is to reiterate the importance of acknowledging and recognizing the injustices meted out to Indigenous communities and other global populations as a result of colonization and unjust trade laws. Reflecting on the earlier

premise noted by Liboiron (2021), without addressing and acknowledging the harm of colonization, land will continue to be treated as a landfill and the industrial and extractive food system will continue. Governments should reverse the chains of discrimination and oppression by supporting Indigenous knowledge and food sovereignty, land and wealth redistribution, and promoting principles such as All My Relations and Seven Generations. These values are necessary because they counter the commodification of food, which results in waste.

The diagram also acknowledges that a closed-loop food system should promote the value of *health*. Unwanted foods are often not suitable for human and animal consumption, which have adverse effects upon overall health and well-being. Creating value-added foods that are highly processed and derived from 'wasted foods' entail an unacceptable trade-off between health and food waste reduction. The value of health challenges the production of ultra-processed foods, which are not only wasteful, but also reliant on the overproduction of cheap and highly subsidized commodities.

The value of *systems thinking* acknowledges interconnectivity in our food system and accordingly encourages innovation and creative approaches to growing, cooking, processing, and food recovery that counters the linear 'take, make, and dispose' mentality. Systems thinking is also critical for understanding how solutions based on short term thinking exacerbate current issues or result in the creation of further issues.

The e*nvironmental* value is reflected by approaches to sustainability that respect biodiversity and nutrient recycling to build the foundation of a healthy soil. The current industrial food system is disconnected and does not necessarily provide the opportunity to properly cycle nutrients back to regenerate the soil. A regenerative agricultural approach may include agroecological practices that integrate animals in a way that that is complementary.

Finally, the value of *education* is premised on the concept of food literacy, in that all generations should know how to sustainably grow, cook and preserve food, and manage organic waste. Knowledge of plants, seeds, animals, and the natural environment will empower people to make decisions beyond the confines of 'best before' date labelling. Critical food literacy education and pedagogy can help transform values around food (Sumner, 2016) and can be implemented through farm to school programming, supporting Elders, and other school or university-based programs.

Figure 2 serves as an example of critical food guidance, as it clearly illustrates a set of relevant criteria that interact to create a paradigm for preventing the wasting of food. In addition, a values-based guidance lays out the principles that challenge the commodification of food by recognizing the need to address the inequalities in the food system due to colonialism and unjust trade. A key feature of this closed-loop model that distinguishes its approach from the Food Recovery Hierarchy is that it includes values rather than a hierarchy of strategies, and that it is circular and interconnected rather than linear. As such, it can serve as a critical guide for communities by focusing on the elements that are necessary to build a foundation for a sustainable food system.

Conclusion

First in the Food Recovery Hierarchy, and the most desirable option to the capitalist logic of overproduction, is source reduction. To address source reduction systematically, it is important to understand the principles and paradigm (colonization, imperialism, capitalism) that serve as the foundations of industrial agriculture. Practices that promote overproduction, unjust subsidies that benefit the rich while crippling the poor, and the exploitation of natural resources, biodiversity, and labour, all shape our current food system which results in the paradox of food waste amidst hunger, and starvation amidst plenty (Patel, 2007; Soma et al., 2021). The consolidation of wealth through land dispossession, speculation, discrimination, and commodification are not challenged under the dominant Food Recovery Hierarchy Framework, as it does not address or embed concerns around social justice within the framework.

From a technical perspective, a better understanding of the quality and categories of foods that go into pig swill or ruminant feed will also allow for a better assessment in regard to the appropriateness of certain types of foods for animal feed and the appropriateness of these industrial feeds to an animal's natural diet. It is also important to understand the composition of feedstock (type of food wasted) provided to biogas companies, as source reduction and prevention of avoidable food waste should remain a priority.

This paper cautions food waste scholars, activists, and policy makers who are currently working on this issue: solutions and policies that are not premised on justice, and that do not challenge the industrial food system, regardless of whether they technically divert or reduce the amount of food wasted in landfills, have the potential to lead to other systemic problems. Overall, this paper argues that a critical food guidance calls for a more holistic approach based in values that support a closed-loop system. Our model was derived from a participatory workshop that integrated social justice and Indigenous teachings. This becomes an entirely different paradigm for critical guidance on food waste, which has yet to be widely tested.

Conflict of interest declaration: The author has no conflict of interest to declare.

Acknowledgements: I would like to thank Belinda Li, Kelsey Carriere and Rafaella Gutierrez for their support. Thank you also to all of the participants of the Food Systems Lab and the peer reviewers who provided extensive feedback. I would like to acknowledge the Pierre Elliott Trudeau Foundation-Targeted Areas of Inquiry Grant for funding support. This study was completed in Toronto, located on the traditional territory of many nations including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee and the Wendat peoples and is now home to many diverse First Nations, Inuit and Métis peoples.

References

Adhikari, B. K., Trémier, A., Martinez, J., & Barrington, S. (2010). Home and community composting for on-site treatment of urban organic waste: perspective for Europe and Canada. *Waste Management & Research*, *28*(11), 1039-1053.

Agyeman, J., Schlosberg, D., Craven, L., & Matthews, C. (2016). Trends and directions in environmental justice: From inequity to everyday life, community, and just sustainabilities. *Annual Review of Environment and Resources*, *41,* 321-340.

Agyeman, J., & Evans, B. (2004). 'Just sustainability': the emerging discourse of environmental justice in Britain? *Geographical Journal*, *170*(2), 155-164.

Alali, W. Q., & Ricke, S. C. (2012). The ecology and control of bacterial pathogens in animal feed. In J. Fink-Gremmels (Ed.) *Animal Feed Contamination: Effects on livestock and Food Safety* (pp. 35-55). Woodhead Publishing Limited.

Alkon, A. H., & Agyeman, J. (Eds.). (2011). *Cultivating food justice: Race, class, and sustainability*. MIT Press.

Beretta, C., Stoessel, F., Baier, U., & Hellweg, S. (2013). Quantifying food losses and the potential for reduction in Switzerland. *Waste Management*, *33*(3), 764-773.

Blatchford, A. (2017). Filipinos urge Trudeau to take out Canadian trash still festering in Manila. *CBC News.* https://www.cbc.ca/news/politics/trash-manila-trudeau-1.4400622

Canadian Food Inspection Agency CFIA. (2015). About Canada's Enhanced Feed Ban. http://www.inspection.gc.ca/animals/terrestrial-animals/diseases/reportable/bse/enhanced-feed-ban/eng/1424374475489/1424374476208

Caplan, P. (2017). Win-win?: Food poverty, food aid and food surplus in the UK today. *Anthropology Today*, *33*(3), 17-22.

Carolan, M. (2011). *The real cost of cheap food*. Routledge Taylor Francis.

CEC. (2017). *Characterization and management of food loss and waste in North America.* Commission for Environmental Cooperation.

City of Vancouver. (2014). By-Law No. 11092: A By-law to amend Solid Waste By-law No. 8417 regarding organic waste. https://bylaws.vancouver.ca/consolidated/11092.PDF

Clapp, J. (2002). The distancing of waste: Overconsumption in a global economy. In T. Princen, M. Maniates,& K. Conca(Eds.), *Confronting consumption*, (155-176). The MIT Press.

Cox, J., Giorgi, S., Sharp, V., Strange, K., Wilson, D. C., & Blakey, N. (2010). Household waste prevention—a review of evidence. *Waste Management & Research*, *28*(3), 193-219.

DEFRA. (2002). Origin of the UK Foot and Mouth Disease epidemic in 2001. https://webarchive.nationalarchives.gov.uk/20130402184227/http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/fmd/documents/fmdorigins1.pdf

Diener, S., Zurbrügg, C., & Tockner, K. (2009). Conversion of organic material by black soldier fly larvae: establishing optimal feeding rates. *Waste Management & Research*, *27*(6), 603-610.

Elinder, L. S. (2005). Obesity, hunger, and agriculture: the damaging role of subsidies. *British Medical Journal*, *331*(7528), 1333-1336.

Eriksson, M., Strid, I., & Hansson, P. A. (2015). Carbon footprint of food waste management options in the waste hierarchy–a Swedish case study. *Journal of Cleaner Production*, *93*, 115-125.

European Commission. (2009). Regulation 1069/2009 of the European Parliament and of the Council of 21 October 2009 Laying Down Health Rules as Regards Animal By-products and Derived Products Not Intended for Human Consumption and Repealing Regulation (EC) 1774/2002 (Animal by-products Regulation). Official Journal of the European Union.

FAO. (2019). The State of Food and Agriculture. http://www.fao.org/3/ca6030en/ca6030en.pdf

Fisher, A. (2017). *Big hunger: The unholy alliance between corporate America and anti-hunger groups*. MIT Press.

Food Systems Lab. (2016). Design Brief. https://foodsystemslab.ca/wp-content/uploads/2016/12/Food-Systems-Lab-Design-Brief-FINAL.pdf

Friesen, B. (2000). Landfill ban stimulates composting programs in Nova Scotia. *BioCycle*, *41*(3), 53-53.

Garrone, P., Melacini, M., & Perego, A. (2014). Opening the black box of food waste reduction. *Food Policy*, *46*, 129-139.

Gentil, E. C., Gallo, D., & Christensen, T. H. (2011). Environmental evaluation of municipal waste prevention. *Waste Management*, *31*(12), 2371-2379.

Giancarlo, A. (2020). Indigenous student labour and settler colonialism at Brandon Residential School. *The Canadian Geographer/Le Géographe canadien*, *64*(3), 461-474.

Giles, D. (2015). The work of waste-making: biopolitical labour and the myth of the global city." In J.P. Marshall & L.H. Connor (Eds.). *Environmental change and the world's futures*. (95-109). Routledge.

Gille, Z. (2012). From risk to waste: global food waste regimes. *The Sociological Review*, *60*, 27-46.

Gilroyed, B. H., Reuter, T., Chu, A., Hao, X., Xu, W., & McAllister, T. A. (2010). Anaerobic digestion of specified risk materials with cattle manure for biogas production. *Bioresource Technology*, *101*(15), 5780-5785.

Giordano, C., Falasconi, L., Cicatiello, C., & Pancino, B. (2020). The role of food waste hierarchy in addressing policy and research: A comparative analysis. *Journal of Cleaner Production*, *252*, 119617.

Giordano, M. (2008). The geography of the commons: The role of scale and space. *Annals of the Association of American Geographers*, *93*(2), 365-375.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., Pretty, J., Robinson, S., Thmas, S.M., & Toulmin, C. (2010). Food security: the challenge of feeding 9 billion people. *Science*, *327*(5967), 812-818.

Gooch, M., Bucknell, D., LaPlain, D., Dent, B., Whitehead, P., Felfel, A., Nikkel, L., & Maguire, M. (2019). *The avoidable crisis of food waste: Technical report* Value Chain Management International and Second Harvest.

Graham-Rowe, E., Jessop, D. C., & Sparks, P. (2014). Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling*, *84*, 15-23.

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). *Global food losses and food waste*. Food and Agriculture Organization of the United Nations.

Hawkins, G. (2012). The performativity of food packaging: market devices, waste crisis and recycling. *The Sociological Review*, *60*, 66-83.

Hendriks, C. F., & Janssen, G. M. T. (2003). Use of recycled materials in constructions. *Materials and Structures*, *36*(9), 604-608.

Holt-Giménez, E., Shattuck, A., Altieri, M., Herren, H., & Gliessman, S. (2012). We already grow enough food for 10 billion people… and still can't end hunger. *Journal of Sustainable Agriculture*, 36(6); 595-598.

Hoornweg, D., Thomas, L., & Otten, L. (1999). Composting and its applicability in developing countries. *World Bank working paper series* 8.

Islam, Md S. (2014). *Confronting the blue revolution: industrial aquaculture and sustainability in the global south*. University of Toronto Press.

Joshi, P., & Visvanathan, C. (2019). Sustainable management practices of food waste in Asia: Technological and policy drivers. *Journal of Environmental Management*, *247*, 538-550.

Kepkiewicz, L., & Rotz, S. (2018). Toward anti-colonial food policy in Canada?(Im) possibilities within the settler state. *Canadian Food Studies/La Revue canadienne des études sur l'alimentation*, *5*(2), 13-24.

Lazell, J., Magrizos, S., & Carrigan, M. (2018). Over-claiming the Circular Economy: The missing dimensions. *Social Business*, *8*(1), 103-114.

Lazell, J. (2016). Consumer food waste behaviour in universities: Sharing as a means of prevention. *Journal of Consumer Behaviour*, *15*(5), 430-439.

Lee, K., & Soma, T. (2016). From “farm to table” to “farm to dump”: Emerging research on household food waste in the global south. In Anderson, C., Brady, J., and Levkoe, C (eds), *Conversation in Food Studies*, University of Manitoba Press, 243-266.

Leib, E., Balkus, O., Rice, C., Maley, M., Taneja, R., Cheng, R., Civita, N., Alvoid, T. (2016). *Leftover for Livestock: A Legal Guide for Using Food Scraps as Animal Feed*. Retrieved from: https://furtherwithfood.org/wp-content/uploads/2017/07/Leftovers-for-Livestock_A-Legal-Guide_August-2016.pdf

Levis, J. W., Barlaz, M. A., Themelis, N. J., & Ulloa, P. (2010). Assessment of the state of food waste treatment in the United States and Canada. Waste management, 30(8-9), 1486-1494

Liboiron, M. (2021). *Pollution is colonialism*. Duke University Press, Durham.

Liboiron, M. (2018). How plastic is a function of colonialism. *Teen Vogue*. Retrieved May 14th 2021 from < https://www.teenvogue.com/story/how-plastic-is-a-function-of-colonialism>

MacLeod, A. (Nov 13, 2015). Don't Reward Corporations for Donating Food Waste, Critic Says. *The Tyee*. Retrieved from: <https://thetyee.ca/News/2015/11/13/Corporations-Donating-Food-Waste/>

MacRae, R., Siu, A., Kohn, M., Matsubuchi-Shaw, M., McCallum, D., Cervantes, T. H., & Perreault, D. (2016). Making better use of what we have: Strategies to minimize food waste and resource inefficiency in Canada. *Canadian Food Studies/La Revue canadienne des études sur l'alimentation*, *3*(2), 145-215.

Mancini, M., and Vellani, N. (Oct 25, 2016). Here's how much food Walmart throws away over 12 days. *CBC Business*. Retrieved from: https://www.cbc.ca/news/business/marketplace-walmart-food-waste-1.3814719

Maniates, M. F. (2001). Individualization: Plant a tree, buy a bike, save the world?. *Global environmental politics*, *1*(3), 31-52.

Mascarenhas, M. (2007). Where the waters divide: First Nations, tainted water and environmental justice in Canada. *Local Environment*, *12*(6), 565-577.

Meeker D., and Hamilton C. (2006). *An overview of the rendering industry*. Alexandria, VA, USA: National Renderers Association.

Mekonnen, T., Mussone, P., & Bressler, D. (2016). Valorization of rendering industry wastes and co-products for industrial chemicals, materials and energy. *Critical reviews in biotechnology*, *36*(1), 120-131.

Millar, S., Parizeau, K., & Fraser, E. D. (2020). The Limitations of Using Wasted Food to "Feed Hungry People". *Journal of Hunger & Environmental Nutrition*, *15*(4), 574-584.

Morgante, Massimo. (2004). Digestive disturbances and metabolic-nutritional disorders. In Pulina,G,, and Benici, R. (Eds.). *Dairy Sheep Nutrition.*(165-190).

Morrison, D. (2011). "Indigenous food sovereignty: a model for social learning." In Wittman, H., Desmarais, A., and Wiebe, N (eds), *Food sovereignty in Canada: Creating just and sustainable food systems,* Fernwood Publishing: Halifax, 97-113

Mosby, I., & Galloway, T. (2017). "Hunger was never absent": How residential school diets shaped current patterns of diabetes among Indigenous peoples in Canada. *Cmaj*, *189*(32), E1043-E1045.

Mourad, M. (2016). Recycling, recovering and preventing "food waste": Competing solutions for food systems sustainability in the United States and France. *Journal of Cleaner Production*, *126*, 461-477.

Nunan, F. (2000). Urban organic waste markets: responding to change in Hubli–Dharwad, India. *Habitat International*, *24*(3), 347-360.

National Zero Waste Council. (2016). Tax Incentive for Nutritious Food Donations. Retrieved from: http://www.nzwc.ca/focus/food/tax-incentive/Pages/default.aspx

O'Brien, M. (2012). A 'lasting transformation'of capitalist surplus: from food stocks to feedstocks. *The Sociological Review*, *60*, 192-211.

Organization for Economic Cooperation and Development. (2004). *Agricultural Policies 2004: At a glance*. Paris: OECD.

Ontario. (2017). *Food and Organic Waste Framework*. Retrieved from: < https://www.ontario.ca/page/food-and-organic-waste-framework>

Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of cleaner production*, *76*, 106-115.

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical transactions of the royal society B: biological sciences*, *365*(1554), 3065-3081.

Parizeau, K., von Massow, M., & Martin, R. (2015). Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste management*, *35*, 207-217.

Patel, R., and Saul, N. (2017). Table scraps for the poor won't end poverty. *The Globe and Mail*. Retrieved from: https://www.theglobeandmail.com/opinion/table-scraps-for-the-poor-wont-end-poverty/article33784638/

Patel, R. (2007). *Stuffed and starved: The hidden battle for the world food supply*. Brooklyn, NY: Melville House.

Princen, T. (2002). Distancing: Consumption and the severing of feedback. In Princen, T., Maniates, M., and Conca, K (Eds.), *Confronting consumption*. (103-131). The MIT Press.

Putnam, J., Allshouse, J., & Kantor, L. S. (2002). US per capita food supply trends: more calories, refined carbohydrates, and fats. *Food Review*, *25*(3), 2-15.

Qi, D., & Roe, B. E. (2017). Foodservice composting crowds out consumer food waste reduction behavior in a dining experiment. *American Journal of Agricultural Economics*, *99*(5), 1159-1171.

Quested, T. E., Marsh, E., Stunell, D., & Parry, A. D. (2013). Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling*, *79*, 43-51.

Rathje, W., & Murphy, C. (2002). *Rubbish! The Archaeology of Garbage*. The University of Arizona Press, Tucson.

Reid-Musson, E. (2017). Grown close to home™: Migrant farmworker (im) mobilities and unfreedom on Canadian family farms. *Annals of the American Association of Geographers*, *107*(3), 716-730.

Riches, G. (2018). *Food Bank Nations: Poverty, Corporate Charity and the Right to Food*. Routledge Taylor Francis, UK.

Riches, G. (2002). Food banks and food security: welfare reform, human rights and social policy. Lessons from Canada?. *Social Policy & Administration*, *36*(6), 648-663.

Ridoutt, B. G., Juliano, P., Sanguansri, P., & Sellahewa, J. (2010). The water footprint of food waste: case study of fresh mango in Australia. *Journal of Cleaner Production*, *18*(16-17), 1714-1721.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, *4*(2), 155-169.

Roodhuyzen, D. M., Luning, P. A., Fogliano, V., & Steenbekkers, L. P. A. (2017). Putting together the puzzle of consumer food waste: Towards an integral perspective. *Trends in Food Science & Technology*, *68*, 37-50.

Rouse, J., Rothenberger, S., & Zurbrügg, C. (2008). *Marketing compost: a guide for compost producers in low and middle-income countries*. Eawag: Swiss Federal Institute of Aquatic Science and Technology.

Rothman, L. (2014). In today's landfills, food is embalmed for decades at a time. *Vice News.* Retrieved from:< https://www.vice.com/en/article/aeyxxz/in-todays-landfills-food-is-embalmed-for-decades-at-a-time>

Schneider, F. (2013). The evolution of food donation with respect to waste prevention. *Waste Management*, *33*(3), 755-763.

Sidder, A. (2016). The Green, Brown, and Beautiful Story of Compost. *National Geographic*. Retrieved from: https://www.nationalgeographic.com/people-and-culture/food/the-plate/2016/09/compost--a-history-in-green-and-brown/

Smil, V. (2004). Improving efficiency and reducing waste in our food system. *Environmental sciences*, *1*(1), 17-26.

Soma, T., Kozhikode, R., & Krishnan, R. (2021). Tilling food under: Barriers and opportunities to address the loss of edible food at the farm-level in British Columbia, Canada. *Resources, Conservation and Recycling*, *170*, 105571.

Soma, T., Li, B., & Maclaren, V. (2020). Food waste reduction: A test of three consumer awareness interventions. *Sustainability*, *12*(3), 907.

Soma, T. (2017a). Gifting, ridding and the "everyday mundane": the role of class and privilege in food waste generation in Indonesia. *Local Environment*, *22*(12), 1444-1460.

Soma, T. (2017b). Wasted infrastructures: Urbanization, distancing and food waste in Bogor, Indonesia. *Built Environment*, *43*(3), 431-446.

Somerville, R. A., Fernie, K., Smith, A., Andrews, R., Schmidt, E., & Taylor, D. M. (2009). Inactivation of a TSE agent by a novel biorefinement system. *Process Biochemistry*, *44*(9), 1060-1062.

Spector, D. (2012). See what happens to millions of pounds of Las Vegas buffet leftovers. *Business Insider*. Retrieved from: https://www.businessinsider.com/las-vegas-buffet-rc-farms-pigs-bob-combs-2012-7

St-Hilaire, S., Cranfill, K., McGuire, M. A., Mosley, E. E., Tomberlin, J. K., Newton, L., ... & Irving, S. (2007). Fish offal recycling by the black soldier fly produces a foodstuff high in omega-3 fatty acids. *Journal of the World Aquaculture Society*, *38*(2), 309-313.

Stefan, V., van Herpen, E., Tudoran, A. A., & Lähteenmäki, L. (2013). Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. *Food Quality and Preference*, *28*(1), 375-381.

Stuart, T. (2009). *Waste: uncovering the global food scandal*. WW Norton & Company.

Sumner, J. (2016). *Learning, food, and sustainability*. Palgrave Macmillan, New York.

Swaffield, J., Evans, D., & Welch, D. (2018). Profit, reputation and 'doing the right thing': Convention theory and the problem of food waste in the UK retail sector. *Geoforum*, *89*, 43-51.

Tarasuk, V., Dachner, N., & Loopstra, R. (2014). Food banks, welfare, and food insecurity in Canada. *British Food Journal*.

Tarasuk, V, Mitchell, A, Dachner, N. (2016). *Household food insecurity in Canada, 2014.* Toronto: Research to identify policy options to reduce food insecurity (PROOF). Retrieved from http://proof.utoronto.ca

Taylor, M. (2009). *Organic waste diversion in Canada*. Master of Public Policy Program Dissertation. Simon Fraser University.

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.

TRC. (2015). *Truth and Reconciliation Commission of Canada: Calls to Action.* Retrieved from: http://nctr.ca/assets/reports/Calls_to_Action_English2.pdf

Treeamnuk, K., Pathaveerat, S., Terdwongworakul, A., & Bupata, C. (2010). Design of machine to size java apple fruit with minimal damage. *Biosystems engineering*, *107*(2), 140-148.

Troutt, H. F., Schaeffer, D., Kakoma, I., and Pearl, G. G. (2001). *Prevalence of Selected Foodborne Pathogens in Final Rendered Products. Directors Digest #312.* Alexandria, VA: Fats and Proteins Research Foundation (FPRF), Inc

Urrutia, I., Dias, G. M., & Clapp, J. (2019). Material and visceral engagements with household food waste: Towards opportunities for policy interventions. *Resources, Conservation and Recycling*, *150*, 104435.

USDA. (2002). Estimated Calorie Needs per Day by Age, Gender and Physical Activity Level. Retrieved November 14th 2018 from: <https://www.cnpp.usda.gov/sites/default/files/usda_food_patterns/EstimatedCalorieNeedsPerDayTable.pdf

Van der Werf, P., Seabrook, J. A., & Gilliland, J. A. (2018). The quantity of food waste in the garbage stream of southern Ontario, Canada households. *PloS one*, *13*(6), e0198470.

Van der Werf, P., & Gilliland, J. A. (2017, May). A systematic review of food losses and food waste generation in developed countries. In *Proceedings of the Institution of Civil Engineers-Waste and Resource Management*, 170 (2): 66-77.

Vidoni, M. (2011). *Community Composting in Toronto: Closing the Food-Waste Loop*. Current Toronto Food Policy Council. Retrieved from: http://tfpc.to/wordpress/wp-content/uploads/2013/01/Community-Composting-in-Toronto-2012-DRAFT-reduced-1.pdf

Walmart Canada. (2018). The Walmart Foundation announces new round of grants available for Canadian organizations focused on reducing food waste. Retrieved from: <https://www.newswire.ca/news-releases/the-walmart-foundation-announces-new-round-of-grants-available-for-canadian-organizations-focused-on-reducing-food-waste-693478631.html>

Weis, T. (2013). *The ecological hoofprint: The global burden of industrial livestock*. Zed Books Ltd, London.

Welch, D., Swaffield, J., & Evans, D. (2018). Who's responsible for food waste? Consumers, retailers and the food waste discourse coalition in the United Kingdom. *Journal of Consumer Culture*, 1469540518773801.

Westley, F., & Antadze, N. (2010). Making a difference: Strategies for scaling social innovation for greater impact. *Innovation Journal*, *15*(2).

World Bank. (2008). *World Development Report 2008: Agriculture for Development,* World Bank, Washington, DC.

WRAP. (2009). Household Food and Drink Waste in the UK. Retrieved from: <http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf>

Yates, M. (2011). The human-as-waste, the labor theory of value and disposability in contemporary capitalism. *Antipode*, *43*(5), 1679-1695.

Zhang, C., Su, H., Baeyens, J., & Tan, T. (2014). Reviewing the anaerobic digestion of food waste for biogas production. *Renewable and Sustainable Energy Reviews*, *38*, 383-392.

Zhou, L., McCartney, D., Chen, W., Yu, S., Abboud, S., & Wichuk, K. (2012). The impact of various contaminants on the trace metal content of compost. *Compost Science & Utilization*, *20*(3), 156-164.