OUT OF SIGHT OUT OF MIND:

AN ANALYSIS OF HOUSEHOLD FOOD WASTE IN ARCATA, CALIFORNIA

By

Jennifer M. Domareki

A Thesis Presented to

The Faculty of Humboldt State University

In Partial Fulfillment of the Requirements for the Degree

Master of Arts in Social Science: Environment and Community

Committee Membership

Dr. Yvonne F. Everett, Committee Chair

Dr. Gregg J. Gold, Committee Member

Margaret Gainer M.S., Committee Member

Dr. Yvonne F. Everett, Program Graduate Coordinator

July 2018

ABSTRACT

OUT OF SIGHT OUT OF MIND:
AN ANALYSIS OF HOUSEHOLD FOOD WASTE IN ARCATA, CALIFORNIA

Jennifer M. Domareki

A rising demand for healthy and sustainably grown food has become a trend of our time. However, there is dissonance in contemporary awareness about where food comes from and where it ultimately ends up. Globally, one third of all food produced is never used. In the United States alone, approximately 55 million tons of food is discarded each year (Venkat, 2012). This is problematic because food waste has environmental, economic and social costs associated with it. Organic materials accelerate anthropogenic climate changing greenhouse gas emissions by releasing methane as they decompose in landfills. In addition, unused food embodies and thus wastes valuable resources in its harvesting, processing and distribution including but not limited to land, water, energy and capital. Food waste has become a function of food security. Countries with the greatest access to food are those that also waste the greatest percentage of food.

The primary goal of this research is to investigate and analyze key driving forces (e.g. the attitudes, beliefs, behaviors, socio-economic influences, management practices) that lead to post-consumer, household food waste for the case of Arcata, CA. The purpose of this research is to provide analysis that will serve as a community-development resource

for motivating more conservative sustainable food waste behaviors and advance management practices in this rural community. My research draws upon environmental psychology for researching the attitudes, beliefs, behaviors and management of food waste in this community. Data was collected using a mixed-method approach including: primary research consisting of semi-structured interviews, community surveys and participant observation coupled with secondary research analysis of peer-reviewed papers, published reports and published data. The case study revealed the challenges of food waste management in rural areas, such as Arcata. In addition, the survey results highlighted common household behaviors and challenges that lead to food waste. In combination the interviews and survey outcomes elucidated plausible opportunities for sustainable food waste management.

ACKNOWLEDGEMENTS

There are many people who deserve recognition for the product of this thesis. First and foremost, I would like to thank my parents for their persistent love and guidance. You both were with me every step of the way, even though we had a country between us. Thank you, Doug, for reading the countless e-mails I sent you that often turned into rants about plastic straws or compost. I send my love and appreciation to Ashley and Tessa for always putting a smile on my face when I needed one, your hugs can be felt from afar.

I give my deepest respect and admiration to my cohort for opening my mind to new perspectives and conversations. You are an amazing group of individuals whom I am happy to have journeyed with. I would like to offer a special thank you to my professors and committee members who helped shape this thesis and my time at Humboldt State University. I appreciate the challenges you presented and the encouragement that followed. I would also like to acknowledge the community members of Arcata and Humboldt County who were the inspiration for this thesis. Thank you for opening up to me and being excited about this topic.

To my friends, new and old, thank you for answering my phone calls no matter what the time zone difference was between us, and who would listen to me talk about food waste as we ate breakfast together. Last but certainly not least, cheers to you, Alex, for being a constant light in my life. Thank you for the little things along the way. You respected my need to work when necessary and you helped create perfect distractions right

when I needed them most. And finally, a special thank you to Rigby, Jude, Jojo, Dog and Koda for being some of the best homework buddies a girl can ask for. I cannot express my gratitude enough to everyone who helped make this thesis such an adventure to write. There are so many people who helped influence this thesis, or encourage me along the way. Thank you, all, for staying with me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Municipal solid waste in landfills results in climate changing greenhouse gas emissions worldwide. It is estimated that landfills contribute 3-5% of the global greenhouse gas emissions budget (Lou, 2009; Papargyropoulou et al, 2014). Although volume and physical composition of landfills will vary depending on local environments and lifestyles (Chen & Lin, 2006) organic material is the largest component of landfills (Thyberg, & Tonjes, 2016). This is the accumulation of compostable and potentially recoverable material including; paper, yard waste, food waste and compostable products (HWMA, 2012). The fact that food waste is a significant component of landfills is a serious economic, ecological and social challenge. Household food waste is the most significant contributor to food waste in industrialized countries (Priefer et al, 2016). Furthermore, household food waste is the greatest environmental threat because of the accumulation of resources use throughout the food life cycle (Russell et al, 2017).

Food production and distribution use finite resources of land and water. All inputs are more or less justifiable when food is consumed. However, disposal of edible food wastes these resources and causes additional pollution and environmental degradation. The collection and transport of food waste and decomposing organic material produce greenhouse gases in landfills that contribute to anthropogenic climate change. There is a moral and ethical responsibility to redesign the food system so that excess food is recoverable to feed hungry people. Food insecurity is exacerbated by food waste because nutritious food goes to waste, while millions of people go hungry. Furthermore, food waste

is an economic issue due to the costly inputs of food production that are ultimately wasted when food is not consumed as intended.

Households generate the majority of organic material in landfills as opposed to municipalities, institutions or industry (Priefer et al, 2016). Yet there is a lack of empirical data on how and why food is wasted by households (Parizeau et al; Visschers et al, 2016). The general discourse indicates that food waste is a complicated issue that no single case study or research investigation can hope to resolve (Parfitt et al, 2010; Parizeau et al, 2015, Bloom, 2011, Evans, 2012). Aspects of this complex issue include a number of factors including unclear and inconsistent definitions of food waste (Koester 2016). These inconsistencies make the conversation about food waste difficult. Without clear and concise definitions, studies are limited in their references to food waste and the specific terms they use to discuss the issue. Recognizing that prevention is essential to combat food waste means that communities will need more knowledge about and access to organic recycling opportunities (Ng et al 2014). Further, community stakeholders are routinely omitted from waste management decision-making processes, which leads to skewed or biased policies that do not reflect the true needs of the community (Thyberg & Tonjes, 2015). There is little analysis on the relationship of food waste to economics, such as income level as it relates to waste and configuring exact statistics on the embedded costs of food waste for households in the US (Evans, 2012, Cuellar & Webber, 2010, NRDC, 2012). Unless these issues are addressed and better understood, the excessive waste at the household level will continue.

Furthermore, there are local and state policies that address the issue of food waste. A California state mandate, AB 32 targets greenhouse gas emissions as a way of combating global climate change. Diverting organic materials from landfills and recycling organic materials are possible solutions for greenhouse gas reduction resulting from the methane production caused by decomposition of organic materials. Additionally, the California mandate, AB 1826, requires all California businesses to recycle their organic waste with recycling programs initiated by local jurisdictions. Although this mandate focuses on commercial and municipal food waste, it is relevant to this thesis in understanding how policy affects food waste management at all levels.

These mandates aim to reduce the organic materials in landfills and optimize the highest economic potential of organic materials by putting the resources back into the economic stream rather than creating waste. They are examples of policies that have positive goals of reducing greenhouse gasses and food waste, but can also raise issues for jurisdictions with limited infrastructure and resources. The requirements place a lot of responsibility on business owners to reduce the organic materials in their waste stream. It is pertinent to understand the psychological behaviors that drive food waste in order to efficiently comply with these policies.

In this thesis, I provide a case study of household food waste in the town of Arcata, California using an analytical approach informed by environmental psychology. I use this framework to focus on the consumer beliefs, behaviors and attitudes that contribute to

household food waste production. This theoretical lens aids in understanding human behavior, therefore it is appropriate address the question(s):

(1) What are common attitudes, beliefs and behaviors relating to food waste that contribute to post-consumer household food waste,

(2) What are the challenges and opportunities for sustainable management of post-consumer, household food waste in Arcata, CA?

First, I review the relevant literature that defines food waste and the residential sector. Then, I examine the environmental, economic, and social impacts of food waste. Next, I identify the individual and societal behaviors are associated with household food waste. Finally, I apply environmental psychology as a theoretical lens through which to analyze the issue of residential food waste as an anthropogenic environmental impact.

I then describe the study area of the City of Arcata in Humboldt County, California where I am currently a graduate student. I explain how I used semi-structured interviews to identify current and historic waste management practices in Humboldt County and Arcata, and how these interviews informed the development of an Arcata-wide survey to investigate the common attitudes, beliefs and behaviors that generally lead to household food waste in this city. After presenting and discussing my results, I make recommendations on approaches to reducing food waste in Arcata and beyond.

LITERATURE REVIEW

Defining Food Waste

It is important to define and distinguish between different types of food waste to properly target waste-causing behaviors and implement appropriate mitigation strategies. This is a difficult task because food materials and reasons for disposal will differ depending on location and time of year. Food waste is considered a place-based issue that is dependent on the demographics and geography of the area where it is produced (Thyberg & Tonjes, 2015: Parizeau et al, 2015; Evans, 2012). Relevant factors that influence and determine the kind of food waste include: stage of food supply chain, the time of year the food was produced, the country where the food was produced, as well as dietary and cultural habits of consumers.

The food supply chain is a series of stages in the food production and distribution process. In this process, food is commonly categorized as pre-consumer or post-consumer. Chronologically, pre-consumer food encompasses all stages of food production, including agriculture (farming, production and harvesting), processing and manufacturing (milling, cooking, packaging), retail and distribution (markets and grocers). Post-consumer food is food bought by consumers (restaurant, business, individual, etc.) (Papargyropoulou et al, 2014). Consumption is the final stage of the food supply chain and refers to food use by households, the food service industry, and institutions (Table 1).

Table 1: Food Supply Chain

	Agriculture	Processing & Manufacturing	Retail & Distribution	Consumption
Pre-consumer	Farming, production and harvesting	Milling, cooking and packaging	Markets, grocery stores and superstores	
Post-consumer				Household, food service

Food is a unique commodity, because it is a biological material that degrades as it moves through the supply chain (Parfitt et al, 2010). Through industrialization and globalization, the food supply chain has become worldwide. Food travels longer distances and more infrastructure is required to properly store and transport perishable commodities efficiently (Priefer et al, 2016).

Food fit for human consumption is wasted around the world. The amount and type of food wasted depends on its location and stage of the food supply chain (Mourad, 2016; FAO, 2013). Food loss and food waste are two discernable types of waste that occur at specific stages of the food supply chain and are more common in different regions of the world. Their impacts contribute to different environmental, economic and social outcomes.

Food loss emerges at the pre-consumer level when food fit for human consumption does not make it to market. This loss occurs due to errors in production, postharvest, handling, processing, storing and transportation that result in food spoilage, damage or

contamination (Thyberg & Tonjes, 2016; Papargyropoulou et al, 2014). Food loss is greater in less industrialized countries during the harvesting and production stages, as a result of inadequate technology, improper storage and transportation for perishable foods (Venkat, 2012). Improper storage occurs most often in less industrialized countries because storage facilities and refrigeration technology are not sufficiently available to store fresh food items (Priefer et al, 2016). Improper storage conditions lead to food spoilage before it reaches the market resulting in greater pre-consumer food loss. Furthermore, damage or contamination of crops leads to food rejection from buyers. In the United States, strict industry standards require food that is not bruised, discolored, or deformed (Priefer et al, 2016; Bloom, 2011). Food loss decreases the amount of edible food from the food supply chain (Papargyropoulou et al, 2014).

Food waste occurs at the post-consumer level during the consumption stage. Industrialized countries accumulate greater per capita post-consumer waste (Priefer et al, 2016; Parfitt et al, 2010). The term "waste" represents food that is not eaten at the household or food industry level primarily for behavioral reasons or due to conscious decisions to discard food (Thyberg & Tonjes, 2016, Schmidt, 2016, Venkat, 2012, Evans 2012). Understanding the behaviors that lead to waste will allow mitigating strategies to reduce waste (Russell et al, 2017). Intervention policies and mitigation strategies can target the common behavioral issues that lead to post-consumer food waste.

A map published by the Food and Agriculture Organization illustrates global food loss and food waste in Figure 1 (FAO, 2011). North America is the only place in the world

where food waste exceeds food loss. Industrialized countries generate the most food waste at the post-consumer level due to food surplus and over-consumption of resources (FAO, 2013). In both instances of food loss and food waste, resources and energy inputs are exploited when the food produced is not consumed (FAO, 2011).

Post-consumer food waste is categorized as avoidable or unavoidable. The creation of some food scraps is unavoidable because of the inedible parts of food such as bones, skins, rinds, pits, shells, seeds and stems (Venkat, 2012). While there are other uses for some of these items, the majority of them end up in the trash. Avoidable food waste is the edible food that was discarded instead of being consumed (Parizeau et al, 2015; Visschers et al, 2016). Most food waste is disposed and brought to landfills by municipal or county trash collection services. Residential waste is defined as, "non-construction waste, collected by a franchised hauler and generated by customers in single-family dwellings and duplexes" (HWMA 2012). Significant environmental, economic and social impacts emerge as a result of food waste throughout the sectors and stages of the food supply chain.

Environmental impact caused by food waste is a focus of the discussion on waste throughout the literature. Patterns of consumption and thinking about natural resources must change in order to achieve environmental sustainability (Vlek & Steg, 2007). Estimates suggest that reducing consumption would attain a more sustainable balance (Jucker, 2004). It is commonly agreed, that specifically reducing food waste, at every stage of the food supply chain can lessen harm to the environment (Koester, 2014; Priefer et al, 2016; Thyberg & Tonjes, 2016). American households throw away 25% of their food

every year. These statistics indicate that Americans live in excess and there is an opportunity to scale back on surplus food production and food waste.

It is essential to understand the relationship between waste management and greenhouse gas emissions (GHG) as contributors to climate change (Lou, 2009). GHGs accumulate at every stage of the food supply chain, from production to disposal (FAO, 2013). Specifically, carbon dioxide is emitted throughout the production, harvesting, processing and distribution of food from the agricultural equipment, to refrigerants and trucks (Chen & Lin, 2008; Papargyropoulou et al, 2014). Approximately 3% of the total global greenhouse gases created are directly correlated to wasted food (Papargyropoulou et al, 2014). That is equivalent to the total global carbon emissions of a medium-sized country (Mourad, 2016).

An FAO report defines a carbon footprint as, "the total amount of greenhouse gases (GHGs) [a product] emits throughout its lifecycle, expressed in kilograms of CO_2 equivalents" (FAO, 2013). The report finds that the consumption phase of the food supply chain has the highest carbon footprint of any other phase due to the embedded energy inputs. At this stage, the carbon footprint accounts for the embedded energy of all previous stages (growing, harvesting, processing and transporting) with the final energy accumulation involved with disposal.

After food disposal, breakdown of organic materials creates methane in landfills. Methane is a greenhouse gas that is twenty-five times more potent than carbon dioxide (Chen & Lin, 2008; Papargyropoulou et al, 2014). Therefore, the gasses created from the breakdown of food trap more climate-changing heat than those created from the production

of food. These statistics strongly indicate that reducing food waste on a global scale will reduce anthropogenic climate change.

Composting is a recommended method for diverting waste from landfills by recycling organic materials and nutrients (Andersen et al, 2010). However there is limited data on the efficiency and environmental assessment of home composting with regards to reducing climate changing greenhouse gasses (Andersen, 2011; Ermolaev et al, 2013). Therefore, while there are associated benefits of composting in using waste as a resource and reducing energy costs for waste disposal, further research is needed to examine the potential greenhouse gas emissions from home composting. Researchers disagree whether home composting is an inefficient waste management tool for mitigating climate change or if home composting produces negligible amounts of methane and nitrous oxide (Andersen, 2010).

Clearly food production and distribution systems tax the environment and therefore, wasting food is an excessive use of resources (Thyberg & Tonjes, 2016). Reducing the amount of food that is produced, but discarded is a solution to lessening the environmental impact of food production (Godfray et al, 2010). Food production contains embedded energy and resources, with agriculture having a greater environmental impact than any other stage of the food supply chain (FAO, 2013). Finite and nonrenewable resources for food production include: depletion of natural resources (soil, water and energy), nutrient loss, degraded land-use, threats to biodiversity, pollution during waste disposal, and disruption of natural nitrogen and phosphorus cycles (Cuellar & Webber, 2010; FAO, 2013; Hall et al, 2009; Mourad, 2016; Papargyropoulou et al 2014; Parizeau

et al, 2015). While these impacts are detrimental in their own right, to some degree many will argue they are justified to feed people. However, the impacts cannot be easily rationalized when food is wasted. Reported estimates of the amount of food waste are staggering.

Studies suggest that wasted food waste accounts for more than a quarter of total freshwater use (Gunders, 2012) and approximately 4% of the total US oil consumption (Hall et al, 2009). Another reports that an average 2% of annual energy consumption in the United States is embedded in food waste (Cuellar & Webber, 2010). Agriculture accounts for 22% of greenhouse gas emissions, with dairy, vegetable and fruit items having the greatest embedded energy (Papargyropoulou et al, 2014). It is problematic that foods with the highest energy costs are also the ones that spoil most rapidly, leading to higher food waste (NRDC, 2012). Reducing food waste will increase the efficiency of resource use and contribute to reducing anthropogenic climate change.

In an effort to address the conservation of resources embedded in discarded food, the Environmental Protection Agency published the Food Waste Hierarchy (2017). This framework prioritizes alternative methods of disposal in order to use food waste as a resource by recovering and recycling food before it is thrown away. This hierarchy is applicable to all sectors of the food supply chain, including household food waste, to reduce and divert food waste. Appendix X illustrates the Food Waste Hierarchy in Figure 2. Prevention and reduction at the source through behavioral change is the primary priority for reducing food waste. The hierarchy proceeds with food recovery (feeding people and livestock) as the second most favorable option, followed by organics recycling (such as

composting), withal seeking to avoid disposal in landfills (EPA, 2017). Similar to the embedded energy and resources, wasting food also wastes disposable income. According to the FAO annual global food waste accounts for $750 billion dollars (FAO, 2013; Parizeau et al, 2015). The average household of four spends an estimated $1,350 to $2,275 on food that is thrown away every year (NRDC, 2012). Redesigning the current systems to prevent food waste behaviors would allow households to reduce spending on food and paying for disposal of wasted food (Papargryopoulou et al, 2014).

Rethinking the way food is distributed and wasted can provide social benefits. The social implications associated with food waste are issues of access rather than availability (Papargryopoulou et al, 2014). Food availability is having sufficient amounts of nutritious food, whereas food access is the physical access an individual has to nutritious food (FAO, 2006). It is well documented that food waste (as opposed to food loss) globally occurs disproportionately more in wealthy and developed countries (FAO, 2013; Mourad, 2016; Thyberg & Tonjes, 2016). On average, consumers in industrialized countries have greater access to food and therefore create more post-consumer waste (FAO, 2011). Reducing food loss and food waste to address food security will require improving the food supply chain to avoid pre-consumer loss, and redesigning food recovery programs to avoid post-consumer waste (FAO, 2011). Furthermore, approximately 49 million Americans experience food insecurity (Bloom, 2011). It is socially unjust to throw away excessive amounts of edible food while so many people face hunger. The fact that so much food is thrown away at the consumer level means that individual behavior changes can aim to recover more food. Reducing household food waste is not directly linked to increasing food

security because food insecurity is an issue of access, rather than supply (FAO, 2011). While authors take difference approaches to analyzing the problem of food waste, they agree that throwing away edible food is unethical behavior while so many people face food insecurity (FAO, 2006, Godfray et al, 2010, Gunders, 2012).

Reducing post-consumer food waste does not ensure more food accessibility (Koester, 2014), but is an opportunity to recover food and improve global food security by making more food available (FAO, 2013, Parizeau et al, 2015, Parfitt et al, 2010; Godfray et al, 2010). The ethical and moral dimensions of this issue demand recognition (Parfitt et al, 2010). Food recovery is an opportunity to take surplus food and for example, send it to a food bank rather than a landfill, which simultaneously can shift the way society, conceptualizes food waste towards activism. A Canadian study, reported 900,000 people used food banks in 2014 (Parizeau et al, 2015). This demonstrates that food banks are a valuable source of food for people. Rather than throwaway uneaten and unused household food, people can deliver food to a food bank and thus provide a family with a meal to curb their hunger. Policy interventions can ensure that more food is accessible to hungry people, within which food banks are one approach to recovering and redistributing food.

The literature suggests that food waste policies will help prevent food waste (Priefer et al, 2016; Thyberg & Tonjes, 2016) however, more research is needed to estimate and quantify the costs associated with food waste reduction policies (Koester, 2014; Cuellar & Webber, 2010). Multiple authors agree that prevention is the most effective technique for reducing food waste (Bloom 2011; Mourad, 2016; Papargyropoulou et al, 2014; Schmidt, 2016). Prevention is a front-end approach that targets behaviors and disrupts the habitual

production of waste. This is a favorable management practice because it can be implemented through educational outreach and awareness campaigns (Priefer et al, 2016).

Policy strategies for food waste diversion should be developed with community input, commitment and goal setting (Priefer et al, 2016; Schmidt, 2016). Given that the generation of food waste is place-based, waste management strategies must also be place-based. As previously mentioned, there is no single strategy that uniformly addresses all food waste issues, and therefore policies should be dynamic and consider the circumstantial factors that influence food waste (Parizeau et al, 2015). Public engagement and including all relevant stakeholders will help form policy that reflects the needs of the community.

A bottom-up approach to implementing programs can promote awareness through education that lead to long-term and sustainable behavior changes (Schmidt, 2016, Ng et al, 2017). Essentially, behavior change is a plausible way to reduce food waste, and policies can incentivize or promote and enforce the behavior change (Parfitt et al, 2010). It is important that policies consider the opinions and perspectives of public and private stakeholders including residents, businesses, institutions, and collection services in conjunction with local government decision-makers (Thyberg & Tonjes, 2015). Effective policy requires consistent collaboration and engagement among key stakeholders in food waste (Priefer et al, 2016). This ensures that policy is relevant and meeting the needs of the community. Bottom-up or grassroots approaches lead by stakeholders can create strong social awareness regarding food waste prevention (Ng et al, 2017). Involving community members in the design and implementation of food waste prevention assures that their perspectives are voiced in order to best identify and mitigate waste causing behaviors.

Furthermore, if people recognize the magnitude of issues associated with food waste, they may be more likely to change their behaviors and attitudes regarding waste (Thyberg & Tonjes, 2016).

Current food waste policies and state mandates are more of a top-down approach that act as a general and overarching policies for the entire state of California. According to CalRecycle, the statewide recycling program, Assembly Bill 939, known as the *Integrated Waste Management Act*, established a statewide mandate for solid waste management in 1989 (1997). This was the first step towards comprehensive solid waste collection. The mandate holds jurisdictions responsible for the collection and management of solid waste. This also helps reduce illegal dumping.

Furthermore, Assembly Bill 32 represented a turning point in managing greenhouse gas emissions. Known as the *California Global Warming Solutions Act* of 2006, the program set a precedent for California and the country in terms of developing a long-term action plan for reducing carbon emissions and addressing global climate change (California Air Resources Board, 2018). This program set the tone for California leading by example for sustainable initiatives.

In 1996, the *Bill Emerson Good Samaritan Act* enacted protection for individuals from liability for food donations. Individuals who donate food items in good faith cannot be held responsible if consumers get sick from the donated food. This act encourages food donations for food that would be thrown away.

Most recently, Assembly Bill 1826, known *as Mandatory Commercial Organics Recycling,* is the first mandate to specifically address food waste management. Under this policy, commercial businesses that generate more than four cubic yards of food waste are required to recycle their organic waste (CalRecycle, 2017). The mandate acknowledges the pressing issues associated with food waste and seeks to divert organics from the landfill. Similar to AB 939, the mandate holds the jurisdictions responsible for developing organics recycling opportunities for commercial businesses. Collectively, AB 939, AB32 and AB1826 create a policy framework that seeks to sustainably manage waste in California while the Bill Emerson Act aids in the redistribution of food.

Economies of scale and economic feasibility in individual communities are a challenge for implementing a sustainable food waste management framework. A major issue for local waste system managers is a lack of time, labor and resources, all of which have costly demands (Thyberg & Tonjes, 2015). Economic feasibility is a place-based issue that depends on the local area's resources. While policy may provide the guidelines and restrictions for waste management, local resources may be limited in fulfilling the mandate requirements. This is demonstrated in the interview and survey responses elucidated in the discussion section of this paper. Policies implementation needs support through educational outreach to teach the public about the issues that policies are seeking to resolve. Educational outreach is required to achieve behavior changes that align with sustainability goals (Jucker, 2004). However, a common issue with education and outreach is insufficient funding and/or labor and staff time to coordinate effective communication campaigns.

Food waste reduction policies and programs require financial budgeting. Given that resources may be more limited some communities, financial analysis from survey data can provide insight to how much money is wasted as a result of food waste (Schmidt, 2016). The survey information can help determine the economic feasibility of implementing such programs (Parizeau et al, 2015; Visschers et al, 2016). More research is needed to determine the economic costs associated with food waste reduction and prevention programs (Priefer et al, 2016).

Challenges associated with food waste prevention arise from lack of resources and inadequate research. Sustainable food waste management is highly dependent on the resources of the municipality or jurisdiction. Programs and implementation are limited by the general lack of knowledge and capacity to campaign against food waste. One arguable challenge related to prevention is that the results are not statistically measurable (Mourad, 2016). This makes it difficult to measure successful outcomes. Diversion from the landfill and financial savings would be potential methods for determining the effectiveness of prevention but may not be strong enough evidence that prevention practices are effective. Ultimately, understanding consumer level behavior is a key component of implementing prevention policies (Priefer et al, 2016).

Drivers of Individual Behavior Leading to Household Food Waste

Household food waste is caused both by consumer agency and the socio-temporal context of food. Most case studies demonstrate that individual consumer behavior acts as the main contributor to household food waste, but many authors agree more research is

needed (Schmidt, 2016; Visschers et al, 2016; NRDC, 2012; Parizeau et al, 2015, Parfitt et al, 2010). Specific studies acknowledge that although individual behavior is a prominent factor, there are external forces influencing individuals that contribute to food waste (Evans, 2012; Graham-Rowe et al, 2014). Significant behavioral themes include; not using all ingredients due to a fixed dietary plan, not using enough criteria for determining when food becomes waste, confusion about expiration date labels, wanting to fit a "good provider identity" and appear abundant with food, over-buying or spontaneous purchasing, lack of meal planning, household dynamics, food placement in the refrigerator, food provisions and portion sizes, and food perishability.

A fixed dietary plan means little room for experimentation or improvisation with the same ingredients in new ways. A fixed culinary repertoire generates food waste by limiting improvisation with different ingredients. People buy ingredients that are used once for specific recipes and discard food items without trying to incorporate them into a new recipe (Evans, 2012). Another issue explored was how people decide to throw food out. In one study, Parizeau and others found that households that use more criteria to determine when to dispose of an item generally wasted less food (Parizeau et al, 2015). Specifically, appearance, smell, taste, expiration date, time in the fridge, and when no one chooses to eat it, were all key criteria used. Educating the public about ways to use leftovers and about food perishability and when disposal of food items is really necessary are opportunities to employ sustainable education with positive consequences (Gunders, 2012).

Multiple studies have found that public confusion regarding food labeling and expiration dates contributes to improperly disposing of edible food (Graham-Rowe et al,

2014; Priefer et al, 2016, Visschers et al, 2016). Companies label food with conservative expiration and "best by" dates in order to ensure freshness of a food item. The dates do not represent the date the food is no longer edible, however consumer safety concerns lead people to throw out food, based on the "best by" dates. Increasing public awareness about food labeling would prevent excess food from being thrown away. \

Common societal beliefs, attitudes and social pressures cause excess food waste. Wanting to appear abundant and well supplied leads to excess. A case study in the UK revealed that nearly two-thirds of food waste is the result of people cooking or serving too much (NRDC, 2012). Good provider identity is a social norm that identifies the responsibility of the household provider. The provider or head of the household takes on this responsibility in order to ameliorate worries about feeding their family. Being perceived as a good provider causes the primary caretaker of the household to over-buy and appeal to all dietary requests for their family (Evans 2012; Graham-Rowe et al, 2014; Visschers et al, 2016). Buying more food than necessary leads to food waste. Over-buying occurs when people shop without a food list, divert from their original meal plan or spontaneously purchase a discounted food item. Many shoppers buy more food to "minimize inconvenience" of having to food shop multiple times during the week (Thyberg & Tonjes 2016; Graham-Rowe et al 2014; Evans 2012).

Spontaneous purchasing is a behavior that leads to acquisition of excess food, however it may not be entirely the fault of the consumer. Supermarkets use clever marketing including e.g. store layouts that encourage customers to buy items they were not originally planning on purchasing. For example, stores offer free samples and special sales

in order to sell more of a product. People who buy items that were not planned for are more likely to forget about or let those items go to waste because they are not part of their regular dietary plan (Bloom, 2011).

Household dynamics factor into how food is wasted. One researcher found that larger households generated less waste per capita than members of smaller households unless the households had children. Households with more children produced more food waste (Visschers et al, 2016). Furthermore, households with single individuals were found to generate higher quantities of food waste because it was more difficult to prepare meals for one, or to buy food items that were packaged for single individuals (Evans, 2012; Parfitt et al, 2010).

Studies have found that householders have concerns about generating food waste in the home. They say they feel guilty about wasting food (Evans 2012), wanting to do the right thing, and the desiring to conserve money (Graham-Rowe et al, 2014). This documentation of beliefs and feelings indicates that consumers are not careless or thoughtless about wasting food. One common justification for food waste is disposing of an item in order to avoid getting sick from eating spoiled food (Visschers, 2016)

Placement of food in the fridge or kitchen can also factor into what food is eaten and what is left to spoil. Food that is visible will have a greater chance of being eaten before it spoils (Bloom, 2011). The refrigerator is a key component of a two-stage process used to preserve food. Although food stored in the refrigerator still becomes waste, people who use the refrigerator to store food are genuinely trying to preserve the food with the intent of using it before it spoils. This indicates that food waste is not entirely an act of

carelessness. Due to the nuances of individual behaviors, preventing household food waste cannot be accomplished with a single behavior change.

Socio-temporal context applies to common household behaviors, beliefs and attitudes and may contribute to excess food waste. A case study from the United Kingdom investigated the common beliefs and behaviors of randomly selected households (Evans (2012). Through a series of ethnographic case studies, Evans revealed three relevant themes: shopping and household behaviors for provisioning food, social conventions, and the socio-temporal context of food (2012). These findings suggested that household food waste was not a consequence of the of the individual's carelessness. Rather, it was created because of the social and material ways in which food was provided (Evans, 2012; Graham-Rowe et al, 2014; Parfitt et al, 2010; Visschers et al, 2016). Food waste at the consumer level has also been found to be a result of practices at the production and processing level. For example, packaging, portion sizes, and marketing sales contribute to food surplus (Mourad, 2016).

A significant barrier to reducing household food waste is healthy food items that are perishable (Graham-Rowe et al, 2014). Food perishability is a challenge to successfully accommodate into a busy lifestyle and schedule because fresh food items like fruits and vegetables rapidly decay if not prepared and eaten within a brief time period (Evans, 2012). Consumers who buy “healthy foods” like produce and non-processed, unpreserved food, have a limited time frame to eat their food. Maintaining weekly meal plans can reduce wasting vegetables by planning to use them in the order of their perishability.

The literature has identified a number of reasons how consumer agency leads to household waste food. However, specific food waste behavior is a local, place-based phenomenon that is likely driven by factors that vary from community to community (Mourad, 2016; Thyberg & Tonjes, 2015). Therefore, environmental psychology is a useful framework for evaluating human behaviors and their impact on the environment.

THEORETICAL FRAMEWORK: ENVIRONMENTAL PSYCHOLOGY

Environmental psychology is a framework that includes theory, research and practice used to examine the reciprocal relationships between individuals and their built and natural environments (Gifford, 2014; Edgerton et al, 2007). It considers personal experience, demographics, knowledge, beliefs and interactions with different types of environments that create a culminating perception of nature and its value (Gifford, 2014). With this in mind, the framework is appropriate for analyzing the human actions that lead to environmental consequences, such as the production of food waste.

It is evident that small changes in a person's experience can result in very different outcomes that can add or detract from the balance of sustainability. This consciousness can affect decisions and actions with associated positive or negative environmental consequences (Gifford, 2014). Environmental psychology suggests that if people gain a deeper understanding of the ripple effect of consequences that follow their actions, then people may choose to act in ways that are more sustainable, conserving and mindful. Therefore, education is a key component of making people more environmentally aware and positively influencing behaviors (Gifford, 2014). Pro-environmental behaviors arise when humans envision themselves as being part of nature, and when nonhuman nature is recognized as a valued priority (Vlek & Steg, 2007). These kinds of behaviors are carried out with a conscious and understanding of minimizing negative environmental consequences (Schmidt, 2016). Understanding human behavior is essential for designing intervention strategies that may reduce and mitigate current environmental degradation

because the policy needs to address the behavior that is causing the problem (Edgerton et al, 2007; Gifford, 2014; Schmidt, 2016).

Designing and implementing policies that are rooted in environmental psychology can potentially mitigate choices that have negative environmental impacts. Understanding the psychological motivations behind consumer actions may assist environmental management professionals with making decisions or developing programs that encourage more pro-environmental behaviors. Environmental psychology is not directly acknowledged in environmental government documents and policies, but is a foundational component of designing environmental policy (Edgerton et al, 2014).

Specifically in California, Assembly Bill 1826 was implemented to reduce commercial organic waste. Jurisdictions are responsible for identifying producers of four cubic yards or more of organic materials and are responsible for creating organics recycling opportunities. The policy is efficient in physically diverting excess organics, but in order to implement it successfully, policy makers need a better understanding of what drives behaviors and how to influence them.

This thesis study seeks to identify behavioral drivers that contribute to household level food waste in one community. Environmental psychology can be used to analyze household food waste because environmental psychology and food waste are directly correlated with individual behavior and environmental impacts. This thesis also offers recommendations for applying local policies that influence behavior and encourage food waste reduction. Using an environmental psychology framework, I address the following research questions:

(1) What are common attitudes, beliefs and behaviors relating to food waste that contribute to post-consumer household food waste,

(2) What are challenges and opportunities for sustainable management of post-consumer, household food waste?

METHODS

In this thesis I apply mixed-methods, triangulating among three approaches to assessing how people manage household food waste for the case of Arcata, California. The three key methods included a series of semi-structured interviews, survey research and critical document analysis.

Interviews & Participant Observation

When I began this research, I was new to Arcata and unfamiliar with the waste management system and the community dynamics of the area. It took a lot of investigative work in order to identify and connect with the people in this community who are knowledgeable about food waste or mainstream waste management. Participant observation allowed me to immerse myself in the community to get a better understanding of the study area's limitations and opportunities regarding both overall waste management and specifically management of household food waste. I attended various events, meetings and lectures in order to understand the dynamics of the waste system in Arcata. At the Zero Waste Conference at Humboldt State University in Arcata I met local professionals and students who presented on various waste related topics. I also volunteered with the non-profit organization Zero Waste Humboldt, which aided in my understanding of the local atmosphere and community engagement with zero-waste and environmental culture. Finally, I attended city council meetings focused on the enactment of the Zero Waste Action Plan (ZWAP) for the City of Arcata. The document outlines benchmark goals for

waste diversion within the next decade. In the goals, food waste was specifically targeted as an area of concern. The ZWAP is evaluated in the discussion section of this thesis.

I interviewed seven staff or members of stakeholder organizations who are active in food waste management. The semi-structured interviews focused on management practices and policies that affect the disposal of household food waste in Arcata. Key stakeholders included Recology, the franchise hauler for Humboldt County where Arcata is located, the transfer station, Humboldt Waste Management Authorities, City of Arcata Environmental Services Department, City of Eureka Community Services (Environmental Division), and members of the local environmental group, Zero Waste Humboldt. The Environmental Services Departments of the Cities of Arcata and Eureka were selected because they are very close in proximity, serve the two largest communities in the area, and collaborate on certain projects.

These interview participants were chosen because of their close connection with waste management and environmental services for the area. All interviews were semi-structured with general guiding questions following a discussion guide, but with flexibility for participants to elaborate on areas of interest to them.

The goal of these interviews was to identify historic and current waste management practices, while also investigating respondents' predicted and hoped for outcomes for future waste management. I asked participants to describe their personal role working with waste management. I also asked them to describe the historical and current dynamics surrounding waste management for the area. The conversations generally focused on waste and recycling, and also specifically on food waste.

In an effort to investigate the relationship between current state mandates and policies and Arcata's food waste management system, I asked participants to describe how their agency implemented, interacted with or supported Assembly Bill 1826 and the Zero Waste Action Plan for Arcata. These two policies were selected because they specifically focus on food waste management.

Participant observation was an on-going process and the interviews occurred over several months during the summer and fall of 2017 and spring of 2018. I used a chain-referral (snowball sampling) method to identify interview participants. Most of the participants interviewed work with one another in some capacity and were able to suggest additional participants. Furthermore, all participants were asked to provide feedback on the development of the subsequent survey. They offered suggestions for questions that would elicit useful information about behaviors and beliefs about food waste among Arcata residents.

Survey

Residents of Arcata were invited to participate in an anonymous survey that focused on behaviors, beliefs and habits regarding household food waste. The survey was called "Food for Thought" and was created on the commercial online platform, Survey Planet. The survey featured 42 questions including multiple-choice and open-ended questions and a question that asked participants to rank the criteria they use to determine when food becomes waste (i.e., smell, taste, sight, expiration date, etc.). These questions were framed

based on other household food waste studies (Graham-Rowe et al, 2014; Schmidt, 2016; Evans, 2012).

The survey design evolved from collaboration with Recology and the Environmental Services Department for the City of Arcata. The analysis and results derived from the survey may help to guide Recology and the City of Arcata in serving Arcata residents in future. The goal of the survey was to better understand the household behaviors that lead to food waste. Questions targeted food shopping, preparation and disposal to elucidate how and why food is wasted in the household. In addition, the survey included specific questions focused on respondents' beliefs and knowledge about food waste.

Prior to launching the survey, the survey link was e-mailed to volunteering participants as a pilot test. The pilot test ensured that the link to the electronic survey was functional on different operating systems, computers, mobile phones and tablets. The participants in the pilot survey provided useful feedback on questions to make them more clear, understandable and concise.

The survey was next distributed through email to 300 HSU students who were off-campus Arcata residents. The email was sent out three times over a two-week period in mid-October. There were 61 responses from students, yielding a statistically significant 20% response rate.

The survey was then emailed to the Recology customer mailing list at the end of October in the customer monthly bill. Due to an error in the messaging, no responses were collected from the Recology customers. In an effort to overcome this challenge and reach a larger population of Arcata residents, the survey was also posted on the website for the

City of Arcata and with the local Internet news outlet, Lost Coast Outpost. The survey link was included again in the January electronic billing and concluded with more responses.

In February, the survey was featured on the Zero Waste Humboldt Facebook page and emailed for a final time to the contacts on the Zero Waste Humboldt mailing list. A question was added to the survey to determine whether people belonged to a local environmental group in the community. This was done in order to see if there was any correlation between people in environmentally conscious groups and willingness to complete a survey about food waste prevention habits. Choices of local groups included Zero Waste Humboldt, as well as the waste reduction program at HSU, WRAPP, Environmental Protection Information Center, and the National Audubon Society. The groups selected were chosen because their mission statements mentioned environmental health and quality of life, two issues that relate to food waste.

A total of 202 survey responses were collected. The initial distribution to the HSU students yielded 61 responses with a response rate of 20.33 percent. The survey was then distributed to the Recology customers of Arcata, the Zero Waste Humboldt mailing list and Facebook page, and posted on the websites for City of Arcata and Lost Coast Outpost. This exposure yielded another 156 responses. Given the nature of exposure of the electronic survey on the Internet, it is unknown how many people had access to the survey; therefore the total sample size, response rate and statistical significance are unknown.

Table 2: Food For Thought Survey Population Distributions

Distribution Population	Population Size	Number of Responses	Response Rate
HSU students	300	61	20.33%
Arcata area residents	Unknown	156	Unknown

RESULTS

Interview conversations with waste management and environmental agencies were largely focused on overall recycling and waste management dynamics in and around Arcata. This was helpful in clarifying the challenges and opportunities for sustainable waste management as they relate to food waste in this context.

Although the interview conversations were largely focused on recycling and waste management dynamics in the area, they also addressed the challenges and opportunities with developing sustainable food waste management. It is evident from multiple interviews that lack of infrastructure; cost efficiency and Arcata's rural location are major challenges to developing organics recycling as a backend diversion strategy from the landfill. Interviews emphasized the optimization of food waste prevention as a front-end approach to waste diversion. Collectively, interview participants told the story of historic waste management for the small town. Furthermore, interview participants offered insight to the survey results and illustrated the diversities and similarities of beliefs, behaviors and attitudes regarding household food waste for Arcata's residents

Background: Defining Arcata and It's History of Waste Management

This study focused on waste management and household food waste in Arcata, California. Located in Northern California, the small coastal town is situated in rural

Humboldt County. The population accounts for approximately 17,231 people and 7,381 households (US Census Bureau, 2010).

Interview participants often described Arcata as an "environmental bubble" and recognized the town for being progressive with strong environmental awareness. With regard to environmental action, Arcata was one of the first towns in the nation to offer a municipal recycling program in the 1970's. Arcata is the second largest city in Humboldt County where many residents define themselves as being part of a "hippie culture" derived from a "back-to-the land" movement that brought environmentalists to the area in the late 1960's. Arcata is also home to Humboldt State University, where every year approximately 8,000 students arrive in the redwoods for undergraduate and graduate education.

Its isolated geographic location North of the Lost Coast of California poses a challenge for Arcata. Access to and from Arcata is limited to two main roads. Highway 101 provides northern and southern access, while Route 299 connects the coastal towns to inland communities and Interstate 5, three-hours' drive away. The Northern Coast Mountain Ranges and the Pacific Ocean add another challenge to making Arcata a remote area with limited infrastructure capabilities. These geographic barriers are important to consider for sustainable waste management because they contribute to lengthy landfill and garbage haul commutes.

Waste management agencies acknowledged Arcata's geographic isolation as a tremendous challenge. Long hauls to distant landfills are not cost effective. All landfills or municipal compost facilities are over one hundred miles away. Multiple interview

participants acknowledged, “We have no facilities in the area” while discussing the limitations for the small town of Arcata, meaning no local landfill or post-consumer composting facility. The County and its individual communities have additional challenges to address.

The student population offers both challenges and opportunities for waste management in the Arcata area. The influx of students from September thru May nearly doubles the population of the small town. Students bring differing waste practices and ideologies about waste management from their hometowns that may conflict with Arcata’s waste management practices and policies. Fortunately, the general population of HSU reflects the progressive attitudes of the town. Many students are innovative and passionate about waste reduction and resource conservation. Environmental programs engage community members and students alike on campus and citywide.

Demographics and mentality differ within the cities and towns of Humboldt. Interview participants were asked to describe Arcata and the common response characterized it as being an environmentally progressive “bubble”. One respondent noted that “Arcata is the most proactive” and therefore more successful with the waste diversion practices already in place. Another respondent exclaimed, “I am really lucky I live in Arcata…because there is a different consciousness in Arcata”.

The cities noted for being more challenging included McKinleyville and Fortuna because of their low population sizes and lack of interest in waste management. Having stronger partnerships with neighboring towns was noted in a few interviews where respondents indicated that plans and policies would be more effective if they were region

wide, instead of only in Arcata. However, they also said that it is challenging to get all municipalities of Humboldt to agree and participate in the same waste management practices. Several community organizations exist that aim to bridge the gap between municipal local governments and community needs throughout.

For example, Zero Waste Humboldt (ZWH) is 501c3 non-profit that acts as a strong resource for Humboldt County (ZWH, 2018). Passionate community members founded ZWH with a desire to reduce waste, promote sustainable lifestyle behaviors and protect Humboldt County's natural beauty. It provides services that focus on sustainable materials management, waste reduction and prevention. The three main services include public education, technical assistance and training, and advocacy. These services aid in policy development with local governments, and offer learning opportunities for handling the various kinds of waste for all sectors of the waste stream. ZWH offers support with time, energy and resources. The City of Arcata is unable to focus on zero waste given their own constraints as a local government with multiple projects.

The 1970s introduced an era of environmental regulations that sought to preserve and conserve natural resources. Federal policies like the Clean Air Act of 1970 and the Clean Water Act of 1972 drastically changed the way things were managed. Under the Clean Air Act, burning municipal waste was prohibited and the Clean Water Act changed how communities were allowed to handle and store waste material.

The survey was closed to the public in March 2018 to begin analysis. The responses that corresponded with zip codes that did not fit the Arcata study area were removed and

not analyzed. A total of 46 responses were removed based on zip code, and 156 responses from Arcata were used for analysis.

In order to understand the history of waste management practices for Arcata leading into the present day, I asked interview participants to provide a historical background for the area. They indicated that prior to 1972 all communities in Humboldt County were responsible for handling their own waste. By the 1970s, residents were frustrated with the amount of waste material accumulated, so the county began to reevaluate how they would handle waste. At the time, the primary approaches to solid waste management in Humboldt County were open-air burning, landfilling into a ravine or illegal dumping. Most of the landfill sites consisted of a valley where people would dispose of anything from garbage to cars and set them on fire. For example, the Cumming's Road Landfill applied open-air burning until 1969.

Interview participants noted that the Arcata Community Recycling Center (ACRC) was the first systematic recycling and diversion effort in the county. In fact, the grassroots, community operated recycling center was one of the nation's first non-profit recycling facilities to offer municipal recycling in the 1970's. There was no mandate for curbside recycling in Arcata, but people could sign up for it if they wanted it. There were a lot of people who wanted to dispose of their recyclable materials. Individuals and neighboring communities would self-haul to the dump or they would recycle at the ACRC. Recycling at the ACRC required self-separation and individual responsibility to clean and sort recyclable materials.

In the late 1980s through the early 1990s, the State of California passed The Integrated Waste Management Act, AB939, which required all counties to develop an integrated waste management approach. AB939 set mandates for 50% waste diversion by January 1, 2000 and curbside waste collection became mandatory for all jurisdictions. The Cummings Road landfill operated and received Arcata's municipal waste until the year 2000, when the city entered into contracts with Humboldt Waste Management Authority (HWMA) for waste disposal to out-of-area landfills. HWMA formed as a joint power authority of six cities and the unincorporated areas of Humboldt County. The member cities include; Arcata, Blue Lake, Eureka, Ferndale, Rio Dell, Trinidad and unincorporated areas. These make up a contiguous area in the North West region of Humboldt County. It is HWMA's responsibility to operate a transfer station and a hazardous waste collection facility, as well as develop waste diversion opportunities for the county (personal interview, 2017).

In 2001 HWMA and ACRC entered into a contractual agreement for recycling that designated ACRC to run the recycling facility. ACRC used bank loans to build a multi-reuse facility (MRF) in Samoa, just thirteen miles south of Arcata. During the inception of the Arcata Community Recycling Center MRF, commodity profits from recycling were valuable and communities wanted to process their own material for financial benefit. Because of this, the ACRC did not have the business demand or contractual agreements to support the capacity of the MRF. In the summer of 2012, after a long, and somewhat personal fight for the community members involved, the ACRC transferred their contract to the HWMA, and the franchise hauler, Recology, bought the Samoa facility. The Arcata

residents who were close to the ACRC had taken pride in their grassroots community-recycling center and were upset to lose the contract to a franchise hauler, when they were no longer able to make processing materials economically feasible. The change in management, in effect a consolidation and take over by a larger regional company allowed the cost of garbage and recycling pick-up to remain affordable for residents.

Since the closing of the Cummings Road landfill in 2000, Humboldt County has experienced frequent transitions in their waste management. The formation of Humboldt Waste Management Authority unified administration, such as municipal waste records and reports for individual communities, and also streamlined collection and processing of waste. Landfill disposal also changed from being local in Humboldt County, to waste being exported to landfills over one hundred miles away. The primary landfills for Arcata are the Dry Creek Landfill in Oregon (approximately 187 miles, one-way) and the Anderson Landfill in Redding, California (approximately 152 miles one-way). In Arcata, the closing of the ACRC transferred the recycling contract to the franchise hauler, Recology. Changes in contracts and landfills mean a lot of transitions, which are time consuming and require logistical coordination.

Currently the contracts for the City of Arcata's waste and recycling reside with Recology and HWMA. Recology is the franchise hauler that collects the curbside garbage and recycling and brings it to the transfer stations. The garbage for Arcata goes to HWMA transfer station for sorting, and is then sent to an out-of-county landfill, while recycling is brought to the Samoa facility, formerly operated by the ACRC.

While discussing the overall waste stream for the area, several interview participants referred to the Humboldt County Waste Characterization Report. In 2011, the Humboldt Waste Management Authority hired the Cascadia Consulting Groups to do a waste characterization report for the communities of northern Humboldt. The report provided a statistical analysis of the sorted and collected samples for member cities of Humboldt Waste Management Authority (HWMA). Cascadia Consulting Group conducted the study in 2011 during one summer and one winter season. The collection team recovered 202 waste samples of 90 material types, with an emphasis on recyclable and compostable materials. The purposes of the study were to, "Identify materials with potential diversion opportunities, provide a baseline for evaluating the future success of current diversion programs, and create a foundation for HWMA's long-term solid waste management and resource recovery plans" (HWMA, 2012).

Across all HWMA members, recycling and compostable materials accounted for nearly two-thirds (13,998 tons) of the residential waste stream. Approximately 43% (9,161 tons) of residential waste was deemed "compostable or potentially compostable", which is defined as "Organic materials typically accepted for use in commercial compost or digestion systems" (HWMA, 2012; 6). Food was the most prevalent disposed material for the residential sector for all members. For the two-season sample, total food waste accounted for 30% of the total (6,438 tons). In Arcata, food was also the highest percentage of the waste stream accounting for 33.8% (682 tons). These statistics were then used to help design and draft the Zero Waste Action Plan for the City of Arcata.

Multiple interviews highlighted that Humboldt County carried out a food waste reduction program in 2012. The respondents noted that the "Food Waste to Watts" pilot project was a model for curbside food waste collection. Although this project focused on commercial food waste in Eureka, CA, the information gathered from the pilot is useful and applicable to understanding curbside collection in Arcata. The two cities are comparable as they experience the same challenge of being geographically isolated. The project began with a grant for about $200,000. The purpose of the study was to develop a food waste collection system and to assess the feasibility of using an anaerobic digester.

The pilot project ran from 2011-2012 and collected pre-sorted, post –consumer food waste from 17 volunteer businesses. The food waste material was brought to HWMA to determine the volume, contaminant level and GHG emissions diverted from the landfill, and then hauled to 182 miles to be composted. While the study was intended in part to test the feasibility of using an anaerobic digester, there was no anaerobic digester available at the time of the pilot.

The pilot project was nevertheless beneficial for determining the "ins and outs" and the challenges associated with diverting post-consumer food waste. Collecting the material and finding a place to efficiently process it was a challenge, but it was beneficial for learning the level of contamination associated with the food waste and assessing the GHG emissions diverted from the landfill. Challenges arose during the project, which highlighted the constraints on offering curbside organics pick-up for the area. First, the collection truck needed to be leak proof because of the high moisture level of food waste material. Additionally, people and wildlife frequently tampered with the curbside bins making the

collection process difficult. Finally, the project was expensive to subsidize and maintain for more than a year.

Ultimately, HWMA could not get the member agencies to commit to the food waste plan for an anaerobic digester. Arcata was included in the member agencies that would not commit. Humboldt County will not permit the digester without region wide buy in from the communities. Without community support, there would not be the mandatory long-term contractual agreements to financially support the anaerobic digester. It was noted that unless everyone participates in the program, collection services would be more expensive for people. For example, the anaerobic digester was implemented in San Francisco in 2015 as a part of their Zero Waste Plan (NCRA, 2016). Since then, San Francisco has had great success with diverting millions of tons of food waste from landfill and turning it into compost for wineries in Napa and Sonoma (EPA, 2017). The zero waste success the metropolis benefits from economies of scale. They have higher population to share the cost of the program. In Arcata, the population size is much smaller; therefore there are fewer people to share the burden of the cost of the digester.

The decision not to build the anaerobic digester without contractual agreements was a reflection on the situation that happened with the Arcata Community Recycling Center in Samoa. A few years prior, the ACRC built the MRF system without the contractual agreements to support it and the county did not want a repeat of the same situation with the anaerobic digester, which requires a large volume of material to process, and a financial commitment to support the installation costs.

Although the food waste collection project was not approved, organic material is still actively being diverted from the landfill. Arcata and HWMA have an agreement that allows residents two options to dispose of their green waste at their convenience. Residents can individually self-haul their yard waste to the West Green collection site (operated by HWMA) for free, or they can opt for a monthly curbside green waste collection service for four dollars per month. This program helps to remove a portion of organics from entering the waste stream. Aside from organics diversion, the green waste program promotes organics recycling by grinding and growing yard waste into useable compost. At the moment, the program is strictly for yard waste, as the processing facility is not built to process post-consumer food waste. Interviewees recognize that the green waste program could act as a model for a more robust organics collection program, should the city ever decide to do municipal composting. A detailed economic analysis for Arcata and Humboldt County would be necessary before creating a municipal composting program.

Waste Management Analysis

Interviews highlighted the economic and internal challenges associated with waste management for rural Arcata. The cost of advertising, marketing campaigns and educational outreach are limiting factors for the waste management agencies of the area. Multiple interviews indicated that staffing, time for projects and outreach materials are costly and limited for individual agencies. One interview participant noted, “We need [a] concerted effort, and so a limitation for us is the cost of advertising and getting the message out there.”

Federal and state regulations are issued to protect environmental quality and human health, but the process of complying can be challenging for local governments. An interview respondent acknowledged the difficulty in aligning mainstream waste management with current policies regulations. Specifically, they acknowledged that it would be useful for policy makers to spend time in the waste industry, in order to experience the waste management process and its challenges. Policy is meant to aid in the reduction and management of waste, but writing and implementing policy is a lengthy process. By the time a regulation is written and passed into effect, the waste stream has often already changed and policy is not as effective. Having policy makers in the position of the waste management agencies would help policy properly target the issues.

Additionally, maintaining landfills are expensive. After a series of rain events in 2006, the Cummings Road landfill was at risk from a landslide and became an environmental hazard. Between 2012 and 2015, HWMA and Recology were responsible for the abatement order that issued the landfill cleanup project. Although they were not responsible for the previous conditions of the landfill, they were current property owners and therefore liable for maintaining the landfill. The project was planned and permitted through the Army Corps of Engineers (ACE) and the National Oceanic and Atmospheric Administration (NOAA) and cost approximately $4.5 million dollars. This is a strong example of collaboration and planning in order to accommodate federal regulations. These organizations completed the cleanup project in eighteen months after a significant amount of labor, investment and coordination on behalf of HWMA and Recology. Furthermore, this demonstrates that landfills are not only environmentally taxing with their pollution and

greenhouse gas emissions, but they are costly to maintain. Even though the Cummings Road landfill is closed, it still requires maintenance and attention in order to ensure it is intact. Recology is a partial owner of the property and HWMA is responsible for the monitoring of the closed landfill.

Interview participants noted that residents often try to avoid or neglect the disposal costs. This is reflected in their behavior towards paying for correctly sized garbage bins, and general attitudes towards paying for disposal overall and in the level of illegal dumping. One participant addressed the issue of correctly sized garbage bins and that using the cost of the bin as an incentive to reduce waste does more harm than good. "People should want to downsize whether it costs less or not. The cost of the garbage and the size of the can are a very small percentage of picking it up…. People should want to do it, and it is getting people to want to do it is the hard part".

Encouraging people to use a smaller bin as a means of saving money is only effective if they will truly reduce their waste to fit in the smaller, less expensive bin. Otherwise, the overflow of their garbage ends up in other less desirable places, such as spilling into the road or into their recycling and green waste bins, ultimately leading to contamination. As one interview participant noted: "People will try to get the cheapest can and they'll take the material, whatever doesn't fit in their can will end up either over flowing into the street or they will try to hid it in the recycling… 'Yea it's somebody else's' problem'… that's what they think. They don't take personal responsibility. It's the garbage man's problem". Additionally, getting people to pay more for disposal costs is a crucial

step for connecting people to their waste. Acknowledging that waste comes with a financial cost is a way for people to take more responsibility in properly disposing of their refuse.

When considering food, the cost of the product is far higher than the cost to dispose of left over waste. Yet people are not interested in paying for waste disposal. In one interview, the example of the salad bar was given to illustrate this sentiment. Buying food at the salad bar costs dollars per pound, but the cost of disposing food costs cents per pound. The issue here is that consumers are willing to pay dollar amounts to cover the production and consumption costs, but they are less willing to pay the same price for disposal costs. They don't see them as part of the same system of transaction costs. Disposal includes curbside collection, labor, sorting, processing, facility operations and transportation to a landfill. Getting consumers to understand the nuances of disposal costs will require education and community-based marketing on behalf of the waste agencies. However, prior to implementing outreach campaigns, the waste agencies need to understand the common household issues faced by Arcata residents that lead to food waste. In an effort to gather this information, I carried out a citywide survey that revealed useful results for future food waste management. For now, the greatest emphasis for food waste management is on preventing food waste. One interviewee claimed, "The biggest bang for the buck where you can make the biggest difference, you know, upfront, proactive, upstream, prevention activities or decision making" (personal interview, 2017).

Prevention

Almost all interview participants were adamant that prevention would be a key strategy to reducing household food waste, and ultimately limiting food sent to the landfill. As indicated in the literature, prevention is a behavioral technique that targets waste-causing habits and addresses food waste prior to its creation (Bloom 2011; Mourad; 2016; Papargryopoulou et al, 2014; Schmidt, 2016). One interviewee acknowledged, "Composting validates food waste," therefore prevention is better model for addressing the issues of food waste.

Another interview respondent reflected, "You have to get people really to fundamentally rethink their basic traditions and norms and really re-evaluate things from a perspective that is new and unique". Interview participants also noted that behavior change is crucial for prevention, however getting people to change their behavior is challenging. Another respondent insisted that prevention should be favored over composting because prevention eliminates the problem at the source. Household food waste can be mitigated through simple proactive behaviors.

It is important to raise awareness about food waste issues and clarify common misconceptions so people are not left "floundering" as to what they should do with their material Engaging residents in the process is key for maintaining a conversation about waste reduction. During one interview, a respondent acknowledged, "you have to have people engaged all the time." A possible engagement tactic for the City of Arcata could be recruiting community members to take part in the implementation strategies of the Zero

Waste Action Plan. Interview participants were curious if the general public was aware of the City's waste diversion goals. Furthermore, one interviewee questioned people's level of awareness by asking, "are people aware that this is an issue? Are they aware that it relates to climate change and are they aware that there are opportunities for improvement? Are they aware that there is a Zero Waste Action Plan and that people are actually thinking about this and there are city waste goals?" (personal interview, 2017).

As interview respondents indicated, Arcata is recognized as being a "progressive" and "proactive" city with regard to waste management. It is the only city in Humboldt County to have developed a Zero Waste Action Plan, and Arcata has been recognized for years for its stellar recycling methods. However, despite its environmentally forward attitudes, recycling contamination and waste accumulation are challenges in Arcata. Public perception of waste needs more consciousness. As interviewee stated, "people are simply used to throwing stuff away into the garbage without giving it anymore thought." Referencing individual responsibility towards their waste accumulation, another interview said, "People should want to do it…this is something you have control over as an individual. You've got to stop seeing it as the garbage man's or the dumps responsibility" (personal interview, 2018). Recycling contamination is an example of the out of sight, out of mind mentality that causes people to disconnect from where their waste goes. Contamination occurs when people do not clean or properly sort their recyclable materials. Another interview participant mentioned, "I think getting people to change their behavior is really challenging" (personal interview, 2017). While this statement may be true, having

data about common behavioral issues will allow management agencies to design their approach in a way that targets the most critical behaviors.

Survey Outcomes

The Food for Thought survey asked questions as a means of understanding household behaviors in addition to elucidating beliefs and attitudes surrounding food waste issues.

Respondents were asked to agree or disagree with the following statement, "Reducing food waste is important." People strongly agreed (n=120) that reducing food waste is important. Twenty-six people somewhat agreed, and six people were neutral to the idea. Only three people disagreed with the statement. Thus, the overwhelming majority of people responding to the survey indicated that reducing food waste is important, yet Arcata residents face a series of challenges with reducing food waste.

Survey participants were also asked to agree or disagree with the statement, "food waste accelerates climate change." A combined 104 respondents agreed or strongly agreed with the statement, while only sixteen combined respondents disagreed or strongly disagreed. The remaining thirty-six respondents answered neutral to the question.

To assess how widespread recycling practices currently are in Arcata, residents were asked about their household recycling habits. A total of 96% (n=150) said they recycle at their household. The six people who said they did not recycle indicated that this was due either to lack of space, their apartment did not have offer recycling, or they did not have access to a recycling bin. As a follow-up to understanding recycling practices, another

question asked if households were recycling organics through backyard compost. Results showed that eighty people (51.28 percent) were already actively backyard composting, and seventy-six people (48.72 percent) people were not composting.

Survey participants who noted that they did not compost were asked to explain what prevented them from composting. Answers to this question were open-ended and coded for analysis (Figure 3). The most common deterrent to composting was lack of space, with nineteen people indicating that they had limited space either in their kitchen, in their yard or both. Nine people specifically mentioned they did not compost because they lived in an apartment, and another five people were prohibited from composting by their landlords. Other respondents claimed that composting takes too much time (n=9) or it was not convenient for their lifestyle (n=8). Respondents also indicated a lack of interest in composting (n=5) or that they intended to compost but were procrastinating (n=3).

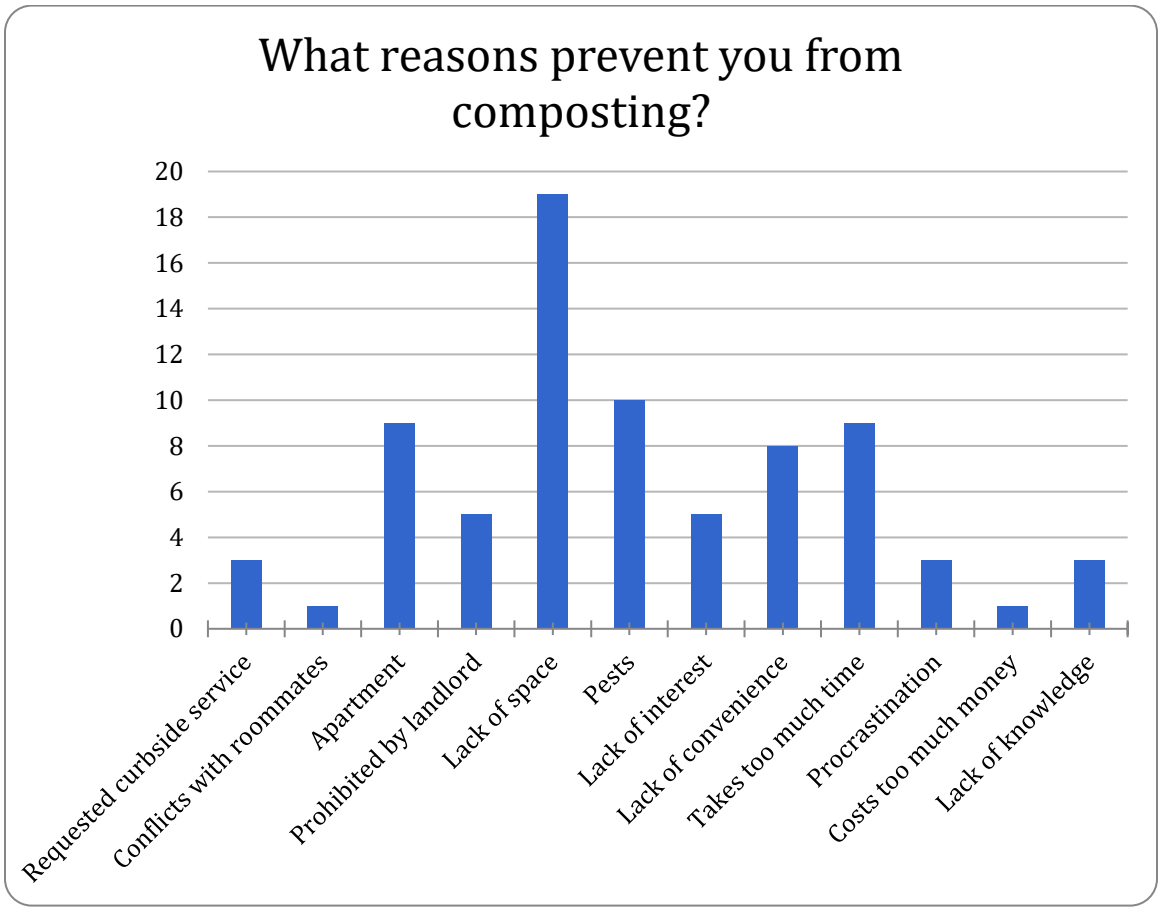

Figure 1: What Reasons Prevent You from Composting?

An open-ended question asked people to identify everyday challenges that lead to food waste in their household. Table 3 illustrates the coded responses organized by topic. A common response given was that people failed to eat food and leftovers because they were forgotten or hidden in the refrigerator (n=25). Having a busy work or school schedule also led to food waste as people said they did not have the time or energy to cook and eat the food they had at home (n=25). Poor planning and failure to follow or make meal plans was another common response (n = 23). Another common reason given for wasting food was respondents' inability to consume produce before it spoiled (n=20). Over-buying food and wanting to eat out with friends was also mentioned (n=8). Several people said they

buy bulk items, which are less expensive or buy large portions due to packaging, but do not eat all of the food before it goes bad (n=5). Others (n=7) mentioned that having to cook for children or having picky eaters led to wasted food.

Table 3: Everyday Challenges Leading to Wasted Food

What are some everyday challenges that lead to food waste in your household?	
Response Topic	Number Responses
Busy schedule	25
Social life/ Eating out/ Traveling	8
Buy ingredients for one recipe	1
Not using condiments before they expire	1
Portion sizes of products/ Bulk is cheaper	5
Produce spoiling/ Over-ripening of food	20
Over-buying	8
Kids don't finish food/ Picky eaters	7
Lack of storage space	5
Cooking large meals/ Cooking for one person	5
Forget about food/ Hidden food in fridge/ Not leftovers	25
Poor planning	23
Not having access to compost	4

As a follow-up, participants were asked to respond to the open-ended question what would make it easier for them to reduce their household waste. Responses were coded by theme for analysis. Better meal planning was the most frequent answer (n=26). Buying and cooking less food was the second most frequent (n=18) with composting food scraps as the third most frequent (n=12). Other responses to the question of what would make it easier to reduce household food waste included more time to cook and eat (n=11), having compost

pick-up services (n=11), more kitchen space/ storage (n=6), and being home more often to eat household food (n=4).

People were asked to indicate all their methods for food disposal to show what the most common methods of disposal were for households. Optional answers included; garbage, compost, repurposing via fermentation or soup stock, kitchen garbage disposal, feed to pets/ livestock, donate/ giveaway or another open ended response. The majority of responses (n=136) indicated they used garbage to dispose of food waste, followed by composted (n=86) as the second most common method of disposal. Repurpose via fermentation or soup stock (n=46), kitchen garbage disposal (n=45) and feed to pets or livestock (n=48) were all nearly tied as the third most common method of disposal.

As a way of determining the economic feasibility for a potential municipal organics recycling program, the survey asked how much money respondents would be willing to pay for municipal curbside composting. Figure 4 shows the range of responses received. Fifty-two responses (36 percent) indicated that they would be willing to pay a small monthly fee for curbside composting pick-up. Twenty-six individuals agreed to pay $4-7 and twenty-six individuals agreed to pay $8-10. A combined twenty-five people said they already composted and or used the green waste program in place in Arcata. Eleven people claimed that they were willing to pay for a curbside program but did not disclose how much they would pay. A total of sixteen people said they were not sure or not willing to pay for curbside food waste collection.

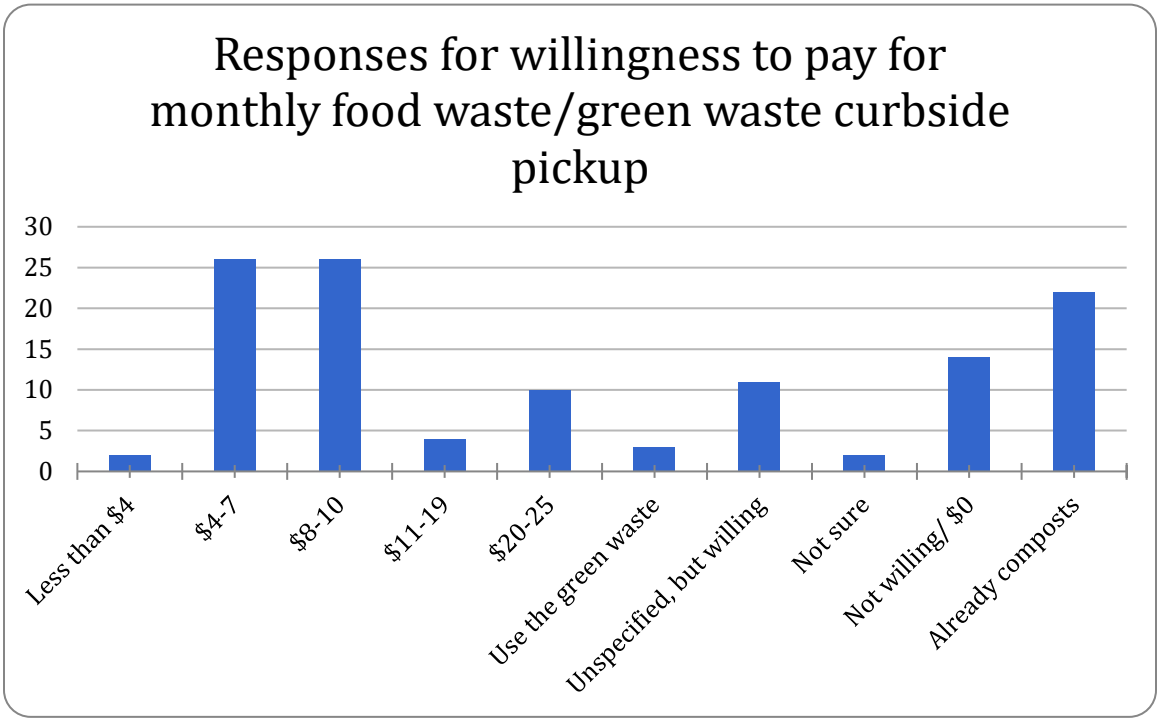

Figure 2: Responses for Willingness to Pay Monthly Food Waste/ Green Waste Curbside Pickup

Another section of the survey explored personal beliefs and perceptions regarding food waste to gauge the level of basic knowledge about food waste related issues. Responses were based on a five point Likkert scale ranging from strongly disagree to strongly agree. First, people were asked to agree or disagree with the statement "On average, I try not to use food items that are brown or wilting." Responses varied from those who said they used brown/wilting food (n=59) to people who did not (n=66), with 31 individuals who answered neutral to the question not disclosing whether or not they use brown/wilting produce.

Next, the survey explored how strictly people follow expiration/ use-by dates. On a five point Likkert scale, ninety-six people (61 percent) disagreed with the statement "expiration dates and use-by dates indicate the last day food is edible." Another thirty-nine people "somewhat disagreed" with the statement while eight people remained neutral. Only ten people responded that they "somewhat agreed" with the statement while three people agreed with the statement.

The survey also used a Likkert scale to ask respondents whether they believed that donating food could put them at risk of a lawsuit if people eating the food were to get sick. Likkert scale results showed that seventy-five people "disagreed" with the statement. Twenty-three people selected "somewhat disagree" while forty people remained neutral for the answer. Only eleven people responded that they "somewhat agree" and seven people "agreed" with the statement.

Proactively planning meals is one tactic of prevention. Residents were asked whether they plan their meals at least the day before. Responses were heavily skewed to show that most people sometimes (n=56) to often (n=51) planned their meals in advance. Furthermore, when respondents were asked what would make it easier for them to reduce their household food waste, a majority of respondents (n=26) answered, "better planning" or "buying and/or cooking less" (n=18). It is arguable that these responses overlap, because buying and cooking less would require the act of planning and reflecting on current behaviors. Other common responses on what would reduce household waste were: "having more time to shop/ cook/ eat/ household food" (n=11) and "having a compost service" (n=11).

In an effort to assess the need for city outreach and education about zero waste, the Food for Thought survey asked respondents if they were familiar with the Zero Waste Action Plan. According to the survey, 64% (n=101) were unfamiliar with the Zero Waste Action Plan, and only 36% (n=56) were familiar with the plan.

DISCUSSION

Despite the City of Arcata being an environmentally progressive town, the City faces significant challenges with regard to waste management that are due to its size, remote location, lack of facilities and polarizing demographics. While these issues will take time to address, it may be possible to address the issue of reducing household food waste through local collaboration and public education on food waste prevention.

Responses to the Food for Thought survey highlighted the common household behaviors and challenges that lead to food waste in Arcata. Behaviors need to be addressed in order to reach waste diversion goals. As indicated in the literature, behaviors are the primary cause of excess food waste, yet they are also the area with the largest amount of uncertainty (Parizeau et al, 2015). Common behaviors elucidated in the Food for Thought survey align with other case studies and can therefore add to the research in learning how to sustainably manage food waste (Schimdt, 2016, Garaham-Rowe et al, 2014, Evans, 2012, Priefer et al, 2016).

Arcata residents strongly agreed that, “reducing food waste is important” and that, “food waste accelerates climate change”. This should indicate to policy makers and individual consumers alike that food waste is a significant issue that needs to be addressed. It is both up to the individual to change their behavior to reduce food waste, and up to policy makers to redesign current management practices in order to more completely reduce food waste.

Arcata residents were defined in interviews as either being very zealous in wanting to do all they can to backyard compost and prevent food waste to begin with, or being part of a population of people who still need education and encouragement to become zero waste producers. This was evident in the survey responses about recycling and composting habits. Responses about recycling practices demonstrate that people participate in the current recycling programs. Composting practices showed half the response population is already taking matters into their own hands when it comes to organics recycling, while the other half provides an opportunity to reduce household food waste. Furthermore, common barriers to both recycling and composting mentioned lack of space or lack of access to recycling or composting for apartment units. These responses should indicate to the City that there is an opportunity for more diversion so long as access to recycling and composting accommodates the apartment constraints.

In addition to lack of space and living in apartments, other limiting factors that prevents people from composting included; lack of knowledge/ interest, costs too much money, procrastination, inconvenience, not wanting to attract pests, prohibited by landlord or roommates, or people said they would compost if there was a curbside service. Citywide curbside collection could address most of the issues that act as barriers or deterrents to people who do not practice backyard composting. Furthermore, during the interviews and city meetings, it was discussed that the new housing development in Arcata is primarily apartment dwellings. Clearly the issue of access to composting in apartment and rental units needs immediate attention. If there was a curbside collection system, people would

not have to physically maintain the compost pile themselves, but their food waste could still be diverted from the landfill and recycled into usable compost.

When asked if they were willing to pay for a potential curbside collection program, most people agreed to pay a range from $4-$10. This demonstrates that people are cognizant of the benefits of composting as a way to divert waste, yet may not have the access or motivation to do it independently.

Current recycling/ green waste behaviors indicate that curbside collection is successful for the most part in Arcata. Given that people practice recycling/ green waste the same as they do curbside garbage, it is plausible that curbside food waste collection could have the same success if it were implemented. It is important to note here that the compost service would not in fact prevent food waste, but willingness to use such a service was a common response that people gave based on their beliefs about food waste prevention. Reflecting on the interview comment about composting validating waste, the public should recognize the distinction between preventing food waste and recycling it through composting. Although composting is a suitable method for diverting and recycling organics, it is still too heavily reliant on the backend of recycling rather than upfront prevention. As noted in the literature, prevention is the most efficient way to address food waste, but it is heavily reliant on individual behavior change (Schmidt, 2016; Thyberg & Tonjes 2016). Furthermore, the same interviewee mentioned embedded benefit of having limited infrastructure for municipal composting because then people do not have the option and excuse to continue wasting food at the same rate. Prevention is consistently the best strategy for mitigating food waste.

The perceptional questions that ask people if they use food that is brown/ wilted or beyond its labeled expiration date are behavioral indicators that could potentially prevent household food waste. People who determine food quality based on appearance and date labeling are potentially prematurely throwing food away prematurely. It is important to recognize the difference between spoiled food that is no longer edible, and food that is slightly bruised or wilted, but suitable for repurposing. Food that is only slightly past its prime should be considered for repurposing, for example as soup stock or for fermentation, or should be composted for soil amendments. Furthermore, food that is labeled with a specific date may still be edible beyond the date printed on the packaging. This is why it is essential that people learn to use their own judgment and use all of their senses in conjunction with the date label in order to truly determine if the food item is no longer edible.

The results indicated that a fair number of people believe that they could be at risk of a lawsuit if someone were to get sick from food they donated. In fact, individuals are protected under the Bill Emerson Good Samaritan Act of 1996 and cannot be sued. In an effort to encourage people to donate edible food that would otherwise go to waste, this law protects people who donate food in good faith. Therefore, there is no chance of the donor being held liable, if the donated food makes someone sick.

Socio-temporal constraints are not influenced by behavior and are therefore more difficult to overcome (Evans, 2012). The survey elucidated conflicts that are similar constraints listed in other case studies. Respondents mentioned that portion sizes of bulk buying and some packaging lead to food waste, especially if they live alone. People who

live alone or who buy bulk products to save money are often left with more food than they can consume. Furthermore, perishable foods, such as fruits and vegetables, comprise a large proportion of household food waste but are often bought with the intention of eating healthy meals. Not having enough space or storage for food and not being home enough to eat household food are social issues that warrant individual's to re-examine and possible re-prioritize their lifestyle and habits.

Social dynamics often interfere with meal planning. Many respondents indicated they experienced conflict with neglecting the food they had at home in order to accept invitations to eat out for social events. In addition, people with children had more food waste because kids often do not finish what is on their plate, are messy eaters, or are picky eaters that are not as adventurous with their palate as parents anticipate. This leads to plate waste (food left on their plate after a meal) or food that becomes inedible after falling to the floor or being mixed with other food items. Once again, household compost or municipal curbside compost were mentioned as a solution to address this form of food waste.

People were asked about their current methods of food disposal because there may be opportunity to educate people on the other ways to dispose of food other than the garbage. Options like composting, repurposing via fermentation or soup stock and feeding food waste to pets/ livestock are opportunities to divert food from the landfill and recycle or reuse food in a new way. Donating and/ or giving edible food away is also an efficient way to address excess food that normally would become waste, but could be used to feed hungry people. This is also illustrated in the EPA Food Waste Hierarchy (EPA, 2017).

Survey responses elucidated numerous ways that individuals can change their own behavior in order to prevent their household food waste. Better planning was the most frequent answer and is wholly within the control of the individual, should they choose to take responsibility for their waste-causing actions. Additionally, buying and cooking less food was identified as a method of preventing household food waste. Proper meal planning and using a premeditated list, will guide the consumer to only buy what they consciously decided they would need and eat. Similarly, not eating food and leftovers in the fridge could be the result of an over-filled fridge or a forgetful mindset (Bloom, 2011). Keeping food properly labeled, and in clear sight will help to remind the individual of what food is available to be eaten, before more food is purchased. Although food waste prevention behaviors seem like minor changes in lifestyle, they typically require education and continued engagement on the part of the individual in order to make the behavior changes successful. Interview said get people to fundamentally change the way they think and behave. This is also supported in the literature, which suggests that food waste prevention should be the primary focus for the City of Arcata management strategies and for individual households (Schmidt, 2016; Thyberg & Tonjes, 2016)). As was noted in an interview, a possible solution to Arcata's waste problems is community-based social marketing and education outreach.

Although many Arcata residents are proud that the City is known for being in an "environmental bubble," the poor attendance at the Zero Waste Action Plan meetings is evidence that the interest in conservation does not extend to waste management. The same people frequently attend the ZWAP meetings. Furthermore, when survey respondents were

asked if they knew about the ZWAP, over two-thirds of the people were unfamiliar with the plan. This is alarming because an overwhelming amount of respondents claimed that food waste accelerated climate change (n=104). Clearly, there is a discrepancy between people's beliefs and their actions. People agree that food waste issue, but neglect to make the first step towards correcting the situation or are unaware of sustainable management opportunities that encourage them to do so.

This shows an opportunity to increase outreach on behalf of the city and encourage community members to have more engagement with these issues. Waste management can no longer be seen as "someone else's problem" In order for Arcata to remain an environmentally progressive city, the responsibility to make sustainable change cannot solely rest with the city government. Individuals need to be more dedicated and responsible if the City is to make progress with sustainable food waste management.

This study concluded that lack of financial support, limited staff and labor, geographic isolation and polarized demographics all contribute to the complexity of sustainable food waste management in Arcata. While these external factors are difficult, they are barriers that can be overcome.

The geographic isolation makes transporting waste out of area expensive and is an opportunity for local and place-based solutions for waste processing facilities in the area. It is inefficient to use energy to collect and transport material to processing facilities hundreds of miles away. Hauling materials away from Humboldt County is no longer a suitable method of disposal. Therefore, it is necessary to redesign disposal systems in order to shorten the distance waste material has to travel. The City of Arcata and Humboldt

County need to have a regional discussion about creating infrastructure opportunities so waste can be processed where it is created. Closing the loop of waste generation and disposal conserves valuable resources.

While this fundamental challenge will take time to coordinate, the general lack of facilities can be used as an opportunity to focus on "low hanging fruit" as indicated in the interviews. For instance, interview participants identified partnerships and collaboration as ways to initiate public outreach and education for reducing household level food waste. It seems this is an untapped resource for the City of Arcata and the County of Humboldt.

As noted earlier, the food waste grant partnership between the cities of Arcata and Eureka, along with non-profits Food For People and Zero Waste Humboldt was the first form of collaboration in waste reduction. This engagement between municipal management and community stakeholders is a beneficial way to include different perspectives in order to create a more holistic approach to management. Furthermore, partnerships and collaborations would allow the waste collection and management agencies, HWMA and Recology, along with neighboring City of Eureka and non-profit organizations to share the costs and labor of marketing campaigns. This also would provide networking and information sharing opportunities in order to share resources, unify city messaging, and reach a larger population.

Streamlined educational messaging would improve region-wide effectiveness and work towards a shared goal of waste reduction. It is common for Humboldt residents to live in one town and work in another. Therefore people travel often throughout the towns

and cities of Humboldt that it would be best for the messaging throughout the county to educate and advocate for the same prevention and recycling practices.

Food waste reduction campaigns and policies are an opportunity for more collaboration between the cities in order to accommodate the food waste challenge as a unified region, rather than individual cities. Fortunately, Zero Waste Humboldt is a non-profit organization that accommodates all of Humboldt County and is focused on zero waste reduction strategies. Streamlining educational messaging would also address the issue of polarized demographics, because it would create a basic level of knowledge for all Humboldt County residents.

Furthermore, plans for expanding housing development in Arcata are primarily for apartment units and/or rental units. Therefore, as Arcata acquires more apartments and rentals, the City of Arcata will have an opportunity to proactively require developers and landlords to address the organics recycling needs of this type of housing in a way that does not make compost an unattractive nuisance.

Although reducing food waste is a challenge for the City of Arcata, I found that carrying out research on the topic has its own challenges. It was difficult to gather information for this study. Arcata's small population size a challenge because key pieces of information were often discovered through personal connections and by word of mouth. I was fortunate to make the connections throughout the town that introduced me to the waste management agencies and local organizations that focused on waste reduction. Without knowing personal informants, some of this research may have gone overlooked as a missed opportunity. This is reflected in the waste management for the area because, unless people

are actively participating and aware, some things are evidently not common knowledge. The snowball sampling process took longer than expected to get in touch with some of the key informants of the area. It is possible that more participant observation and deeper investigative background research on my part would have fostered relationships with informants earlier. Furthermore, the distribution of the Food for Thought survey required overcoming challenges that delayed analysis process. I chose to use an electronic survey because the postage and paper for a mail-in survey would have been too expensive to distribute. However, this meant that the survey did not reach as many Arcata residents as online surveys exclude individuals who do not have access to a computer. It would have helped to have more time to try again to have the survey distributed to all Arcata households as planned. Using the alternative of publishing the survey on public sites, had the drawbacks of my not knowing how many people were exposed to the survey and having responses collected from outside the Arcata study area.

CONCLUSION

It should work to Arcata's benefit that California has enacted a series of policies that aim to reduce waste. These policies call for and seek to support fundamental behavior change and they aid in raising awareness about intentions to reduce waste. Historically, we can refer to the Clean Air and Clean Water Acts for increasing global awareness about environmental conditions. Similarly, the California state regulations parallel the recent emphasis on climate change mitigation. Society now understands the importance of taking drastic measures towards reducing waste in order to prepare for future generations. Threats of climate change are evident, and resources need to be conserved. Food waste reduction is a direct and achievable way to conserve energy and resources and limit anthropogenic climate change.

This research provides examples of food waste management in a rural area. The challenges and lessons learned about the waste management system are unique to Arcata, but may provide insights for other areas with similar constraints. In addition, the survey results highlight common consumer behaviors that lead to household food waste. The majority of these behaviors can be changed in order to prevent future food waste. Ultimately, prevention is the key tool for addressing food waste. Prevention techniques should be taught and promoted as sustainable lifestyle habits. Bottom up communication approaches applied by citizens working with local government will be more effective in raising awareness about food waste issues and implementing sustainable behavioral changes. Community engagement and individual responsibility are necessary to maintain

pro-environmental behavior changes. Household food waste has the greatest potential for reduction because it results from individual behavior and consumer agency. Once these behaviors are better understood, they can be immediately mitigated and prevent food waste.

REFERENCES

Andersen, J., Boldrin, A., Christensen, T., & Scheutz, C. (2011). Home composting as an alternative treatment option for organic household waste in Denmark: An environmental assessment using life cycle assessment-modelling. *Waste Management, 32*(1), 31-40.

Andersen, J., Boldrin, A., Christensen, T., & Scheutz, C. (2010). Greenhouse gas emissions from home composting of organic household waste. *Waste Management, 30*(12), 2475-2482.

Bloom, J. M. (2011). *American wasteland: How America throws away nearly half of its food (and what we can do about it)*. Cambridge: Da Capo Press.

California Air Resources Board. (2018). Assembly Bill 32.

CalRecycle. (2017). Mandatory Commercial Organics Recycling.

Chen, T., & Lin, C. (2008). Greenhouse gases emissions from waste management practices using Life Cycle Inventory model. *Journal of Hazardous Materials, 155*(1-2), 23-31.

Cuéllar, A. D., and Webber, M. E. (2010). Wasted Food, Wasted Energy: The Embedded Energy in Food Waste in the United States." *Environmental Science & Technology 44.16*, 6464-469.

Edgerton, E., Romice, O., & Spencer, C. (2007). *Environmental psychology: Putting research into practice*. Newcastle upon Tyne: Cambridge Scholars Publishing.

EPA. Zero Waste Case Study: San Francisco. (2017, June 12). Retrieved from https://www.epa.gov/transforming-waste-tool/zero-waste-case-study-san francisco

Ermolaev, E., Sundberg, C., Pell, M., & Jönsson, H. (2014). Greenhouse gas emissions from home composting in practice. *Bioresource Technology, 151*, 174-182.

Evans, D. (2012). Beyond the Throwaway Society: Ordinary Domestic Practice and a Sociological Approach to Household Food Waste. *Sociology, 46*(1), 41-56.

FAO. (2006) Policy Brief: Food Security

FAO. (2011). Global Food Losses and Food Waste.

FAO. (2013). Food Wasted Footprint, Impacts on Natural Resources; Summary Report

Gifford, R. (2014). Environmental Psychology Matters. *Annual Review of Psychology, 65*(1), 541-579.

Godfray, H. C., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., . . . Toulmin, C. (2010). Food Security: The Challenge of Feeding 9 Billion People. *Science, 327*(5967), 812-818.

Garaham-Rowe, E, Jessop, D. C., and Sparks, P. (2014). Identifying Motivations and Barriers to Minimizing Household Food Waste. *Resources, Conservation and Recycling 84*, 15-23.

Gunders, D. (august 2012). Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill. *Natural Resource Defense Council*.

Hall, K. D., Guo, J., Dore, M. and Chow, C. C. (2009). The Progressive Increase of Food Waste in America and Its Environmental Impact. *PLoS ONE*. 4.11

Humboldt Waste Management Authority. (2012). Humboldt County Waste Characterization Report. *Cascadia Consulting Group.*

Jucker, R. (2004). Have the Cake and Eat It: Ecojustice Versus Development? Is it Possible to Reconcile Social and Economic Equity, Ecological Sustainability, and Human Development? Some Implications for Ecojustice Education. *Educational Studies, 36*(1), 10-23.

Koester, U. (2014). Food Loss and Waste as an Economic and Policy Problem. *Intereconomics, 49*(6), 348-354.

Lou, X., & Nair, J. (2009). The impact of landfilling and composting on greenhouse gas emissions – A review. *Bioresource Technology, 100*(16), 3792-3798.

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

Ng, B. J., Mao, Y., Chen, C., Rajagopal, R., & Wang, J. (2015). Municipal food waste management in Singapore: practices, challenges and recommendations. *Journal of Material Cycles and Waste Management, 19*(1), 560-569.

NCRA. South San Francisco Scavenger Anaerobic Digester Tour. (2016, October 13). Retrieved from https://ncrarecycles.org/2016/10/ssfs-ad-tour/

Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N. and Ujang, Z. B. (2014). The Food Waste Hierarchy as a Framework for the Management of Food Surplus and Food Waste. *Journal of Cleaner Production 76,* 106-15

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: Quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences, 365*(1554), 3065-3081.

Priefer, C., Jörissen, J., & Bräutigam, K. (2016). Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling, 109*, 155-165.

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

Russell, S. V., Young, C. W., Unsworth, K. L., & Robinson, C. (2017). Bringing habits and emotions into food waste behavior. *Resources, Conservation and Recycling, 125*, 107-114.

Schmidt, K. (2016). Explaining and promoting household food waste-prevention by an environmental psychological based intervention study. *Resources, Conservation and Recycling, 111*, 53-66.

Staley, B. F., & Barlaz. M. A. (2009). Composition of Municipal Solid Waste in the United States and Implications for Carbon Sequestration and Methane Yield. *Journal of Environmental Engineering 135*(10), 901-09.

Thyberg, K., & Tonjes, D. (2016). Drivers of Food Waste and Their Implications for Sustainable Policy Development. *Resources, Conservation and Recycling 106*, 110-23.

Thyberg, K., & Tonjes, D. (2015). A Management Framework for Municipal Solid Waste Systems and Its Application to Food Waste Prevention. *Systems*, *3*(3), 133-151. U.S. Census Bureau (2010, October 05).

Venkat, K. (2012). The Climate Change and Economic Impacts of Food Waste in the United States. *Int. J. Food System Dynamics. 2*(4), 431-46.

Visschers, V. H., Wickli, N., & Siegrist, M. (2016). Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households. *Journal of Environmental Psychology*, *45*, 66-78.

Zero Waste Humboldt (2018). *Website*

APPENDICES

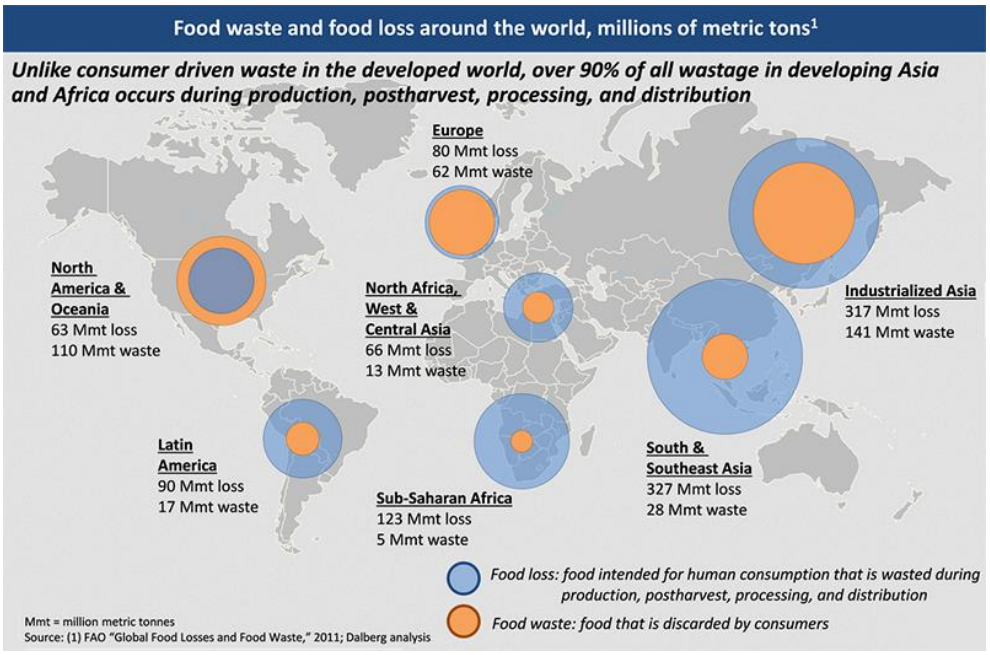

Figure 3: FAO Global Food Waste/ Food Loss

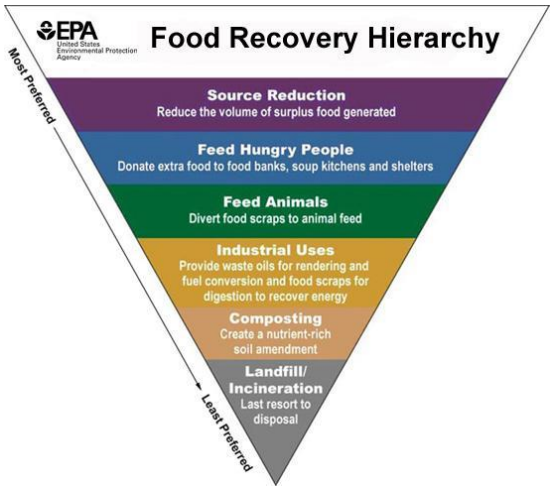

Figure 4: EPA Food Recovery Hierarchy