A Qualitative Study of United States Food Waste Programs and Activities at the State and Local Level

Christine Benson

A thesis

submitted in partial fulfilment of the

requirements for the degree of

Master of Public Health

University of Washington

2017

Committee:

Jennifer Otten

William Daniell

Program Authorized to Offer Degree:

Nutritional Sciences Program

University of Washington

Abstract

A Qualitative Review of United States Food Waste Programs and Activities at the State and Local Level

Christine Benson

Chair of the Supervisory Committee:

Assistant Professor Jennifer Otten

Environmental and Occupational Health Sciences

In the United States, 40 percent of all food intended for human consumption is lost or wasted. This has economic, environmental, and social consequences that justify the involvement of public agencies. Although there have been actions taken by public agencies across the country to address the issue of food waste, little is known about how public agencies are addressing this complex and multifaceted issue. To investigate current efforts of agencies at the state and local level, we conducted a qualitative study of the strategies, challenges, successes, and recommendations of agencies currently doing this work. Comparing the experiences of different agencies, we identify how a scarcity of organizational resources, a lack of dedicated personnel, inadequate metrics, dissimilar

goals, and perceived conflicts with EPA recommendations contribute to difficulty in developing and implementing successful programs. We also explore how agencies have used existing metrics, activities, and resources along with a phased-in approach to overcome these barriers. Finally, we address how agencies view stakeholder engagement, cross-sector collaboration, improved metrics, education, comprehensive approaches, and improvements to food recovery as integral components that need to be addressed at a systems-level in order to make food waste prevention possible in a lasting and meaningful way. These findings can be used to inform agencies about strategies and best practices to be used to create effective and successful programs to reduce the burden of wasted food.

Introduction

In the United States, it is estimated that 40 percent of all food grown in the country and intended for human consumption is lost or wasted [1,2]. These high and increasing losses not only represent economic loss, but also needless environmental degradation and missed opportunities to meet the needs of hungry people. Given the strain of wasted food on our public goods, public agencies are becoming compelled to act. However, little is known about the ways in which public agencies are addressing this problem, including the barriers and challenges they might be facing, or the roles they might play to more effectively reduce this problem.

Reducing the amount of wasted food is vital to improve the economy, hunger, and the environment. The cost of wasted food in the U.S. has been valued at $166 to $218 billion annually [3,4]. Meanwhile in 2015, 12.7 percent of U.S. households were considered to be food insecure [5] and nearly $680 million was spent to provide food to low-income people through the Emergency Food Assistance Program [6]. It has been estimated that reducing the amount of wasted food in the U.S. by only 15 percent could feed 25 million Americans [7]. Food that is wasted also has significant environmental consequences. Estimates of CO_2 emissions related to wasted food in 2009 were 112.9 million metric tons or 2 percent of net greenhouse gas emissions nationally [8]. Food waste that ends up in landfills accounts for 16 percent of US methane emissions, a gas that is 25 times as harmful to climate change as CO_2 [9]. Food that is wasted also wastes valuable resources spent growing, harvesting, processing and transporting food, including water, labor, and energy [2,10].

National and international public agencies have recently called for a reduction in wasted food. In 2015, the U.S. Department of Agriculture (USDA), the U.S. Environmental Protection Agency (EPA), and the U.N. Food and Agriculture Organization launched initiatives, calling for

a 50 percent reduction in wasted food [11,12]. That same year, the EPA created the *Food Recovery Hierarchy* in an attempt to prioritize and direct food waste reduction efforts, naming source reduction (the reduction of the volume of surplus food that is generated) as the highest priority, followed by feeding hungry people (also referred to as food recovery), feeding animals, repurposing food for industrial uses, composting and finally landfilling [13].

In response, state and local public agencies have begun to develop and incubate programs and activities aimed at preventing food waste and improving food recovery [4,14]. To date, little is known about these activities, such as current successes and challenges, or whether these are common between agencies. Reports published by individual agencies on issues of food waste have focused mainly on their own food recovery programs [15-17]. Additional publications by industry and prevention-promoting businesses look mostly at promoting services and best practices [18,19]. These reports have been representative of only one agency or business and do not address common challenges, successes, or lessons from which other agencies can learn.

This study examines how multiple public agencies are addressing food waste reduction through source reduction (also referred to as food waste prevention) and feeding hungry people, the top two methods for waste reduction as outlined in the *Food Recovery Hierarchy*. Using qualitative interviews with public agency staff heavily involved in food waste prevention and recovery, we explore the capacity of agencies for addressing wasted food, challenges, ways agencies have overcome these challenges, and recommendations for addressing the problem at a broader systems level.

Methods

Participants and procedures

From April 2015 through March 2016, four pre-identified federal, state, and local public agencies were approached via phone or e-mail with a study invitation describing the goals of the study and requesting their participation in semi-structured interviews about their food waste prevention and/or recovery programs and activities. The initial agencies selected were pre-identified through internet searches and in discussion with a food policy and food waste specialist within the City of Seattle and Seattle Public Utilities, respectively. Interested participants were instructed to contact a research staff to schedule an in-person or phone interview. Inclusion criteria were that they had current programs or activities related to food waste prevention and/or recovery. After the initial set of interviews, an additional three public agencies were identified for recruitment using the snowball sample method in which one public agency referred another public agency and so forth. One agency declined to participate. After the first six interviews had been conducted, four additional agencies were selected in order to make a geographically diverse sample. These four agencies were identified through an internet search of food waste prevention and recovery programs across the country using key terms from the first six interviews. Potential interviewees were contacted in the same manner as with the other agencies and none declined to participate. Contact information for all potential interviewees was collected through internet search or referrals from other agencies. Interviews were conducted by phone (n=9) and in-person (n=1) and audio-recorded. Interviews lasted approximately one hour and were conducted by two trained researchers to ensure consistency (SD and CB). In total, 10 geographically diverse participants were interviewed until the research team felt that theme saturation had been reached [20].

Semi-structured interviews

A semi-structured interview format was used by the research team because it allowed for uniformity but also flexibility to incorporate new topics and follow-up questions as they emerged [21]. A series of open-ended questions were designed to explore the strategies, challenges and opportunities for public agencies participating in food waste prevention and/or recovery based on key constructs that were identified via a review of food waste prevention and recovery strategies at the county, city, state and national levels. The initial interview guide was reviewed by two collaborators from the City of Seattle and Seattle Public Utilities (SPU) for clarity and relevance and by an internal SPU team for survey design. The final interview guide consisted of 21 open-ended questions; all questions were covered in each interview. In general, interviewees were asked to describe their agency's current programs and/or activities for food waste prevention and recovery. They were also asked to describe challenges, successes and evaluations of these programs/activities, to list whom they have partnered with, to describe improvements to programs/activities, and to make recommendations for other agencies. Slight modifications were made to individual interview guides to accommodate the varying scope of different agencies.

Data analysis

All interviews were professionally transcribed verbatim. Using best practices in qualitative analysis and an inductive approach [22], the research team (CB, SD, JO) created a preliminary codebook based on major categories and themes within categories identified in interview guides. Additional categories were identified as they emerged [23]. This process continued until a codebook was developed that contained all relevant themes. Two researchers double-coded the first two interviews (CB, SD). Discrepancies were reviewed and discussed until consensus was reached and the codebook was modified to final [23]. The remaining

interviews were coded by one researcher (CB) using Dedoose Software [24] and in conjunction with regular discussion meetings with team members (SD, JO) trained in qualitative research. Each major category and the major variations within category are described in the results section below along with illustrative quotes.

Ethical issues

The University of Washington Institutional Review Board approved the study. Participants received written and verbal information about the study prior to obtaining written informed consent. Identifiers were removed and results were reported in aggregate.

Results

The ten participating public agencies were geographically diverse (2 South, 1 Midwest, 1 Northeast, 6 West) and varied in scale of jurisdiction (5 county, 4 state, 1 national). The departments in which each agency's food waste reduction and prevention initiatives were housed differed, but were most often waste management or environmental protection. The scope or capacity of agency initiatives ranged from overseeing one local food waste prevention or recovery program to multi-level programs, some with a national focus. The following sections summarize key findings.

Current programs and activities aimed at food waste recovery and prevention

All agencies had food *recovery* programs and/or activities and eight of ten agencies had food waste *prevention* programs and/or activities. Five agencies had one or more activities that combined prevention and recovery. Table 1 provides detail about the current food waste recovery and prevention programs and activities in which public agencies are involved.

Table 1: Current Programs and Activities of Public Agencies Aimed at Reducing Food Waste through Source Reduction and Food Recovery

Programs/activities that supported food waste prevention
➢ Funding LeanPath software for businesses and institutions and providing training and technical assistance ➢ Supporting food waste education to students in elementary schools ➢ Conducting residential food waste prevention pilots in neighborhoods ➢ Supporting residential food waste prevention through websites, media campaigns, social media, toolkits, and materials distributed at fairs and community events designed to inform consumers how to reduce food waste in the home ➢ Supporting food waste prevention programs for schools by providing equipment and assistance with programs, data collection and waste audits ➢ Hiring an employee for 1 year to do food waste prevention work
Programs/activities that supported food waste recovery
➢ Utilizing existing software or designing new software to coordinate food recovery at the county or state level ➢ Providing education around food safety and training for food recovery volunteers ➢ Supporting recognition programs to incentivize commercial food donation ➢ Providing funding and equipment to support current recovery efforts and set up new programs ➢ Aggregating data collected from food recovery agencies using a conversion factor ➢ Coordinating meetings with local anti-hunger agencies ➢ Providing consulting services to food banks to help maximize operations ➢ Showing support by promoting food donation through workshops and social marketing ➢ Supporting the creation of guides for food donation that included information on best practices, food dating, and location of donation-accepting facilities in the area ➢ Assisting with the set-up of food donation programs at businesses and institutions ➢ Creating a map of food recovery organizations, distribution centers and waste processing facilities statewide
Programs/activities that supported both food waste prevention and recovery
➢ Hosting conferences with state, national and/or international partners to talk about food waste reduction ➢ Providing technical assistance for businesses that includes both prevention strategies and setting up donation programs ➢ Conducting state-wide assessments of food waste and/or the environmental benefits of waste reduction and publishing a report ➢ Allocating funds from landfill fees to support food waste prevention and recovery programs

Interviewees often described their food recovery programs and activities as more comprehensive than prevention programs because they were related to the long-standing existing emergency food system and also because food recovery programs were characterized as easier to understand and implement. Recovery programs and activities included providing funding to support food bank efforts, creating guides or toolkits to inform donors about food donation, matching donors to food banks, coordinating recovery, and providing consultation and technical assistance to donors and food banks.

In contrast, prevention programs and activities were often described as harder to implement than recovery programs due in part to a lack of existing programs or strategies on which to learn from or model. Prevention programs and activities included funding third parties to provide technical assistance to businesses and institutions, supporting food waste education to schools and households, and conducting residential food waste prevention pilot programs.

Combined activities included hosting conferences to talk about food waste reduction, conducting assessments on waste and the environment to garner support for programs, and allocating funds from landfill fees to support prevention and recovery efforts.

Challenges to food waste prevention and recovery efforts

The main challenges to food waste prevention and recovery programs that emerged from the interviews included the disorganized nature of current efforts that occurred throughout the agency or across agencies or even within the larger municipality or state; a lack of internal agency resources and centralization that would allow them to prioritize, create, and implement effective programs; difficulties in effectively engaging key players throughout the system, often due to competing priorities, general misperceptions, or a lack of education; and a lack of common metrics or measurements to describe the problem and garner support for it. Another

unexpected challenge mentioned by many interviewees was a perceived conflict between programs addressing different levels of the EPA hierarchy.

Organization

Agency participants often described their food waste prevention and recovery efforts as uncoordinated and splintered — a situation where different teams and departments throughout an agency or across agencies, or even outside of an agency, were responsible for various and sometimes overlapping aspects. As one interviewee stated,

> "One of the things we have noticed is that we have basically these two boxes…when you're looking through the lens of food: Food-to-people or food-based prevention and then discard is food to composting. Because of these two boxes, they have separate staff that work on separate projects, separate meetings. There is a little bit of crossover, but really there is not a comprehensive sort of thread that ties those two groups together."

Responsibility was also divided between local, county, and state government agencies. "Within each municipality within our community there's different goals and policies and political affiliations." This was often seen as being the result of established priorities within agencies taking precedence. One interviewee discussed this,

> "We are just competing for their attention with so many other things. That's a chronic problem just in society today, is just how do you get your message to the forefront? What media do you use? What is most effective? How do you get people to not just pay attention but to take action?"

Resources

The organizational discord described above was often discussed in relation to a lack of resources. All interviewees felt that inadequate internal resources prevented them from developing, coordinating, and implementing effective food waste prevention and recovery

programs. The mentioned resources included funding, staff, training, technology, and infrastructure. As one interviewee summarized, “We just didn’t have the resources here to… give it the attention that it deserved.” Many discussed that food waste prevention and recovery responsibilities were tacked on to existing job descriptions and budgets rather than being created as part of a single strategy. As one interviewee described, “it's a fraction of my job and so I think it's just hard to do a whole lot. We don't have a budget. So it's basically when I have time to do something or if somebody gets a grant we're able to do that.” Many felt that coordinating or centralizing limited resources could better drive more cohesive strategies and allow this emerging area to be recognized and prioritized.

Key players

Another challenge noted by interviewees was the difficultly in effectively engaging key players throughout the system in support of food waste prevention and recovery. Interviewees often discussed the complexity of the system and approaching the different needs of the inter-related key players, including food rescue organizations, food-generating businesses, and the agency itself. Challenges commonly cited across key players included competing priorities, general misperceptions, or a lack of education.

Interviewees mentioned that food rescue organizations were often the easiest to reach because their mission aligned so closely with recovery efforts and they were mostly supportive of prevention strategies. However, they also felt that organizations involved in the emergency food recovery system were severely limited in their ability to be effective because they were often underfunded, understaffed and under-resourced, making it hard to effectively engage them.

Food-generating businesses were seen as important partners in prevention and recovery programs, but interviewees noted difficultly making lasting connections to the food recovery

system or in training them in waste prevention due to high staff turnover. As one agency interviewee said, "The industry itself is very volatile. We'll reach out to a kitchen manager, and then a few weeks later we'll find out that they're gone. We were having discussions with a hospital who seemed to be onboard and was ready to sign the MOU and then just kind of went silent."

In addition, agency participants described how businesses often felt that it was costly to set up a donation system and, while the businesses cared about hungry people, they had other higher priorities in sustaining the business that came first. As one participant described, "It's perceived as a big commitment. I think that there is still this perception of how will we, you know, how much time is this going to take from our labor force?" Agency participants recognized tax incentives as a way to encourage commercial food donation, but felt businesses were often unaware or did not understand these incentives, or that they were structured in a way that did not apply to all businesses. One interviewee described this challenge, "I think a challenge is that organizations that donate, I don't know if they fully understand that they can get a tax deduction."

Interviewees felt businesses disbelieved or lacked knowledge about protections for food donation that were covered under the Good Samaritan law, noting concerns about food safety liability as one reason businesses didn't donate food. As one agency interviewee discussed, "A definite [barrier] from the food rescue is the fear factor of 'what if I'm liable if somebody gets sick?' It's all going to go under the Good Samaritan Law… but helping people understand that. Most people have no idea." On the waste prevention side, agencies encountered many businesses that did not believe wasted food was a problem because they were already mindful of their

bottom line. As one interviewee said, "You first have to get over that perception or misconception that we don't waste food. That's one of the biggest hurdles."

Agencies tried to overcome some of these barriers to participation in both prevention and food donation by offering to train and educate staff. One participant acknowledged that these misconceptions existed even at the agency level.

> "Even with just our staff, I feel like there is sort of a misunderstanding and misconceptions about what food waste prevention is; that food waste can be prevented… I hear from staff 'Well, you're always going to have food waste. How could you possibly prevent… all this food waste?'"

Many interviewees also noted a challenge getting businesses and organizations to adhere to programs without regulation. "There has to be some teeth behind it," one participant noted, "I think it needs to be made into a rule in order for people to take it seriously, and a rule that has actual consequences behind it."

Metrics

A fourth challenge mentioned by all interviewees was the lack of common metrics that could be used to describe the problem of food waste and garner support for it. For recovery programs, measurements of food waste were usually made by the donor or food rescue organization. Units of measure were widely varied and often impossible to compare or aggregate. Examples included pounds of recovered food, number of trays or meals served from recovered food, number of boxes of food recovered, growth of food rescue organizations, and cost per ton of food recovered. Also, these measurements were conducted by untrained staff, and interviewees considered them very unreliable. One interviewee described this,

> "They would give us the estimates of weight in pounds or number of boxes, or if they had new clients they had started working with. A lot of those metrics were a little more on the anecdotal side. There was nothing you could really do a statistical study on."

In terms of prevention, participants found measurements especially challenging. As one interviewee mentioned,

> "Prevention is… like you're measuring what doesn't exist… there are ways to do it but it's just so much more complicated. For example, we see decreases in consumption during recessions because people just don't have the buying power, not because the county did anything to help people prevent waste."

On a broader scale, when measurements were done on food waste, they were rarely separated into what was edible versus inedible, or for recycling versus composting. As one interviewee noted, "If people track the amount of waste going out, they just track it as waste, they don't really classify it as 'oh, this [is] food waste, this is recycling, this is landfill'."

Many participants noted that even when measurements were done effectively, they were difficult to scale up. This contributed to a lack of available broad-scale metrics. One interviewee expressed that, "There's still a gap in measurement that's worth noting at the macro level. And then even at the state level, the way we're measuring doesn't align."

The lack of available and reliable metrics made it difficult to establish a baseline, measure progress, evaluate programs and garner support. This also raised questions about the accuracy of current wide-scale food waste estimates. As one interviewee mentioned,

> "A lot of the data we have on farm loss doesn't include what's really being lost on the farms. Most of that production data we don't even know. We think food waste is a problem, and it's probably an even bigger problem than we think it is."

Conflicting goals

Finally, an interesting challenge that emerged from the interviews was a perceived conflict between different levels of the EPA hierarchy. According to the EPA hierarchy, food waste efforts should prioritize prevention first, followed by recovery, diversion to animal feed or industrial uses, composting, and then landfill. For many reasons, this presented a challenge for agencies, most commonly because these goals were viewed as conflicting or being in direct competition. For example, making improvements at a prevention and donation level often interfered with how compost and recycling success was viewed. As one interviewee noted, these agencies "get no credit for prevention… in fact, sometimes [they] get dinged because if you prevent things you can decrease your recycling rate for a variety of reasons." In addition, even though prevention is prioritized in the hierarchy, it was often given lowest priority among agencies due to difficulties with implementation. As one participant described, "It's just easier to divert to composting. It's much easier to wrap your head around than food waste prevention."

Many had trouble implementing prevention programs due to the unique challenges they posed. Some participants also expressed concern that prevention or compost programs would equate to less food available for recovery. Two interviewees commented,

> "We found that for that particular audience the food waste prevention is much more challenging to implement and surplus food donation is much more tangible".
> "There was definitely a fear when we started the composting program that people would quit donating, because just tossing it in the compost bin would be easier."

These barriers often led agencies to prioritize compost or recovery programs over prevention. Models for improvement were lacking for public agencies. As one interviewee described,

> "I do feel like source reduction is the most important conversation we should be having, but I think it is difficult and maybe there aren't enough good models out there for people to copy so we aren't really talking about it. Instead we're jumping to the end use factors."

Overcoming challenges to building food waste prevention and recovery programs in public agencies

Interviewees described four main strategies that helped them overcome the challenges to building food waste prevention and recovery programs. These strategies included using what metrics existed or could easily be collected to build support for programs; identifying what activities were currently in place and building on existing work; combining resources from different sectors to bolster support; and employing a slow and phased-in approach to implementation.

Employing metrics

All interviewees underscored the importance of using what metrics could be gathered to make the case for food waste prevention and recovery. As one interviewee described, "…metrics will be extremely important to reporting to our current funders, and then going forward to the community as a whole in supporting our whole program." Metrics used by agencies ranged from quantitative measures, such as residences or businesses reached by a particular program, to qualitative measures, such as success stories or behavior changes. Metrics were useful in setting goals, tracking and measuring progress, and education and outreach. Some metrics were existing while other metrics were generated by grantees as part of grant awards or by agencies gathering and aggregating new data. One interviewee explained,

> "All the counties are responsible every year to report to the state the amount of waste that's generated, how much they're recycling and then break down how much they're composting, how much they're sending to a waste facility… some of the counties report how much food

> is being rescued or recovered… so we're able to at least kind of track a little bit what's happening."

Technology was frequently used as a tool to track and measure waste. Some participants reported funding end-users to pilot technology and providing training and technical assistance to get those systems up and running. Many also said that the process of asking businesses or households to track their waste was crucial for catalyzing change. As one interviewee said,

> "The weighing of the food always seems to be the biggest aha moment for them all… When you're forced to realize through weighing [your waste] and measuring it that you're part of the problem… that always seems to be something that inspires people to try to do a better job."

Complementary impact metrics, such as those that measure greenhouse gas emissions, water saved, or nutrients recovered by lessening food waste, were mentioned as additive for making the case by half of interviewees. The use of these impact metrics helped make food waste relatable to other organizations and causes. Two participants commented,

> "Now there's some research that allows you to show the environmental impacts and how huge they are. It's definitely something that has been helpful in convincing our management to look at it and take it seriously."
> "I always try to consider the driver that's going to speak to that particular audience, whether it's the climate action plan… or our integrated waste management plan… the message varies depending on the audience."

In particular, cost savings were considered an important impact metric for recruiting businesses to participate. Cost savings for businesses came from reduced landfill fees, reduced food costs, and tax incentives. An interviewee described this,

> "I think it would be very difficult for us to [implement our program] if it was going to cost businesses more money. And because we were able to make a pretty informed and compelling case that either they were going to save some money or they could pretty much do it cost neutrally over time. That was really important. And that was the reason we were able to get the support and buy-in that we had."

Leveraging existing activities

A second strategy used to overcome barriers was identifying current activities and finding ways to build upon existing work. This identification step was considered important. Interviewees often saw their role as creating partnerships between groups already doing this work or coordinating efforts between departments, organizations, businesses and communities. As two interviewees described,

> "For us, we started by trying to figure out the lay of the land here and what was already happening and if there was an area that was not being covered, that might be our role."
> "Understand the existing network… then figuring out, based on what you've learned from who is in that network, how you might plug into that network in a way that helps all of these organizations achieve their goals while you make progress on your own."

To help connect these groups, participants often created food waste reduction committees that served as learning networks amongst key stakeholders at the government, commercial, and organizational levels. One agency developed a food policy council, which connected state agencies and NGO's from the public health, nutrition and economic sectors to influence the local legislature to support food waste prevention and recovery programs.

Combining resources

A third strategy was finding ways to combine money and resources from different sectors to support new efforts. For example, one city combined public health and solid waste

dollars to fund a hunger awareness media campaign that resulted in increased public and stakeholder support for food recovery programs. As an agency interviewee described,

> "They were able to get a budget … to do that media campaign. As a result… they were able to get enough public acceptance around why hunger is important and what we can do about it. We need more infrastructure and now they're able to invest in that, because they have buy-in at the county level; buy-in with their appointees, and the public is really supportive."

Another agency created an outreach coalition of cities and counties that combined their funding and resources to develop media campaigns geared toward educating their communities on the importance of food waste prevention and recycling.

One county passed a measure that imposed a tonnage fee on all refuse accepted for landfilling or incineration. The fee has increased over the years and now generates several million dollars per year, a percent of which gets allocated to increasing food prevention activities. Agency websites were commonly used as a way to coordinate resources across sectors. Websites were considered successful because they helped to raise awareness about food waste issues, broaden the reach of the agency's efforts, and make resources available to a wider audience. Some web programs were multifaceted. One agency created "a web application that matches food donors with food recipient organizations and volunteer food runners… but it's more than that because it's also education; it's also recognition; it's grant giving… and it's information sharing."

Implementing programs slowly

A fourth strategy was growing programs slowly. Wide-scale food waste prevention, recovery, and diversion is a complex system. Taking a phased-in approach was seen as essential

to run pilot programs, conduct needs assessments, build infrastructure, and raise awareness. As one participant said,

> "I think this stuff just takes a lot of time and I think it's the kind of thing that is much more successful if it's done in stages, rather than just trying to launch a statewide program or countywide program… starting on a smaller scale and then building up from there, I think that's really important."

Growing slowly also helped some agencies gather vital support from businesses, policymakers, and communities. "The [program] was developed over a very long period of time," one interviewee noted, "so businesses and institutions and stakeholders had a long time to prepare for it."

Agency perspectives for improving food waste prevention and recovery across the system

A number of common themes emerged regarding the need for system-level improvements, including stakeholder engagement, cross-sector collaboration, system-level metrics, and education. Interviewees also mentioned the importance of building comprehensive programs using a systems approach and making wide-scale improvements to existing food recovery programs.

Stakeholder engagement

Many interviewees emphasized the need for appealing to the broader group of stakeholders. This included groups within and beyond the agencies' jurisdictions such as governments, communities, non-profits, food banks, private businesses, industry associations, existing experts, academia and anyone involved in food production, distribution, and retail.

Interviewees felt this stakeholder input was a key element and needed to be involved throughout the planning and implementation processes. As one interviewee said,

> "I see the improvements over time being more around growing awareness and building new relationships between local government, the community, nonprofits like the food bank, and private business. There are links that are not yet fully or even exist at all between the key sectors in the community."

Local committees, regional conferences, and events with national and international partners were strategies used by some agencies to try to bring together stakeholders.

Cross-sector collaboration

Interviewees also said that food waste efforts need to connect to and among the many sectors that are impacted by food waste issues but are not specifically focused on food waste, especially those that are already doing good work in this area. Interviewees mentioned groups that are focused on food security, food justice, environmental health, public health and chronic disease prevention, among others. Environmental and public health were of particular interest to a number of participants because they felt that metrics from these sectors would be impactful and resonate with a wider audience. As one interviewee stated, "I see food as a way to connect with a much more diverse set of individuals and organizations in the county. Folks are interested in food and from a whole variety of fronts."

Recommendations were also made to combine efforts within agencies and between departments. This included sharing information, responsibility, and funds as well as aligning goals. As one interviewee described, "I think the combination of public health dollars with solid waste dollars, there is a lot of potential there and I don't think that's been tapped to the extent that it could."

Metrics

Another area where interviewees felt large scale improvements were needed was in terms of metrics. Interviewees felt that the issue of food waste needed both a national baseline and a national language. One participant proposed creating a conversion factor for all of the different ways that food waste is currently measured, while others suggested streamlining how food waste is measured locally. Large-scale measurements were seen as important for all elements of food waste programs including garnering support, collaborating, scaling up, and setting goals. "It's really about measuring what matters… so you have people who get the work and who can do the work." Some participants felt that measurements needed to be separated into what is food waste versus other waste and edible versus non-edible. Increased alternative measurements were also seen as important and included wasted water, energy and nutrients as well as health benefits and other environmental outcomes. Some interviewees mentioned that improvements were also needed in how waste is measured on farms and within homes.

Education

Many interviewees mentioned the importance of improving and broadening education to a national scale. A few mentioned the importance of better education at the agency level, while others focused on smaller scales; this included better education around food donation best practices based on what people who utilize the emergency food system are willing to eat and what foods are best for their health. As one agency interviewee noted "I could literally send you pictures of mountains of sweet potatoes that get donated and carrots that aren't utilized, because people either don't know how to cook it, or don't have a taste for it, or are unfamiliar with it."

Almost all interviewees mentioned confusion about food product dating (i.e. use-by, best-by, sell-by dates) as a major contributor to food waste, and suggestions for improvement scaled

from educating consumers to making labeling more clear and accurate by imposing legislation. As one participant explained, "The sell-by, pull-by, best-buy dates - that is just a universal issue from all levels, because they're arbitrary."

Interviewees also mentioned the benefits of consumer education around the acceptance of "ugly" produce to create a market that can incentivize farmers to harvest all of their crops, ensuring that no food is wasted at the farm level. "There is not a real incentive to pick a blemished apple," one participant noted, "You're not going to get a premium price from the grocery store for it. If we can incentivize that."

Better sharing about best practices and successful programs was important because certain municipalities don't have adequate information about what is being done in other localities and what is and isn't working. One interviewee noted, "There needs to be more… education to those of us who are trying to implement these programs on what we can do, like best practices and models that we can use."

Comprehensive approaches

Interviewees felt a comprehensive approach was needed to address all levels of the EPA hierarchy and incorporate these into goals and messaging. One participant summarized this by saying,

> "Where I think we could dramatically improve, you know, is… to start discussing this concept of a dual message in all of our programs from residential to commercial of eat your food; take only what you need; donate and then compost the rest. I see that as sort of one of the biggest improvements that would support all of our projects and efforts across the country."

Other interviewees emphasized the importance of prioritizing prevention, even though it was often the most technical and challenging strategy. Starting with prevention programs was mentioned as a way to overcome the barriers associated with people who felt that they were already doing their part by composting. As one participant explained,

> "I see more of an emphasis on composting as a gateway to achieving prevention… I think it's more cost effective to start up front and raise awareness. You're also going to get more participation in the composting program when people understand the problem of food waste. For the communities that don't have programs it's probably a good place to start."

Improve food recovery

A final idea that emerged from almost all interviews was the need to address the current barriers and inadequacies of the emergency food recovery system as a whole. Better coordination and infrastructure were seen as integral to reducing food loss and improving food recovery. Food banks' reliance on donations, grants, and volunteers affected their ability to distribute food, transport food safely, and maintain relationships with donors. Coupled with the barriers at the donor and agency level, this resulted in what some referred to as a "broken system" that discouraged donation and encouraged easier but less desirable diversion methods like compost or landfill. One interviewee summed up these barriers,

> "There's all these costs that other foundations and other people are fronting that are generated from a broken food system… it's really hard for those nonprofits to make a case to be able to get more funding, to be able to have more trucks… And many times their staff is not really well-paid, sometimes they're volunteers, sometimes the volunteers don't show up at the grocery store and the grocery store just has all this food that is supposed to be donated that nobody picks up. And then now the grocery store doesn't really like this food donation program that they established because they think some food rescue organizations are flaky because they just don't show up. So then those relationships get tainted a little bit and then

> that's when many grocery stores just want to deal with the compost and say, okay, we're going to put everything in one bin and it's just going to go to the composting facility."

Discussion

Food waste issues are complex, and constructing programs that address their multiple levels is a complicated task. In this study, we identify common challenges that public agencies face as they try to develop and implement programs that reduce the burden of food waste in their communities. This study also explores successful approaches for overcoming key challenges and potential systems-level improvements that might be tried. Most notably, we identify perceived conflicts that exist between levels of the *Food Recovery Hierarchy* for agencies that make it difficult to prioritize waste prevention over food recovery. Coordination and collaboration by appealing to the common goals of multiple stakeholders emerged as a vital strategy to overcome this and other challenges and improve efforts across the food system, possibly even at a national level.

The need for consistent and reliable metrics also emerged as an essential part of setting and measuring progress toward food prevention and recovery goals. Since these interviews were conducted, the World Resources Institute has developed a standard for food waste measurement [14], the effectiveness of which remains to be seen. However, the fact that even rudimentary metrics were successfully employed by agencies to strengthen efforts supports the importance of this advancement. Implementing this first step will be important to improving food waste reduction.

Interestingly, throughout this study, agency interviewees expressed great interest in these findings and in learning more about efforts of other public agencies around this issue. This may

indicate that agencies are ready to kick start this conversation, adopt best practices, and engage in national-level interventions and improvements.

Until this point, most research on the topic of food waste has focused on quantifying food waste, exploring environmental and economic impacts, and proposing industrial uses [1,3,7,8,25-35]. Although some research has examined different strategies and the potential role that public agencies can play [4,36-39], this was the first to interview public agencies about their perspectives on efforts in state and local governments. This study was limited by a small sample size of agencies which results in limited generalizability to local and state governments beyond those interviewed. However, the small sample size was in large part due to a lack of agencies involved in both food waste prevention and recovery efforts. Despite this limitation, interviewees represent a geographically diverse sample.

Significant gaps still remain in the areas of food waste and public action. Future research could include applying the food waste measurement standard to provide insight into the effectiveness of current programs which would help identify best practices. Additionally, investigating alternative metrics such as environmental benefits and cost savings could prove important in engaging multiple sectors and garnering support for future programs. In terms of developing comprehensive programs that address the multiple levels affected by food waste programs, researchers can look to literature on how coordinated and comprehensive structures were established at the agency level to deal with similarly multi-faceted topics such as obesity prevention.

Conclusion

Public agencies are in a unique position to address issues of food waste in their localities. This study identifies challenges to addressing food waste, approaches for overcoming these

challenges, and agency perspectives for improving food waste prevention and recovery across the system. Agencies can use this information to develop informed strategies to address this important issue.

Acknowledgements

The authors would like to thank Liz Fikejs, Senior Conservation Program Manager with Seattle Public Utilities; Sharon Lerman, City of Seattle Food Policy Advisor for assisting with the development of interview guides and identifying agencies; Sara Diedrich for researching food waste programs, conducting interviews, and assisting with analysis; and, Katherine Getts for assisting with analysis.

References

1. Buzby JC, Wells HF, Hyman J. The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States. 2014. Economic Information Bulletin-121.
2. Hall KD, Guo J, Dore M, Chow CC. The progressive increase of food waste in America and its environmental impact. PloS One. 2009;4(11):1-6
3. Buzby JC, Hyman J. Total and per capita value of food loss in the United States. *Food Policy*. 2012; 37:561-70
4. ReFED. A roadmap to reduce U.S. food waste by 20 Percent. Available at: http://www.refed.com/ downloads/ReFED_Report_2016.pdf. Accessed March 30, 2016.
5. Coleman-Jensen A, Gregory C, Singh A. Household food security in the United States in 2013. 2014. Economic Research Report No. EER-173.
6. US Dept of Agriculture Food and Nutrition Service. Nutrition program fact sheet: The emergency food assistance program. Available at https://www.fns.usda.gov/sites/default/files/tefap/ pfs-tefap.pdf. Accessed July 15, 2016.

7. Gunders D. Wasted: How America is losing up to 40 percent of its food from farm to fork to landfill. 2012. Natural Resources Defense Council. Available at https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf. Accessed September 28, 2015.
8. Venkat K. The climate change and economic impacts of food waste in the United States. *International Journal on Food System Dynamics*. 2011; 2(4):431-46.
9. U.S. Environmental Protection Agency. Inventory of U.S. greenhouse gas emissions and sinks: 1990-2010. 2012. Available at https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2012-Main-Text.pdf. Accessed January 13, 2016.
10. Food and Agricultural Organization, United Nations. Global Initiative on Food Loss and Waste Reduction. 2015. Available at http://www.fao.org/3/a-i4068e.pdf. Accessed October 9, 2016.
11. U.S. Environmental Protection Agency. *EPA and USDA Join Private Sector, Charitable Organizations to Set Nations First Goals to Reduce Wasted Food*. 2015. Available at https://www.epa.gov /newsreleases/epa-and-usda-join-private-sector-charitable-organizations-set-nations-first-goals. Accessed September 28, 2015.
12. U.S. Environmental Protection Agency. *Food Recovery Hierarchy*: *Sustainable Management of Food*. Available at https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy. Accessed September 28, 2015.
13. Neff RA, Kanter R, Vandevijvere S. Reducing food loss and waste while improving the public's health. *Health Affairs*. 2015; 34(11):1821-9.
14. Hanson C, Lipinski B, Robertson K, Dias D, Gavilan I, Gréverath P et al. Food Loss and Waste Accounting and Reporting Standard. 2016. World Resources Institute. Available at http://www.wri.org/sites/default/files/REP_FLW_Standard.pdf. Accessed June 6, 2016.
15. Ernsdorf S. Food Rescue in Seattle and King County: Current Status and Growth Opportunities. 2006. Seattle Public Utilities and King County Public Waste.

16. Curtis RB, Curtis KG. The Food Donation Infrastructure: An Assessment of the Portland Metropolitan Region. 2011. Portland State University.
17. Franz D, Morris H, Abbe R, Mourad M, Rehberger E, Rivero S. Food Rescue Services, Barriers, and Recommendations in Santa Clara County. 2015. Food Shift.
18. Food Waste Reduction Alliance. Best Practices & Emerging Solutions Toolkit. Food Marketing Institute, Grocery Manufacturers Association and the National Restaurant Association. 2014. Available from: http://www.foodwastealliance.org/wpcontent/uploads/2014/04/FWRA_Toolkit_FINAL_0415141.pdf. Accessed October 9, 2015.
19. LeanPath. 10 ways to save money by managing food waste differently. LeanPath, Inc. Available from: http://info.leanpath.com/10-ways-to-save-guide. Accessed September 3, 2016.
20. Miles MB, Huberman AM, Saldana J. *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks, CA: SAGE; 2014.
21. Brinkmann, S. *Qualitative Interviewing (Series in Understanding Qualitative Research)*. New York, NY: Oxford University Press; 2013.
22. MacQueen KM, McLellan E, Kay K, Milstein B. Codebook development for team-based qualitative analysis. *Cultural Anthropology Methods*. 1998; 10(2):31-6
23. Guest G, MacQueen KM, editors. *Handbook for Team-Based Qualitative Research*. Plymouth, UK: Altamira Press; 2007.
24. Dedoose. Version 7.0.23. Los Angeles, CA: SocioCultural Research Consultants, LLC; 2016.
25. Griffin M, Sobal J, Lyson TA. An analysis of a community food waste stream. *Agriculture and Human Values*. 2009; 26(1-2):67-81.
26. Fonseca JR. A Latent Class Model to discover household food waste patterns in Lisbon City in support of food security, public health and environmental protection. *International Journal on Food System Dynamics*. 2014; 4(3):184-97.

27. Hall KD, Guo J, Dore M, Chow CC. The progressive increase of food waste in America and its environmental impact. *PloS One*. 2009; 4(11):e7940.
28. Parfitt J, Barthel M, Macnaughton S. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society of London B: Biological Sciences.* 2010; 365(1554):3065-81.
29. Girotto F, Alibardi L, Cossu R. Food waste generation and industrial uses: a review. *Waste Management*. 2015; 45:32-41.
30. Shafiee-Jood M, Cai X. Reducing Food Loss and Waste to Enhance Food Security and Environmental Sustainability. *Environmental Science & Technology*. 2016; 50(16):8432-43.
31. Beretta C, Stoessel F, Baier U, Hellweg S. Quantifying food losses and the potential for reduction in Switzerland. *Waste Management*. 2013; 33(3):764-73.
32. Love DC, Fry JP, Milli MC, Neff RA. Wasted seafood in the United States: Quantifying loss from production to consumption and moving toward solutions. *Global Environmental Change*. 2015; 35:116-24.
33. Business for Social Responsibility. Analysis of U.S. food waste among food manufacturers, retailers and wholesalers [Internet]. Grocery Manufacturers Association and Food Marketing Institute; 2014. Available from: http://www.foodwastealliance.org/wpcontent/uploads/2014/11/FWRA_BSR_Tier3_FINAL.pdf. Accessed September 9, 2016.
34. High Level Panel of Experts on Food Security and Nutrition. LPE. Food losses and waste in the context of sustainable food systems. Committee on World Food Security, Rome. 2014.
35. Bagherzadeh M, Inamura M, Jeong H. Food waste along the food chain. (2014). OECD Food, Agriculture and Fisheries Papers. Available from: http://dx.doi.org/10.1787/5jxrcmftzj36-en
36. Lipinski B, Hanson C, Lomax J, Kitinoja L, Waite R, Searchinger T. Reducing food loss and waste. World Resources Institute. 2013. Available from: http://www.wri.org/publication/reducing-food-loss-and-waste. Accessed September 24, 2016.

37. Koester U. Food loss and waste as an economic and policy problem. *Intereconomics*. 2014; 49(6):348-54.
38. Neff RA, Kanter R, Vandevijvere S. Reducing food loss and waste while improving the public's health. *Health Affairs*. 2015; 34(11):1821-9.
39. Leib EB, Rice C, Balkus O, Mahoney J, Anello A, Brown J, Cheng R, Dunyak E, Edelstein D, Golden C, Hensley C, Jerrett M, Malavey M, Montgomery S, Sandson K, Shkuratov M, Xie S, Zhong C. Keeping Food Out of the Landfill: Policy Ideas for States and Localities. 2016. Harvard Food Law and Policy Clinic.