Retail food loss and waste reduction interventions: A scoping review

Caitlin Olauson Barlas,[a] * Wanda Martin,[b] and
  Alejandra Fonseca-Cuevas [c]
University of Saskatchewan

SPECIAL ISSUE

**Community-Based
Circular Food Systems**

Sponsored by
the Thomas A. Lyson Center
for Civic Agriculture
and Food Systems

Abstract
Globally, one third of food produced goes to
waste, which contributes to climate change, nega-
tively impacts air and water resources, and can lead
to environmental and human health risks. Mitiga-
tion efforts have surged in response to these stag-
gering statistics on food loss and waste, including
initiatives such as food rescue and upcycling pro-
grams. Circular economy practices are important
for a sustainable future. Limited literature is availa-
ble that compares different food rescue programs
worldwide and synthesizes considerations for plan-
ning new interventions. This paper is a scoping
review of peer-reviewed literature on programs and
interventions for food rescue and food waste
reduction that occur at the retail level. The search
in Scopus and Web of Science yielded 400 records
for studies published in the past 30 years. Analysis
of 18 full-text reports showed diverse food pro-
grams from the United States, United Kingdom,
Germany, Greece, New Zealand, Canada, Sri
Lanka, and Israel. Studies were conducted in vari-
ous settings, including restaurants, institutions, and
retail food stores. The collection methods of res-
cued food varied according to the program's capac-

[a] * *Corresponding author*: Caitlin Olauson Barlas, Graduate
Student, Department of Community Health and
Epidemiology, University of Saskatchewan; 107 Wiggins Road;
Saskatoon, Saskatchewan S7N 5E5 Canada; +1-306-966-6264;
caitlin.olauson@usask.ca;
 https://orcid.org/0009-0008-2084-7686

[b] Wanda Martin, RN, PhD, Associate Professor, College of
Nursing, University of Saskatchewan; 107 Wiggins Road;
Saskatoon, Saskatchewan S7N 5E5 Canada; +1-306-966-5429;
wanda.amartin@usask.ca;
 https://orcid.org/0000-0002-9774-1790

[c] Alejandra Fonseca-Cuevas, MPH, College of Nursing,
University of Saskatchewan; 107 Wiggins Road; Saskatoon,
Saskatchewan S7N 5E5 Canada; alejandra.fonseca@usask.ca;
 https://orcid.org/0000-0003-2908-8432

ity and included accepting donations, redistribution programs, and social enterprises. The results of these reports highlight some of the barriers that food rescue programs face, including logistical and workforce challenges, liability concerns, food availability, and financial restraints. Facilitators that promoted food rescue included the use of complementary technology, cooperative alliances, supportive policies, and favourable incentives. Report findings highlight the key role of volunteers, partnerships, and innovative technological solutions in advancing food rescue and waste reduction programs. Our research focuses on consolidating the lessons previously learned as a means of helping future food waste diversion programs overcome obstacles and improve operational efficiency. While food rescue is an important intermediary endeavour, addressing the root causes of wasted food and reducing inefficiencies in the current modern industrial food system is necessary to meaningfully reduce food waste at a global level.

Keywords
community-based circular food systems, food rescue, food upcycling, food reclamation, food redistribution, food waste, programs, scoping review

Introduction and Literature Review
Food loss and waste (FLW) encompasses all food that is grown, raised, caught, or harvested but ultimately not consumed (Environment and Climate Change Canada, 2019). In 2015, the United Nations (UN) identified 17 Sustainable Development Goals to improve education and health, stimulate economic growth, reduce inequality and combat climate change (United Nations, 2015). Among these targets, Goal 12 aims to ensure sustainable consumption and production patterns by decreasing half per capita global food waste at the distribution and consumer levels by 2030 (United Nations, 2015). According to the Food and Agriculture Organization (FAO), up to one-third of all food produced globally goes to waste with 14% of this waste occurring between harvest and retail (2019). FLW contributes to resource depletion and exacerbates climate change due to the potent greenhouse gasses created during landfill

decomposition (Bellemare et al., 2017). FLW can additionally negatively impact air and water sources, leading to environmental and health risks and thus classifying food waste as a global health issue (Environment and Climate Change Canada, 2019). In response, countries worldwide are exploring ways to mitigate the adverse effects of food waste while addressing sustainability challenges (Manzoor et al., 2024). Mitigation efforts often focus on recovering edible food before it reaches landfills as part of broader food waste reduction strategies. These initiatives, however, face significant challenges due to complex and systemic inefficiencies of the modern, industrial food system (Environment and Climate Change Canada, 2019). In 2019, Schroeder and colleagues identified how a circular economy approach can address overconsumption and waste challenges, as well as respond to the needs of waste management.

FLW is a "wicked problem," meaning it is a complex problem that is difficult to solve and is deeply interconnected with other societal, environmental, and economic issues (Coyne, 2005; Rittel & Webber, 1973). Wicked problems are characterized by interconnected elements that often include a high level of uncertainty and multiple, often conflicting, perspectives where simple solutions are not possible (Levin et al., 2012). Efforts to reduce FLW must, therefore, navigate competing priorities, such as food safety regulations, economic incentives for overproduction, consumer behaviour, and systemic inefficiencies in the global food supply chain (Hoehn et al., 2023; Ishangulyyev et al., 2019; Urugo et al., 2024). Addressing FLW requires interdisciplinary approaches at multiple levels and involves coordinated actions that address policy interventions, technological innovations, and community-driven solutions (Hecht & Neff, 2019; Urugo et al., 2024). Without acknowledging its wicked nature, programs designed to address FLW are at risk of being fragmented and can fail to create meaningful and lasting change. It is beyond the scope of this paper to synthesize a meaningful path forward to mitigate total food waste created throughout the system. The focus of this work instead intends to capture and clarify the scope of programs currently in operation that aim to address food recovery and redistribution with

the goal of highlighting what is working well and what gaps need to be addressed further.

Food diversion programs are not sufficient to address the full scope of the wicked problem of food waste, but they can act as a helpful interim measure until broader changes are made. Frameworks presented by the U.S. Environmental Protection Agency (U.S. EPA), such as the Food Waste Hierarchy and the Wasted Food Scale, have emerged, guiding different options for the management of food surplus in all steps of the supply chain (EPA, 2023). These frameworks highlight a prioritized pathway for food waste minimization to decrease edible food disposal (Papargyropoulou et al., 2014), which includes buying and serving only what is needed as the preferred prevention method, and landfill and incineration being the last choice (Papargyropoulou et al., 2014). Following EPA's Waste Food Scale, the second preferred method for food waste minimization is donation/ upcycling (EPA, 2023). Donation consists of rescuing and diverting safe and palatable food from the landfill and redistributing it to those in need (Reynolds et al., 2019). Examples of food rescue initiatives include making soup for donation, utilizing programs that use "ugly" and distressed products, and collecting surplus food from public events and farmers markets (Hecht & Neff, 2019). Alternatively, upcycling involves taking unused food and changing it or adding value to become a different product, such as making pasta from wasted spaghetti squash and fish patties from fish off-cuts (Thorsen et al., 2024).

Food rescue efforts have gained popularity in recent years as rates continue to rise for both food waste and the number of individuals universally experiencing food insecurity (Thyberg & Tonjes, 2016). Driven by the popularity of these efforts has been a simultaneous increase in published studies since 2008 of food waste diversion programs (Zhang et al., 2018), reflecting a growing awareness and urgency to address these complex food waste issues. Previous studies have identified different strategies and interventions for upcycling and food rescue (Lai et al., 2022), but there is limited literature comparing the various interventions to reduce food waste. Given the lack of available literature, opportunities exist to address the FLW problem

that profoundly impacts social and environmental concerns. One way that this can be changed is by applying new business models based on circular thinking, where retailers connect with charities, food recovery groups, and consumer groups (Schroeder et al., 2018). Using the concept of a circular economy, our research aims to understand how to best use food resources in a continuous process that reduces waste to zero (Cela et al., 2024) while addressing multiple needs through a multisector and multidisciplinary partnership. This scoping review aims to identify global food rescue and upcycling interventions, focusing on the resources used and outcome measurements employed to support ongoing efforts to reduce FLW. By highlighting existing gaps and opportunities, this review may inspire future food rescue program designs and simplify implementation for current initiatives, supporting collective learning and more effective FLW reduction.

Applied Research Methods
This study follows a scoping review methodology to systematically capture existing literature on FLW diversion programs and interventions. Our goal is to identify and analyze different types of existing FLW diversion programs, address barriers and facilitators to FLW recovery, and identify the various metrics used to quantify food recovery. The review process adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure transparency and methodological rigor.

Search Strategy
A preliminary exploratory search of literature on food rescue and upcycling programs and interventions was conducted to determine the scope of this review and potential keywords. This was conducted through a Google Scholar search using the terms "food rescue programs" and "upcycling food programs." Using the PRISMA framework for scoping reviews (Selçuk, 2019), our research involved identifying and synthesizing literature on programs that focus on food rescue or the reduction of food surplus and waste at the retail level, such as point-of-sale, prepared foods, and grocery store surpluses. One of the university librarians on our team devel-

oped a systematic search strategy using keywords from two main categories. The first category was Food Rescue: gathering rescuable food and redirecting it for human consumption (Hecht & Neff, 2019). Given the study's objective to focus on donation and upcycling methods for minimizing food waste, we also included upcycling under this definition. The second category was Programs: groups of people and resources aimed at achieving desired results, which includes activities to reach specific outcomes (Longest, 2004). To conduct a more comprehensive search, we included any additional terms that referred to activities aimed at improving human health, such as interventions, initiatives, and strategies (Smith et al., 2015). Keywords included "food rescue," "food upcycling," and "food reclamation," in combination with "programs," "initiatives," and "projects." Keywords in each category were joined by the Boolean operator "OR," while categories were joined by the operator "AND." We searched both the SCOPUS and Web of Science databases within a time frame of 1995 to 2024. This period was specifically chosen as the mid-1990s marked a significant shift in food waste diversion efforts, highlighted by the emergence of key policies, such as the adoption of the U.S. Bill Emerson Good Samaritan Food Donation Act in 1996, as well as increased sustainability initiatives focusing on environmental protection (Zhang et al., 2018). Choosing this timeframe enabled us to analyze long-term trends, capturing the evolution from early, policy-driven initiatives to the rapid expansion of food waste recovery programs in recent years, including the adoption of Sustainable Development Goals (SDG) 12.3 in 2015, which aims to reduce food waste by 50% (UN, 2015). Our specific search strategy is detailed in the Appendix, Table A1. Additional studies from the reference list were incorporated and marked as a *hand search* in the scoping review flow chart (Figure 1).

Study Selection and Eligibility Criteria
All identified citations were collated and uploaded to the Covidence web-based platform,[1] and duplicates were removed. The inclusion criteria for stud-

ies were as follows: (1) focused on food rescue or food surplus and waste repurposing; (2) conducted in settings at the retail level, such as point-of-sale, prepared foods (including restaurants, convention centres, or institutions such as post-secondary cafeterias), and grocery stores; (3) described or evaluated food programs, initiatives, projects, models, activities, or interventions; and (4) published in English. Exclusion criteria were: (1) studies conducted only on farms and/or gleaning (farms were included only if food was also collected from other locations defined in the selection criteria within the same study); (2) studies focusing on machine learning or algorithms; (3) studies on attitudes and perceptions of clients; and (4) reports, book chapters, commentaries, review articles, and opinion pieces. There were no criteria to identify specific countries therefore, we were able to capture the range of programs regardless of the geopolitical and socioeconomic status. Screening of the abstract and title and full-text review were conducted by two independent reviewers (C.O. and W.M.) against the inclusion criteria described previously. Reasons for excluding references were recorded and reported in the PRISMA flow chart (Figure 1). Disagreements between reviewers were resolved through discussion.

Data Extraction and Synthesis
To standardize the process and capture relevant details, including the intervention type and main outcomes, we designed and pilot-tested a data extraction framework on a sample of included references. Categories on the framework were modified and revised accordingly based on the pilot test. Data was extracted by two independent reviewers (C.O.B. and W.M.) using Covidence (*Covidence*, 2024), and compared and categorized to explore the range of interventions and how or if researchers have evaluated these interventions. From each reference, we retrieved data on the study design, location, aim of the study, food sources, food rescuers, transportation type, distributor organizations, consumers, challenges, and facilitators. Two reviewers (C.O. and W.M.) discussed discrepancies in the data extracted until a consensus was reached.

[1] https://www.covidence.org/

Figure 1. PRISMA Scoping Review Flow Chart
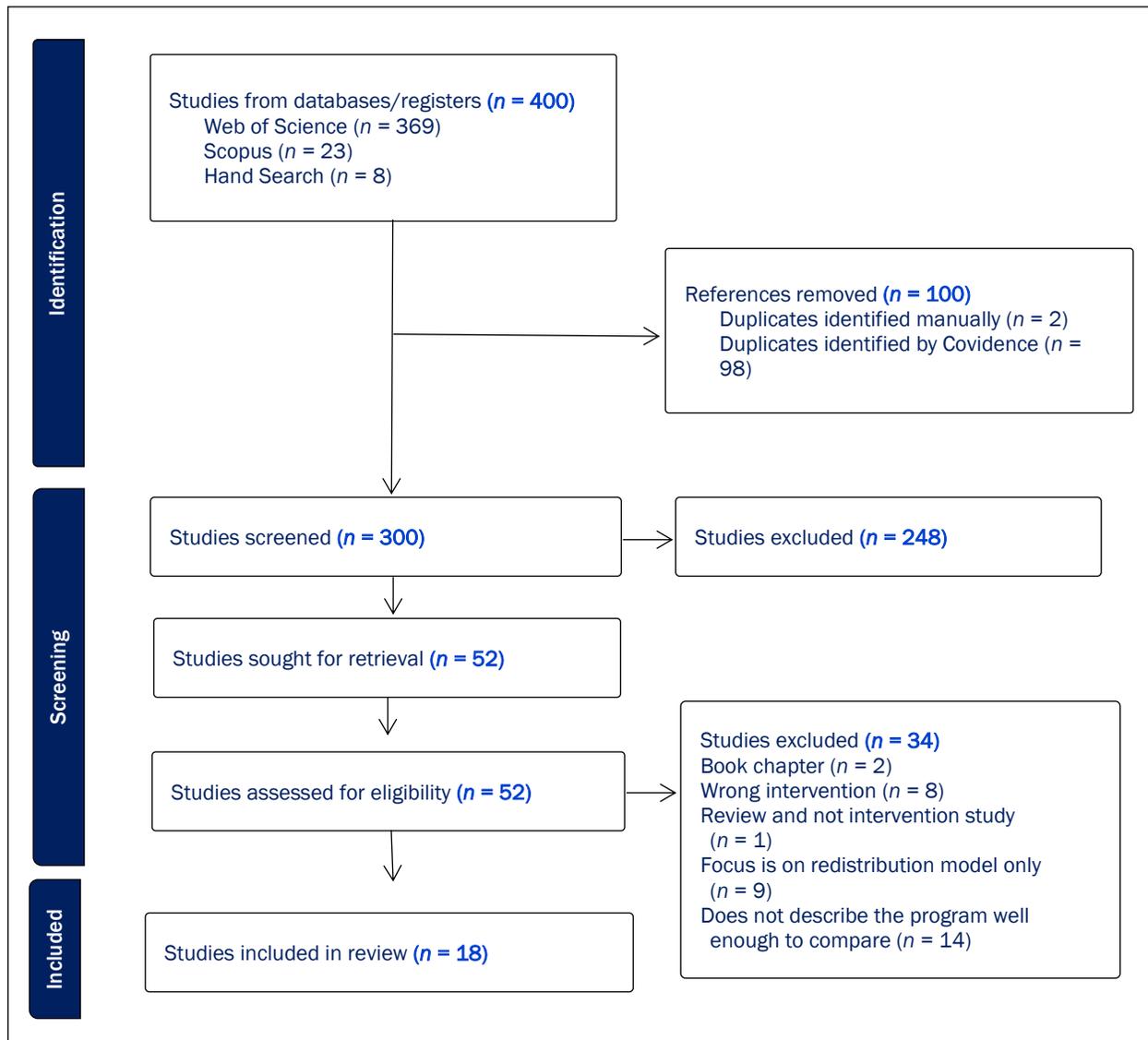
The data collected was synthesized in a table to provide a structured overview of the existing approaches and highlight the different methodologies used within the field along with outcomes associated with food waste intervention studies.

Results

The search yielded 400 articles. Removing duplicates resulted in 300 articles being screened by title and abstract. The abstract and title scan resulted in a detailed examination of 52 full texts, with 18 fulfilling all inclusion criteria to undergo final data extraction (Table 1).

Description of the Dataset

The 18 studies selected in this review were conducted in various global locations, focusing most significantly on the United States and Europe. Half of the studies took place at various locations across the United States, examining food rescue and redistribution efforts in areas such as Colorado, Virginia, Nevada, and various university campuses on the East Coast (Adams & Tabacchi, 1997; Ayala et al., 2022; Bankson, 2009; Frank et al., 2021; Mittal et al., 2021; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Warshawsky, 2015). Three articles described programs implemented across

Table 1. Summary of Literature Included in the Extraction of Data

Reference (Country)	Study Design	Food Source	Food Rescuer	Method to organize pick up	Distributor Organization/ Business	Target Consumer	Key Metrics
Adams, 1997 (United States)	Opinion article informed by survey data	Restaurant/ Institution	Traditional (food banks)	It depends; not a lot of information is provided	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; # of donor agencies
Alexander, 2008 (UK)	Case report	Retail food store	Complimentary (use of apps to manage donation and delivery logistics)	App (FareShare); Pick-up is organized through both pre-scheduled depot deliveries from retailers and ad hoc collections from retail outlets.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; # of deliveries; # of donor agencies; # of recipient agencies
Aloysius, 2023 (Sri Lanka)	Case report	Restaurant/ Institution; Retail food store	Traditional (food banks)	Pick-up is organized through direct communication between food donors and volunteers, often facilitated by mobile applications or social media platforms like WhatsApp.	Free (pantries, kitchens, food bank)	Experiencing food insecurity; Children; Families; Note specifically elderly, orphanages, homelessness	Weight rescued; Weight redistributed; # of people served; # of volunteers; # of deliveries; # of recipient agencies
Ayala, 2022 (United States)	Qualitative research	Restaurant/ Institution; Retail food store; Schools (public and private)	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Pick-up is organized through an app that connects food businesses with surplus food to enable on-demand pick-up and tracking of food donations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; Economic value; GHG emissions; # of people served
Bankson, 2009 (United States)	Case report	Restaurant/ Institution	Complimentary (use of apps to manage donation and delivery logistics)	Salvageable food is collected from dining halls and taken to a meal preparation area, where student volunteers package the meals for distribution to the community.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; Sustainability measured through student involvement and administrative support
Clare, 2023 (New Zealand)	Case report (Multi-case report)	Restaurant/ Institution; Retail food store; Processor; Farm (grower)	Community hub, free store, and mixed model	Food is collected from donors and delivered to recipient organizations, logistics managed by food rescue organizations (ex phone calls), use of volunteers for transportation	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; # of meals, Weight redistributed; # of people served; Tonnes of CO2 reduced, # of recipient organizations
Dresler, 2019 (New Zealand)	Qualitative research (interpretive approach)	Restaurant/ Institution; Retail food store; Wholesaler/ distributor; Farm	Using a "Free Store" model.	Volunteers perform all necessary tasks	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Satisfaction; self-concept

Table 1, continued

Frank, 2021 (United States)	Case report	Restaurant/ Institution	Through Canvas (learning management system)	An announcement is sent to students through Canvas for a "quick and easy" pickup at an on-campus location in a designated time window.	Uses Canvas to alert students to come and pick it up directly from the event	Food insecure University students	# of donor agencies; # of events and student feedback
Mirosa, 2016 (New Zealand)	Case report	Restaurant/ Institution; Retail food store	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Volunteers and staff accept scheduled donations from food donors and redistribute to recipient agencies	Free (pantries, kitchens, food bank); Discount (retailers, com-plimentary rescue orgs/businesses). Social enterprise	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; # of volunteers; Social return on investment
Mittal, 2021 (United States)	Case report (multi-case study)	Restaurant/ Institution; Retail food store; Farm	Varies based on program; some use food banks and others connect directly with volunteers	Combination of direct collection by non-profit organization, volunteer-driven pickups facilitated by mobile applications (ex. Meal Connect)	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served
Philip, 2017 (Israel)	Case report	Restaurant/ Institution; Farm	Traditional (food banks)	Computerized call centre that coordinates schedule deliveries with Non-Profit Organizations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; economic value; Savings of disposal/compost cost; GHG emissions; # of people served
Sedlmeier, 2019 (Germany)	Case report (multi-case report)	Restaurant/ Institution; Retail food store; Processor; Farm	Original food source (businesses that implement alternative sale strategies)	Picked up by participating entrepreneurs or delivered by collaborative partners	Sold to consumers	No food insecurity mentioned	Weight rescued; Weight redistributed; # of people served; # of volunteers; # of employees; Satisfaction
Sewald, 2018 (United States)	Case report	Retail food store	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Web-based app ("Food Rescue Robot")	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued
Sherman, 2004 (United States)	Article describing a research case study	Restaurant/ Institution; Farm	Complimentary (services and apps to manage donation and delivery logistics)	Not described in detail: food rescue agencies provide their containers and transportation	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued
To, 2019 (United States)	Case report	Convention centre catering	Traditional (food banks)	Collected using a refrigerated truck (supplied by Aria convention centre) with scheduled deliveries to Three Square Food Bank	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; GHG emissions; # of meals, EPA's WARM tool

Table 1, continued

Vander Vennen, 2023 (Canada)	Case report	Not explicitly stated: "Most of the Upcycle Kitchen's food supply is sourced through donation" (p. 6). Surplus from local food bank	Social enterprise (Upcycle Kitchen)	Not described	Resold on a sliding price scale	Experiencing food insecurity	Economic value; cost-revenue estimate
Veeckman, 2018 (Greece)	Case report	Restaurant/ Institution; Retail food store; Farm/Farmers Market	Complimentary and food banks	Use of digital platforms that facilitate matchmaking of food donations with recipient organizations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; Economic value; Savings of disposal/ compost cost; GHG emissions; # of people served; # of volunteers
Warshawsky, 2015 (United States)	Case report	Wholesaler/ Distributor; Processor; Farm; Other: farmers market and backyard gleaning	Complimentary (services and apps to manage donation and delivery logistics)	Glean Team lead and volunteers distribute empty boxes to farmers market vendors, which is collected by one of the 55 charity partner organizations	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed

Europe, including specific examples from Germany, the United Kingdom, and Greece (Alexander & Smaje, 2008; Sedlmeier et al., 2019; Veeckman et al., 2018). The study published by Greek scholars Veeckman et al. (2018) involved cross-national collaboration and included projects that spanned the countries of Belgium, Hungary and Greece. Also included in this scoping review were three studies that examined food rescue initiatives in New Zealand (Clare et al., 2023; Dresler & Tutt, 2019; Mirosa et al., 2016), one study from Canada (Vander Vennen & Parizeau, 2023), one from Sri Lanka (Aloysius & Ananda, 2023), and another based in Israel (Philip et al., 2017). The breadth of countries included in the scoping reviews highlights the global reach of food waste concerns and their attempts to address these complicated scenarios by implementing rescue initiatives. All studies, aside from one, noted the dichotomy of high food waste with increased food insecurity levels and included the acknowledgment of household food insecurity through food waste diversion as an outcome of interest.

Study Designs

Case study and multi-case study design dominated the literature, with 14 of the 18 studies employing these methods (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Philip et al., 2017; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Warshawsky, 2015). Case study design helps provide in-depth data from locations and programs that explore food rescue initiatives' effectiveness, challenges, and outcomes (Bellemare et al., 2017). Within the case study designs, the research methods included in this review tended toward qualitative design, with 11 studies using interview data (Ayala et al., 2022; Sewald et al., 2018; Warshawsky, 2015) and two studies describing survey results (Adams & Tabacchi, 1997; Frank et al., 2021). Despite the emphasis on qualitative studies, quantitative measurements of food waste diversion were included in the review as well, with weight of food being the most common metric (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius

& Ananda, 2023; Ayala et al., 2022; Mittal et al., 2021; Philip et al., 2017; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). One study exclusively used quantitative methods to measure the environmental impact, measured in metric tonnes of avoided Greenhouse gases (GHG) and the number of meals generated from rescued food over a specified period (To et al., 2019). The influence of case study design allows the collection of rich and specific data on individual programs or interventions, such as the motivations and challenges experienced by stakeholders (Longest, 2004). However, the lack of variability in the types of studies conducted fails to capture any comparison between programs or interventions and limits the comprehensive understanding of how the social, geographical or political context of the food diversion initiatives impacts the outcomes.

Food Source

The process of diverting food from the waste stream involves food rescuers who act as intermediaries between the food source (retailer, restaurant, institution) and the charitable organization, free store, or other consumers (Hecht & Neff, 2019). Food was collected from a variety of sources; nine studies focused on food rescue from restaurants or institutions (Adams & Tabacchi, 1997; Bankson, 2009; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015), five studies examined food sourced from retail food stores (Alexander & Smaje, 2008; Dresler & Tutt, 2019; Mittal et al., 2021; Sedlmeier et al., 2019; Veeckman et al., 2018), and another five studies included food rescued from farms, primarily through gleaning, in addition to other sources of rescue (Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015). Many studies included in the review collected donations from more than one food source (Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015), and the size of the intervention sites varied as well. For example, the Las Vegas Convention Food Rescue Program focused on rescuing surplus food from large events held at

the Aria Resort and Convention Center, where prepared but untouched food was collected and redistributed to food banks (To et al., 2019). Additional studies focused on smaller quantities of surplus food, primarily from local grocery stores and retail outlets (Sewald et al., 2018). Some interventions, such as Free Food on Campus, did not directly transport food but provided notifications to students of collection sites for leftover food from individual campus events (Frank et al., 2021).

Food Diversion Efforts
The process of collecting rescued food varies across initiatives and is often influenced by the project's scale and resources. Many programs, especially smaller ones, rely heavily on volunteers for tasks like food pick-up, delivery, and quality checks (Aloysius & Ananda, 2023; Ayala et al., 2022; Mittal et al., 2021; Sewald et al., 2018). Larger operations often utilize paid staff along with volunteers to manage roles and logistics (Aloysius & Ananda, 2023; Ayala et al., 2022). Social enterprise models, such as the German-based food rescue entrepreneurs and the Upcycle Kitchen in Guelph, Canada, introduce a potential profit stream in the food redistribution stream to support the continuous sustainability of the food rescue initiatives (Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023). Other programs, such as Free Food on Campus opt for direct pick up of the surplus food from individual consumers rather than delivery (Frank et al., 2021). Coordination methods for food collection range from traditional phone calls and emails to modern mobile apps, such as WhatsApp or web-based platforms (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Sewald et al., 2018; Veeckman et al., 2018). Volunteers occasionally use their own vehicles for pick-up (Aloysius & Ananda, 2023; Mittal et al., 2021), while some initiatives combine volunteer and paid staff efforts (Ayala et al., 2022; To et al., 2019), with one study highlighting bicycle deliveries (Sewald et al., 2018). These diverse organizational structures reflect the adaptability of food rescue programs to their specific needs and resources.

Sixteen of these studies shared the goal of redistributing the salvaged food for free to community members in need (Adams & Tabacchi, 1997;

Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mirosa et al., 2016; Mittal et al., 2021; Philip et al., 2017; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Several studies commonly cited partnerships with local food banks for redistribution, while other food rescue efforts engaged directly with customers by distributing through home deliveries, pick-up locations, or free stores (Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Warshawsky, 2015). These studies exemplify the mission-based approach to addressing food insecurity through food rescue efforts.

Intervention Outcomes
The primary outcome measurements across many of the studies focused on quantifying the impact of food rescue initiatives on the volume of salvaged food (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Mirosa et al., 2016; Mittal et al., 2021; Philip et al., 2017; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015). Some studies, such as the one conducted in Las Vegas, provided detailed metrics of the outcome measurements, (including the weight of food rescued during the pilot year) and provided calculations that translated the volume into the number of meals provided to food-insecure individuals (To et al., 2019). This program also used the EPA's Waste Reduction Model tool to calculate the reduction in greenhouse gas emissions from the food rescue intervention, estimating the number of metric tons of CO_2 equivalents that were avoided due to the diversion of food from landfills. Limitations existed for interpreting the metrics included in the studies; for example, if the food weight included any packaging or food that would later be discarded due to poor quality. Securing replicable outcome measurements in future studies is critical in demonstrating the tangible benefits of food rescue initiatives, including their contributions to food security and environmental sustainability.

Challenges and Barriers

Despite the reported positive outcomes, these studies also highlighted barriers to food recovery and redistribution success. These difficulties included operational and logistical challenges, liability concerns, workforce irregularities, inconsistency of food availability, and financial restraints.

Logistical/operational

One of the most prominent obstacles identified across many of the studies was navigating the logistical complexity of food rescue operations (Adams & Tabacchi, 1997; Ayala et al., 2022; Clare et al., 2023; Sedlmeier et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Coordinating food collection and distribution requires careful planning to ensure efficiency and compliance with food safety regulations. The authors of "SavingFood" in Greece emphasized that food redistribution organizations often struggle with promptly connecting food donors to community organizations, which is critical to preventing food spoilage (Veeckman et al., 2018). The authors described how community organizations frequently operate in silos, which can contribute to poor communication and inefficient matching of food surpluses with recipients (Veeckman et al., 2018). Similarly, in Los Angeles, logistical hurdles of food recovery efforts are exacerbated by a decentralized governance model, where food rescue organizations must independently manage collection schedules, often from geographically dispersed locations, all while ensuring the preservation of perishable food during transport (Ayala et al., 2022; Warshawsky, 2015). Small organizations struggled with the lack of necessary infrastructure, such as storage facilities, to accommodate large quantities of food, adding another layer of complexity (Adams & Tabacchi, 1997; Sedlmeier et al., 2019). Coordinating timely pickups, ensuring food safety, and maintaining adequate communication between stakeholders are crucial logistical considerations in food rescue. Maintaining these channels can also present significant problems when managing and assessing the program's effectiveness.

Liability concerns

Another noteworthy challenge in our review was liability concerns, which were particularly promi-

nent in the U.S. studies (Adams & Tabacchi, 1997; Ayala et al., 2022; Sherman, 2004). Authors noted that some potential food donors hesitate to participate in food waste recovery programs due to fears of legal repercussions should the donated food cause harm (Adams & Tabacchi, 1997). These concerns often arise from misconceptions about food safety regulations, leading to the rejection of food that is otherwise safe for consumption (Adams & Tabacchi, 1997). Retail-level confusion about "use by" and "best before" dates can cause potentially edible food to be needlessly discarded (Sherman, 2004). Food businesses still show hesitancy despite the existence of protective laws in many regions, such as the Bill Emerson Good Samaritan Food Donation Act in the United States (Ayala et al., 2022) and New Zealand's 2014 Food Act's Immunity of Food Donors (Mirosa et al., 2016). Some authors also highlighted liability and food safety issues as barriers to recruiting businesses for participation in food recovery initiatives (Adams & Tabacchi, 1997; Ayala et al., 2022; Mirosa et al., 2016).

Volunteer workforce

Several studies described challenges associated with using volunteers in food rescue programs (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Sewald et al., 2018; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Reliance on volunteers can introduce complicated considerations such as schedule coordination and ensuring timely pickups, as described in the Boulder Food Rescue model (Sewald et al., 2018). The creation of a web-based tool called the "Food Rescue Robot" was introduced in response to the burden of managing a volunteer workforce (Sewald et al., 2018). The "Food Rescue Robot" is a mobile app designed to streamline the coordination of pick-ups and deliveries of surplus food from retail stores by volunteers through a centralized platform (Sewald et al., 2018). However, even with such innovations, the volunteer-based model still presents challenges (Sewald et al., 2018). Boroume, a nonprofit organization focusing on food waste in Greece, also noted issues with inconsistent volunteer availability, which hampers the consistent collection and redistribution of food

(Veeckman et al., 2018). To et al. (2019) also reported that the lack of regular volunteers can lead to gaps in food collection, ultimately increasing food waste despite the best intentions. Ensuring proper training and retention of volunteers requires consistent monitoring, as not all individuals have the time or resources to commit to long-term participation (Aloysius & Ananda, 2023; Sewald et al., 2018). While volunteers are integral to the success of food rescue programs, the management of irregular volunteer workforces remains a significant challenge to operational efficiency.

Inconsistent/unpredictable donations
Inconsistency of food donations was another notable issue among the food rescue studies (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Sedlmeier et al., 2019; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). The German food rescue entrepreneurs faced logistical difficulties in acquiring regular and reliable supplies of surplus food, as many businesses only donated sporadically and the items received were not predictable (Sedlmeier et al., 2019). Such inconsistency hinders the ability of food rescue programs to plan and repurpose food efficiently, as the quantity, quality and type of donated food are often variable. In a similar fashion, FareShare in the UK also grappled with uneven donations from retailers, which can lead to gaps in supply or wasted trips to collect unavailable food (Alexander & Smaje, 2008). Rescuing perishable items is particularly challenging, as they often arrive too late in the supply chain to be effectively redistributed before they spoil (Alexander & Smaje, 2008). Establishing standardized systems and planning for staffing requirements on any given day is challenging, and inconsistent situations can adversely affect the efficiency of these food rescue operations.

Funding/financial resourcing
Funding and financial resourcing are other critical considerations for food rescue programs, as highlighted in various studies (Alexander & Smaje, 2008; Ayala et al., 2022; Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023; Veeckman et al., 2018; Warshawsky, 2015). Alexander and Smaje (2008) described these challenges in the case study

of FareShare, which encountered ongoing financial strain due to the operational costs associated with collecting, storing, and redistributing food, as these labour-intensive activities are not fully covered by financial donations or governmental support. Relying on grants and charitable donations often leaves food rescue programs vulnerable and limits their ability to scale or invest in necessary infrastructure, such as refrigerated storage and transportation (Alexander & Smaje, 2008; Sedlmeier et al., 2019; Sewald et al., 2018; Vander Vennen & Parizeau, 2023). The administrative burden of securing and maintaining funding sources can also detract from the core mission of food rescue, forcing many programs to prioritize fundraising over direct service provision (Alexander & Smaje, 2008; Vander Vennen & Parizeau, 2023). To navigate financial hardships, some organizations have adopted social enterprise models that generate internal income through the sale of rescued food or related services (Alexander & Smaje, 2008; Ayala et al., 2022; Mittal et al., 2021; Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023). In Germany, some food businesses monetize surplus food through discounted sales of rescued food and upcycled products for social supermarkets. Feed Iowa First collaborates with local farms to share resources (like storage) in exchange for part of the produce (Mittal et al., 2021; Sedlmeier et al., 2019). In the same way, Los Angeles-based technology companies offer subscription fees for participating food donors to help supplement the program costs (Ayala et al., 2022). These innovative approaches aim to help create continual funding streams that allow organizations to better plan for long-term sustainability. The resulting literature, however, does not describe the actual financial outcomes in detail.

Facilitators
Despite the reported challenges and barriers, the studies highlighted several facilitators to food recovery and redistribution success. These included technology, partnerships, supportive policies and incentives, and innovative ways to reduce stigma.

Use of technology
Technology and innovation play a critical role in

streamlining operations and increasing efficiency. Several of the reviewed studies incorporated technology, such as apps and online platforms, to facilitate food pick-up and delivery, with seven studies specifically highlighting the use of these tools (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Frank et al., 2021; Sewald et al., 2018; Veeckman et al., 2018; Warshawsky, 2015). One example is the "FareShare" app, which streamlines the coordination of surplus food collection from retail stores by organizing pick-ups through a centralized platform (Alexander & Smaje, 2008). The Boulder Food Rescue created a "Food Rescue Robot," which allows volunteers to coordinate real-time pick-ups and deliveries, optimize their routes, and reduce logistical challenges, ultimately making the food rescue process more efficient and responsive to community needs (Sewald et al., 2018). In Greece, the SavingFood project leveraged a digital platform to directly connect food donors, such as farmers' markets and retailers, with charities and organizations in need, allowing surplus food to be quickly and effectively redirected to those most in need (Veeckman et al., 2018). Some studies did report concerns with the initial costs of developing and maintaining these platforms as well as the sustained need for consistent user engagement to ensure their effectiveness (Sewald et al., 2018; Warshawsky, 2015). Another important consideration is that technological solutions might not be accessible to all potential users, particularly in regions with limited digital infrastructure or among populations less familiar with digital tools (Mirosa et al., 2016). These challenges suggest that while technology holds significant promise for enhancing food rescue efforts, carefully considering its implementation and user accessibility is crucial for continued success.

Partnerships

Community engagement and partnerships are essential facilitators of food waste diversion efforts, especially when formal agreements are needed to define specific roles and responsibilities (Adams & Tabacchi, 1997; Sewald et al., 2018; To et al., 2019; Veeckman et al., 2018). Collaborations between food banks, local businesses, and volunteers are

crucial, as they create shared and delineated responsibilities and provide essential resources for food rescue operations. Some of the studies described the benefits of informal but well-coordinated partnerships between entities such as local grocery stores, volunteers, and community organizations in fostering regular communication and shared goals that drive the program's success (Clare et al., 2023; Mittal et al., 2021; Sewald et al., 2018). Formal agreements were discussed as a necessity in the To et al. (2019) study to ensure that food safety protocols are strictly followed during collection and redistribution, particularly when handling prepared foods. Consistency between the nature of the agreements and partnerships varies, but many authors consider these relationships as beneficial and suggest that they enhance the scalability, safety, and impact of food waste diversion efforts.

Policy support/incentives

Another integral facilitator of food recovery efforts is policy support. This includes the laws and guidelines that encourage food donation and protect donors from liability, as well as tax incentives that make participation more appealing to businesses (Adams & Tabacchi, 1997; Bankson, 2009; Sewald et al., 2018). Both the University of Virginia and the Boulder food rescue programs advocate for increased awareness of the Good Samaritan Food Donation Act, which protects donors from legal liabilities and can make businesses more comfortable with donating surplus food (Bankson, 2009; Sewald et al., 2018). The Las Vegas Convention Food Rescue Program also highlights local health policies and protection in food recovery through formal agreements ensuring that donated food adheres to safety standards and complies with health regulations (To et al., 2019). These policies and legislation provide an important legal framework for safe and protected food donations by providing clear guidelines for food safety, making it easier for businesses to participate and contribute to food recovery efforts.

Reducing stigma through creative redistribution

Stigma remains a significant barrier in food charities, often discouraging individuals from accessing

needed resources (Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Sewald et al., 2018). Creative redistribution models can help to reframe food assistance as a positive community initiative rather than a charitable handout. Programs like "Free Stores," highlighted by Dresler and Tutt (2019), empower customers and volunteers by normalizing participation and fostering a sense of individual ownership over the process rather than dependency. Comparably, the "Free Food on Campus" initiative shifts the focus from food insecurity to environmental sustainability, encouraging students to participate by highlighting food waste reduction rather than need (Frank et al., 2021). By involving participants in the process and reframing the narrative around food rescue, these programs foster dignity and increase participation while simultaneously addressing food insecurity and waste.

Discussion

The question of the best option for food reuse for human consumption through upcycling or donation remains. Of the 300 articles obtained through the search process, only 18 met the inclusion criteria of adequately describing the programs to be assessed and compared. Within these 18 studies, wide variability in the data collection and methods of outcome metrics made comparison difficult. There is an overall lack of theoretical influence and evaluation in the literature, which suggests that interventions may be missing components to reduce FLW and provides fertile grounds for future research. There are also contextual considerations for planning new interventions, as well as a need for policy support to move the food system in the direction of structural change while meeting the challenges of food redistribution. We briefly consider these opportunities below.

Use Comparable Metrics

A predominant metric used in nearly all studies was the weight of food rescued (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Philip et al., 2017; Mirosa et al., 2016; Mittal et al., 2021; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; Veeckman et

al., 2018; Warshawsky, 2015). However, the method for weighing the food varied widely across these studies, and oftentimes it was unclear whether the weight of the food included packaging or other materials that would later be discarded. While the weight of rescued food is a valuable metric to track program effectiveness, the inconsistency in recorded data makes comparison difficult. Encouraging and increasing standardized metrics in future studies would help quantify the initiatives' direct impact and offer a framework for evaluating both the sustainability and scalability of food rescue efforts. Additional guidance, such as that provided by the U.S. EPA in the form of the Waste Reduction Model (WARM) tool, may help provide additional assistance to meet this need in future research (EPA, 2023). Hecht and Neff (2019) likewise suggested that adapting The International Food Loss and Waste Accounting and Reporting Standard could help address the need for consistent metrics and methodology. Encouraging organizations to report on economic metrics, such as the cost recovery of food rescue and redistribution, may help influence policy reform to support food waste reduction and potentially offer tax incentives. Reporting on land and water use impacts of food waste may also help contextualize the environmental toll of the current food system. Finally, incorporating temporal elements through longitudinal food recovery studies can be valuable for tracking the impact of such efforts, as it allows for evaluation of changes and trends over an extended period. This additional dimension enables an inclusive analysis of how food recovery programs evolve, assessing whether they remain effective over time, as well as monitoring long-term contributions which reduce the amount of food waste reaching landfills.

Lack of Theoretical Influence

The literature on FLW diversion is rich with diverse methodologies and findings, yet it also reveals the need for more rigorous, theoretically informed designs and longitudinal studies. The application of theory use is necessary in food waste programs to offer uniformity and guiding metrics for program creation, implementation, and evaluation (Kim et al. 2022). While universal theoretical

models are not yet available to guide food waste behaviour change, the development of a practical, conceptual framework that integrates insights on the multitude of factors and influences contributing to food waste reduction would aid in advancing this field of knowledge (Beretti et al., 2013; Dessart et al., 2019; Pollitt & Shaorshadze 2013). Scholars working to address waste diversion in New Zealand have suggested that combining theories based on behavioral, sociological, and Indigenous theories may be useful for waste minimization due to the complexity of food systems (Sharma et al., 2021). Other research has suggested that varied approaches may be considered appropriate at different stages of the food lifecycle; for example, theories directed at individual-level change may be useful in initial stages (i.e. food provision) and stochastic, environment-level theories are better suited for later phases (i.e. food disposal) (Kim et al., 2022). A review of food waste theory application by Kim et al. did not endorse any deterministic, individual theory explored in the articles they reviewed (ex. Theory of Planned Behaviour) but instead suggest that stochastic approaches (ex. Nudge Theory) appear promising for advancing theory-application within this field and are therefore worth further exploration (2022). Continued interdisciplinary research and the development of standardized metrics are essential guidelines for advancing the field and achieving meaningful reductions in food loss and waste.

Contextual Considerations

Context plays a critical role in the development and success of food rescue programs, as local cultural norms, socioeconomic conditions, and logistical frameworks vary widely across regions. Future research that considers the unique cultural values surrounding food distribution, community engagement, and economic structures can significantly influence how such programs are received and implemented. Understanding local practices, from food safety perceptions to the economic viability of redistribution models, is essential for designing programs that meet the community's needs. Additional logistical considerations such as transportation infrastructure, volunteer management, and local regulations must also be tailored to fit the specific needs and capacities of each individual region. Investigating and adapting to these contextual factors is crucial to ensure long-term sustainability and effectiveness of food rescue programs in diverse global settings.

Volunteer management can be significant work, as described above. In addition to the responsibility of managing a volunteer workforce, it is important to consider what role volunteers play within food recovery efforts in terms of scalability, ongoing economic feasibility, and the ethical considerations of unpaid work (Biewener, 2016. In their discussion on alternative agriculture systems, Biewener expressed concern about the reliance on unpaid labor, questioning whether these initiatives can provide "good jobs" alongside "good food" and avoid exploitative practices (2016). While unpaid work can foster community and skill-building, it also risks exploitation resulting from systemic challenges (like economic inequality) that can be difficult to resolve (Biewener, 2016). Significant progress is needed to advance the current food system practices and policies on a broader level that supports equitable and sustainable economic practices of unpaid labour, rather than relying on individual organizations to self-regulate (Biewener, 2016).

Structural Change

The modern industrial food system often prioritizes producing large quantities of inexpensive food over minimizing waste. Shifting this focus requires policy support which values food as a vital resource rather than a disposable commodity. By promoting system-level approaches that reduce the ecological footprint of food production, such policies can counter profit-driven practices. Academic research on FLW, combined with community advocacy, plays a crucial role in informing policymakers and government officials. Together, these efforts can help guide the transition toward more sustainable food production and consumption practices.

Several authors spoke to the need for robust system change, while also noting the importance of addressing community-level food rescue, redistribution and FLW as a short-term or intermediatory solution (Mirosa et al., 2016; Mittal et al., 2021; Sherman, 2004; Warshawsky, 2015). Food rescue,

while important, may inadvertently reinforce a neoliberal framework that shifts the responsibility for feeding vulnerable populations and reducing FLW onto individuals and communities, effectively absolving governmental agencies from their duty to be stewards of environmental sustainability for future populations and ensuring food security for the current population (Warshawsky, 2015). Sherman (2004) voiced similar concerns by stating that food waste diversion is a temporary measure that does not address the underlying systemic issues, such as poverty and unequal food distribution, which are the primary drivers of food insecurity. The reliance on food rescue as a primary strategy is not a permanent solution and risks normalizing a response that prioritizes individual action over structural change. Adopting more comprehensive policies to eradicate the wastefulness of food through each stage of its lifecycle is required for sustained change (Mirosa et al., 2016). Until considerable political action is taken toward meeting this goal, assisting the development of rescue and redistribution program by sharing existing approaches can help reduce the burden of waste that is created within the current system.

Strengths and Limitations

This study has some important strengths. First, we conducted our search worldwide, which allowed us to compare programs with various food sources, challenges, and facilitators, leading to our contextualized considerations for planning new opportunities. Second, we conducted pilot testing to select the search terms, including additional search words such as reclaim*, redirect*, service* and model*, thus broadening the reach of the literature reviewed. Third, we conducted our scoping review following the PRISMA framework to ensure the rigour and transparency of the review process.

Some limitations should be considered. First, given the scoping nature of this study to map the current evidence of food rescue and upcycling interventions used worldwide, we did not assess the quality of the studies. We did, however, evaluate the methodologies used in each reference to understand the context, validity and impact of the study's findings. Second, our research team exclusively reviewed peer-reviewed literature and we did not include gray literature in our study, potentially signifying the absence of relevant programs. Given this, it is possible that some food rescue programs may lack the capacity for a full evaluation. When initial gray literature searches were conducted on food rescue and upcycling programs, the resulting information on funding, resources and outcome measurements was limited. As such, it would be key to do a scoping review of the excluded grey literature to understand the breadth of such programs, and to capture the complete range of opportunities that could be adopted for the local context. Third, our search was limited to references written in the English language, thus leading to a gap in information on programs developed in non-English speaking countries.

Conclusions

This scoping review explores the current breadth of available studies on food recovery models to learn best practices and cultivate improved capacity for future programs. These studies revealed the critical role of volunteers, collaborative partnerships, and innovative technological solutions in overcoming logistical and operational barriers. However, inconsistencies in data collection and metrics across all studies hindered comparability, emphasizing the need for standardized evaluation methods. Future research should prioritize developing and adopting standardized metrics, such as those outlined in the International Food Loss and Waste Accounting and Reporting Standard, to enhance the comparability and scalability of food rescue initiatives. Furthermore, incorporating longitudinal studies could provide deeper insights into the long-term impact and sustainability of these interventions.

While food rescue initiatives can help address certain aspects of FLW, they remain short-term solutions that do not address the systemic causes of food insecurity or the structural inefficiencies within the food system. Future research should explore the intersection of food rescue efforts with broader socio-economic and environmental issues, focusing on tackling the root causes of food waste and food insecurity. The application of theoretical frameworks, such as behavioural and sociological theories, can help guide the development of inter-

ventions that account for cultural, economic, and logistical factors unique to specific regions.

Community-led advocacy can encourage policymakers to recognize the limitations of viewing food rescue as a primary strategy and instead support systemic reforms to create sustainable and equitable food systems. Policies that incentivize sustainable production and consumption patterns, offer support for social enterprise models, and invest in infrastructure which enhances the efficiency of food redistribution networks are all recommended practices. Fostering public awareness and reducing the stigma associated with consuming rescued food can also improve participation and acceptance of food rescue efforts.

This review offers a current summary of work being done by organizations working to reduce food waste while addressing the need for more comprehensive solutions and strategies that acknowledge systemic barriers. By combining practical solutions with policy support and theoretical advancements, future efforts can contribute to a more sustainable, equitable, and efficient global food system. It is important to remember that the food system is complex, and the ultimate goal is to maximize food production and distribution within a circular economy model (Vilarino et al., 2017). To build a truly circular and equitable food economy, we must strive to ensure that every stage of food production and consumption, including both edible and non-edible, is optimized, repurposed, and reintegrated into the system to nourish both people and the planet.

References

Adams, C., & Tabacchi, M. (1997). Perishable-food-rescue programs: Status and prospects. *Cornell Hotel and Restaurant Administration Quarterly, 38*(2), 62–67. https://doi.org/10.1177/001088049703800225

Alexander, C., & Smaje, C. (2008). Surplus retail food redistribution: An analysis of a third sector model. *Resources, Conservation and Recycling, 52*(11), 1290–1298. https://doi.org/10.1016/j.resconrec.2008.07.009

Aloysius, N., & Ananda, J. (2023). A circular economy approach to food security and poverty: A case study in food rescue in Sri Lanka. *Circular Economy and Sustainability, 3*, 1919–1940. https://doi.org/10.1007/s43615-023-00255-4

Ayala, V., Caldwell, J. I., Garcia-Silva, B., Shah, D., Garcia, V., & Kuo, T. (2022). Increasing surplus food redistribution to improve food access through a partnership between public health and a technology-based company. *Journal of Health Care for the Poor and Underserved, 33*(4), 7–24. https://doi.org/10.1353/hpu.2022.0156

Bankson, J. D. (2009). Food rescue system for UVa dining and Charlottesville community. *2009 Systems and Information Engineering Design Symposium*, Charlottesville, VA, USA, 2009, 85–89. https://doi.org/10.1109/SIEDS.2009.5166160

Bellemare, M. F., Çakir, M., Peterson, H. H., Novak, L., & Rudi, J. (2017). On the measurement of food waste. *American Journal of Agricultural Economics, 99*(5), 1148–1158. https://doi.org/10.1093/ajae/aax034

Beretti, A., Figuières, C., & Grolleau, G. (2013). Behavioral innovations: The missing capital in sustainable development? *Ecological Economics*, *89*, 187–195. https://doi.org/10.1016/j.ecolecon.2013.03.004

Biewener, C. (2016). Paid work, unpaid work, and economic viability in alternative food initiatives: Reflections from three Boston urban agriculture endeavors. *Journal of Agriculture, Food Systems, and Community Development, 6*(2), 35–53. https://doi.org/10.5304/jafscd.2016.062.019

Cela, N., Giorgione, V., Fassio, F., & Torri, L. (2024). Impact of circular economy information on sensory acceptability, purchase intention and perceived value of upcycled foods by young consumers . *Food Research International*, *175*, Article 113765. https://doi.org/10.1016/j.foodres.2023.113765

Clare, G., Diprose, G., Lee, L., Bremer, P., Skeaff, S., & Mirosa, M. (2023). Measuring the impact of food rescue: A social return on investment analysis. *Food Policy, 117*, Article 102454. https://doi.org/10.1016/j.foodpol.2023.102454

Coyne, R. (2005). Wicked problems revisited. *Design Studies, 26*(1), 5–17. https://doi.org/10.1016/j.destud.2004.06.005

Dessart, F. J., Barreiro-Hurlé, J., & Van Bavel, R. (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics*, *46*(3), 417–471. https://doi.org/10.1093/erae/jbz019

Dresler, E., & Tutt, H. (2019). Food insecurity, customer to volunteer transition and self-concept repair: A free store example. *Journal of Marketing Management, 35*(17–18), 1584–1599. https://doi.org/10.1080/0267257X.2019.1683596

Environment and Climate Change Canada. (2019). *Taking stock: Reducing food loss and waste in Canada*. https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/food-loss-waste/taking-stock.html

Food and Agriculture Organization of the United Nations [FAO]. (2019). *The state of food and agriculture 2019: Moving forward on food loss and waste reduction*. https://www.fao.org/3/ca6030en/ca6030en.pdf

Frank, L. B., Finkbinder, E. M., & Powell, V. S. (2021). "Free food on campus!": A novel use of instructional technology to reduce university food waste and feed hungry students. *Journal of Hunger & Environmental Nutrition, 16*(5), 706–724. https://doi.org/10.1080/19320248.2020.1850389

Hecht, A. A, & Neff, R. A. (2019). Food rescue intervention evaluations: A systematic review. *Sustainability 2019, 11*(23), Article 6718. https://doi.org/10.3390/su11236718

Hoehn, D., Vázquez-Rowe, I., Kahhat, R., Margallo, M., Laso, J., Muñoz, I., Hospido, G., Fernández-Ríos, A., Ruiz-Salmón, I., & Aldaco, R. (2023). A critical review on food loss and waste quantification approaches: Is there a need to develop alternatives beyond the currently widespread pathways? *Resources, Conservation and Recycling*, *188*, Article 106671. https://doi.org/10.1016/j.resconrec.2022.106671

Ishangulyyev, R., Kim, S., & Lee, S. H. (2019). *Understanding food loss and waste—Why are we losing and wasting food? Foods 2019, 8*(8), Article 297. https://doi.org/10.3390/foods8080297

Kim, J., Knox, K., & Rundle-Thiele, S. (2022). Theory application in food waste behaviour programs: A systematic literature review. *Australasian Journal of Environmental Management, 29*(4), 344–367. https://doi.org/10.1080/14486563.2022.2140211

Lai, M., Rangan, A., & Grech, A. (2022). Enablers and barriers of harnessing food waste to address food insecurity: A scoping review. *Nutrition Reviews, 80*(8), 1836–1855. https://doi.org/10.1093/nutrit/nuac012

Levin, K., Cashore, B., Bernstein, S., & Auld, G. (2012). Overcoming the tragedy of super wicked problems: Constraining our future selves to ameliorate global climate change. *Policy Sciences, 45*, 123–152. https://doi.org/10.1007/s11077-012-9151-0

Longest, B. Jr. (2004). *Managing health programs and projects*. John Wiley & Sons.

Manzoor, S., Fayaz, U., Dar, A. H., Dash, K. K., Shams, R., Bashir, I., Pandey, V. K., & Abdi, G. (2024). Sustainable development goals through reducing food loss and food waste: A comprehensive review. *Future Foods*, *9*, Article 100362. https://doi.org/10.1016/j.fufo.2024.100362

Mirosa, M., Mainvil, L., Horne, H., & Mangan-Walker, E. (2016). The social value of rescuing food, nourishing communities. *British Food Journal, 118*(12), 3044–3058. https://doi.org/10.1108/BFJ-04-2016-0149

Mittal, A., Krejci, C. C., Lopez, M., Kundert, J., Oswood, C., & Grimm, J. (2021). Transition toward a circular economy through surplus food management. In R. S. Mor, A. Panghal, & V. Kumar (Eds.), *Challenges and opportunities of circular economy in agri-food sector: Rethinking waste* (pp. 245–260). Springer, Singapore. https://doi.org/10.1007/978-981-16-3791-9_13

Papargyropoulou, E., Lozano, R., Steinberger, J., 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. https://doi.org/10.1016/j.jclepro.2014.04.020

Philip, D., Hod-Ovadia, S., & Troen, A. M. (2017). A technical and policy case study of large-scale rescue and redistribution of perishable foods by the "Leket Israel" food bank. *Food and Nutrition Bulletin, 38*(2), 226–239. https://doi.org/10.1177/0379572117692440

Pollitt, M. G., & Shaorshadze, I. (2013). The role of behavioural economics in energy and climate policy. In R. Fouquet (Ed.), *Handbook on energy and climate change* (pp. 523–546). Edward Elgar Publishing. https://doi.org/10.4337/9780857933690.00035

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V. K., Evans, D., Koh, L., Carlsson Kanyama, A., Katzeff, C., Svenfelt, Å., & Jackson, P. (2019). Review: Consumption-stage food waste reduction interventions— What works and how to design better interventions. *Food Policy, 83*, 7–27. https://doi.org/10.1016/j.foodpol.2019.01.009

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*(2), 155–169. https://doi.org/10.1007/BF01405730

Schroeder, P., Anggraeni, K., & Weber, U. (2019). The Relevance of circular economy practices to the Sustainable Development Goals. *Journal of Industrial Ecology, 23*(1), 77–95. https://doi.org/10.1111/jiec.12732

Sedlmeier, R., Rombach, M., & Bitsch, V. (2019). Making food rescue your business: Case studies in Germany. *Sustainability, 11*(18), Article 5101. https://doi.org/10.3390/su11185101

Selçuk, A. A. (2019). A guide for systematic reviews: PRISMA. *Turkish Archives of Otorhinolaryngology*, *57*(1), 57–58. https://doi.org/10.5152/tao.2019.4058

Sewald, C. A., Kuo, E. S., & Dansky, H. (2018). Boulder Food Rescue: An innovative approach to reducing food waste and increasing food security. *American Journal of Preventive Medicine, 54*(5), S130–S132. https://doi.org/10.1016/j.amepre.2017.12.006

Sharma, S. R., Walton, M., Baker, V., Hepi, M., & Manning, S. (2021). Realist review of interventions influencing waste management and minimization practices in New Zealand: Protocol and initial program theory. *International Journal of Qualitative Methods*, *20*, Article 1609406920981453. https://doi.org/10.1177/1609406920981453

Sherman, S. (2004). Increasing edible food recovery. *BioCycle, 45*(2), 33–37. https://www.biocycle.net/increasing-edible-food-recovery/

Smith, P. G., Morrow, R. H., & Ross, D. A. (2015). Introduction to field trials of health interventions. In P. G. Smith, R. H. Morrow, & D. A. Ross (Eds.), *Field trials of health interventions: A toolbox* (3rd ed., pp. 1–4). Oxford University Press. https://doi.org/10.1093/med/9780198732860.003.0001

Thorsen, M., Mirosa, M., Skeaff, S., Goodman-Smith, F., & Bremer, P. (2024). Upcycled food: How does it support the three pillars of sustainability? *Trends in Food Science & Technology, 143*, Article 104269. https://doi.org/10.1016/j.tifs.2023.104269

Thyberg, K. L., & Tonjes, D. J. (2016). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, *106*, 110–123. https://doi.org/10.1016/j.resconrec.2015.11.016

To, S., Coughenour, C., & Pharr, J. (2019). The environmental impact and formation of meals from the pilot year of a Las Vegas convention food rescue program. *International Journal of Environmental Research and Public Health, 16*(10), Article 1718. https://doi.org/10.3390/ijerph16101718

United Nations. (n.d.). *The 17 goals*. Retrieved September 9, 2024, from https://sdgs.un.org/goals

U.S. Environmental Protection Agency [US EPA] (2023). *Wasted food scale* [Overviews and factsheets]. https://www.epa.gov/sustainable-management-food/wasted-food-scale

Urugo, M. M., Yohannis, E., Teka, T. A., Gemede, H. F., Tola, Y. B., Forsido, S. F., Tessema, A., Suraj, M., & Abdu, J. (2024). Addressing post-harvest losses through agro-processing for sustainable development in Ethiopia. *Journal of Agriculture and Food Research*, *17*, Article 101316. https://doi.org/10.1016/j.jafr.2024.101316

Vander Vennen, R., & Parizeau, K. (2023). Beyond charity? Insights on the Upcycle Kitchen: A food rescue work integration social enterprise in Guelph, On. *Journal of Social Entrepreneurship*. Advance online publication. https://doi.org/10.1080/19420676.2023.2205420

Veeckman, C., Vanobberghen, W., Kalemaki, E., Madesi, V., & Theodoridis, A. (2018). An engagement-related behaviour change approach for saving food in Greece. In S. Diplaris, A. Satsiou, A. Følstad, M. Vafopoulos, & T. Vilarinho (Eds.), *Internet science. INSCI 2017. Lecture Notes in Computer Science* (Vol. 10750, pp. 153–167). Springer. https://doi.org/10.1007/978-3-319-77547-0_12

Vilariño, M. V., Franco, C., & Quarrington, C. (2017). Food loss and waste reduction as an integral part of a circular economy. *Frontiers in Environmental Science, 5*, Article 21. https://doi.org/10.3389/fenvs.2017.00021

Warshawsky, D. N. (2015). The devolution of urban food waste governance: Case study of food rescue in Los Angeles. *Cities, 49*, 26–34. https://doi.org/10.1016/j.cities.2015.06.006

Zhang, M., Gao, M., Yue, S., Zheng, T., Gao, Z., Ma, X., & Wang, Q. (2018). Global trends and future prospects of food waste research: A bibliometric analysis. *Environmental Science and Pollution Research, 25*(25), 24600–24610. https://doi.org/10.1007/s11356-018-2598-6

Appendix.

Table A1. Search Strategy

Terms	Scopus	Web of Science
Food Rescue	food W/3 (rescue OR rescued OR rescues OR redirect* OR upcycl* OR reclaim*)	food NEAR/3 (rescue OR rescued OR rescues OR redirect* OR upcycl* OR reclaim*) (title)
Programs	program* OR initiative* OR strateg* OR project* OR model* OR activit* OR service* OR intervention*	program* OR initiative* OR strateg* OR project* OR model* OR activit* OR service* OR intervention*