

Pre-Consumer Food Waste at Three Dining Facilities at a Large University

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### ABSTRACT

The objectives of this 8-week study were to assess the amount (weight) of pre-consumer (production) food waste at a large university, serving 18,000 meal plan holders, and identify major contributors of food waste (i.e. food categories, types of waste). Dining facility managers and waste coordinators (WCs) were voluntarily recruited from three dining facilities to oversee all food waste data collection and entry by dining staff, and attend weekly meetings with the research team. Food waste was weighed by staff at the designated facilities using institutional food scales. Information about the food waste was then written on tracking sheets and entered into an online database. The tracking sheet and database contained information on: product description (i.e. food type), reason for waste, weight of food (lbs), disposal method (compost/food scraps, diverted, or trash), and any related comments. Waste analysis included aggregating weekly data by total waste (lbs), facility, food type, food groups of MyPlate, and reason for food waste. Quantitative results from this study reveal that thousands of pounds of food waste are disposed of each week, especially for proteins and grains. Results derived from qualitative interviews and focus groups indicated that waste tracking is beneficial for staff buy-in, creating waste standards to improve efficiency, and adjusting food production schedules. Implications from these results indicate ability to help guide policy and practice, and provide insight into major contributors of institutional food waste.

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## Chapter 1: Introduction and Review of Literature

Projections indicate that two billion more people will be on the planet by 2050, raising concerns about the sufficiency, adequacy, and sustainability of local, national, and global food systems among citizens, health professionals, academicians, producers, and policy-makers (United Nations, 2005). Currently, one in five workers and their families worldwide live in extreme poverty, on less than \$1.25 per day, with inadequate access to nutritious food, safe drinking water, proper sanitation or shelter (United Nations, 2011), highlighting a major food access gap. Meanwhile, the rate of obesity in the United States and many more industrialized and developed countries is reaching alarming rates, alongside consistent rates of food insecurity and hunger in those countries (Ogden & co-workers, 2006; Kim & Popkin, 2005; ERS, 2011). Waste generation also continues to rise across the globe. In the U.S. alone, 249 million tons of municipal solid waste is collected per year. Per person, this equates to 4.43 pounds per person per day, rising from 3.66 pounds per person in 1980. As the food access gap continues to grow, it is alarming to note that food waste is the fastest growing contributor to total municipal solid waste (MSW), from 10.1% in 2007 to 13% in 2010 (EPA, 2010). In addition, of the 3900 calories produced per person per day in the U.S., almost a third of these calories are lost during the food supply chain (ERS, 2003; ERS, 2010).

In response to these increasing concerns, an emphasis on sustainability, or “the creation and maintenance of conditions under which humans and nature can exist in productive harmony; that permit fulfilling the social, economic and other requirements of present and future generations” (EPA, 2011), is warranted. A more sustainable, community-based food system, one that integrates these important considerations during the food production, processing, distribution, consumption, and disposal stages (Figure 1, C.S. Mott Group ) has been regarded most often by leading national organizations as a means to improve public health outcomes, the environment and economy (Garrett & Feenstra, 1999; APHA, 2007; ADA, 2010). Very little scientific literature exists, however, to provide strategies to improve community-based food systems from a systems or institutional level, although examples are prolific among practice-oriented organizations (Winne, 2003). One area of study that may positively influence our food system may be in addressing food loss, or “any change in the availability, edibility, wholesomeness or quality of the food that prevents it from being consumed by people” (FAO, 1981). The following sections point to the resulting health and nutrition, environmental, and economic consequences of food waste, along with discussion of the influential nature of increasingly sustainable dining facilities at U.S. institutions.

**Figure 1:** Community Food Supply Chain (Michigan State University, C.S. Mott Group)



### *Health and Nutrition Concerns*

The shift in Americans' perception of food itself – from relationships to fragments or things – as stated by Fred Kirschenmann, has created a modern food system of unsustainable proportions (Kirschenmann, 2010). This transition has affected the ability to control food portions, and thus has resulted in the current generation of “luxus consumers,” or an industry that over-consumes materials and resources used for food production (Blair & Sobal, 2006). As previously noted, the U.S. produced 3900 calories per person in 2006, a significant 24.5% increase from 1970 (ERS, 2010). Most of these calories are of low nutritive quality, supplying 9.5% more grains (mostly refined), 9% more fats and oils, and 4.7% more sugars in 2000 than in 1970. Of these 3900 calories, an estimated 1100 calories or 28.2% is wasted due to spoilage, plate waste, and cooking loss (ERS, 2003), of which fruits and vegetables are wasted the most, at 19.6% of total food loss (Kantor & co-workers, 1997). Considering 14.5% or 17.2 million U.S. households were food insecure in 2010, improved food waste management that includes food diversion



or gleaning may be in order (ERS, 2011). The EPA, for instance, recently began promoting their “Feeding People, Not Landfills” campaign, providing resources for food banks and other food recovery programs (EPA, 2012). Initiatives and campaigns such as this may improve distribution of calories in the U.S. and possibly reduce hunger and promote community food security (Hamm & Bellows, 2003).

Food safety is also an important consideration for the food supply. Estimates of 31 known major pathogens in the United States have caused 9.4 million episodes of food borne illness, 55,961 hospitalizations, and 1,351 deaths each year (Scallan, 2011), and thus remains motivation for even tighter safety controls. The United States Department of Agriculture (USDA) enacted a Pathogen Reduction/Hazard Analysis and Critical Control Point regulatory standard that was to be mandated by all foodservice handlers by 2000 (Olinger, 2003). This rule was designed to reduce the number of pathogens found in the food system by a series of 7 steps, including conducting a hazard analysis, identifying critical control points, establishing critical limits for each critical control point, establishing critical control point monitoring requirements, establishing corrective actions, establishing procedures for verifying HACCP systems work as intended, and establishing record keeping procedures (FDA, 2011). Since unsafe food at any point in production is unfit for human consumption, increased volume of food waste and therefore nutrient loss, is a direct result of food handling techniques important for health and consumer safety (FSIS, 2012; FAO, 2011).

### *Environmental Considerations*

It has been estimated that waste from schools, institutions, and businesses constitutes between 35 and 45% of total MSW in the United States and will continue to rise (EPA, 2007). MSW contributes, in part, to the emission of greenhouse gases (GHG) - water vapor, carbon dioxide, methane gas, and nitrous oxide - that are channeled into the atmosphere and result in slow temperature increases. The building of atmospheric carbon dioxide and other GHG as catalytic factors have been largely debated in regards to effects such as rising sea levels, causing drastic flooding; depletion of mountain glaciers and snow cover reduction, thereby diminishing fresh water sources; loss of biological diversity and eco-system collapse; and agricultural shifts impacting crop yields and productivity (EPA, 2006). An increase in the proliferation of infectious diseases and increased heat-related mortality due to higher temperatures that promote infectious diseases, along with projected droughts and possible food shortages from eco-system changes, may also take place (Godfray & co-workers, 2010). Over the last century, atmospheric temperature has already risen one degree Fahrenheit (EPA, 2006). Global anthropogenic emissions of methane, 20 times more effective at trapping heat than carbon dioxide, has grown from 14% in 2004 to

18% in 2008 (Bogner & co-workers, 2008). Food waste is the fastest growing contributor to MSW collected in landfills, the third-largest source of total U.S. methane emissions and the primary source of anthropogenic methane emissions (EPA, 2012). Thus, a potentially worthwhile climate mitigation strategy should include food waste reduction (Gentil & co-workers, 2011).

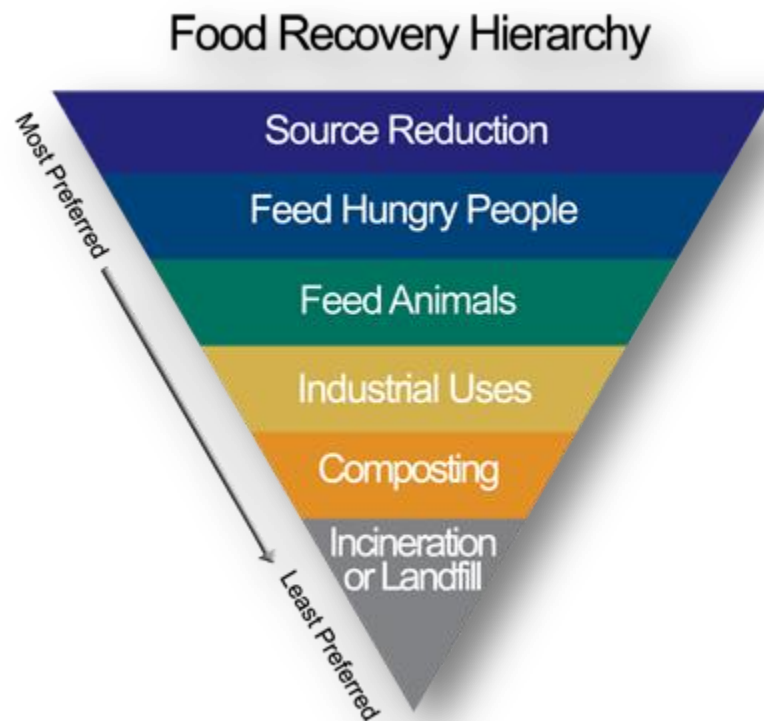
A behavioral shift on behalf of consumers and food producers is also warranted. Lehman and Geller (2004) note that most environmental studies, since the pro-environment movements of the 1970's, focused on the attitudes of consumers versus impactful behavior change of consumers and producers. They further claim that imposing effective intervention strategies such as environmental design, or the manipulation of a physical environment to increase individual adherence to a protocol, may provoke behavior change (Lehman & Geller, 2004). This paper cites one study, for example, that experienced a 28% recycling rate when bins were put in central locations of an office space, yet increased to 85-94% when a recycling tray was put on individual's desks (Brothers & co-workers, 1994). Recognizing that design plays a critical role in behavior change, the time frame or stage of a process at which an intervention is focused also matters, which in this case involves the end of the waste stream with the emphasis of recycling. Studies such as this encourage further investigation of other areas of impact along the food system, such as waste reduction at the source (Gardner & Stern, 1996). Additionally, since past studies have mostly collected data about the attitudes and perceptions of consumers, it appears that a shift towards studying the behaviors of food handlers and consumers could be more influential at making an environmental impact (Stern, 2000), additionally improving sanitation, public safety, and health (EPA, 2010).

### *Economic Implications*

From farm to decomposition, food expenses in the U.S. are high. The foodservice industry makes up 4.3% of U.S. gross domestic product, of which 0.7% accounts for agricultural shares; the rest accounting for processing and handling of food (ERS, 2012). Not included in this percentage is the \$429 billion spent on food by American consumers, of which \$36 billion is spent in schools and colleges (ERS, 2011). Food disposal costs are also not included in this total share, however average national landfill tipping fees have risen to \$34.29 per ton, from \$8.2 per ton in 1985 (Repa, 2005). The high price of waste disposal, estimated at \$1 billion, is a top concern for most industries, especially in the foodservice sector (EPA, 1999). The EPA has developed a cost calculator specific to food waste disposal methods, including source reduction, donation, composting, and recycling (EPA, 2009), and also has published materials that specifically emphasize source reduction and diversion, such as the Food Recovery Hierarchy (Figure

2). In this diagram, highest of importance is source reduction, or reducing the amount of food waste generated; secondly, feeding people, or excess food donation to food banks, soup kitchens and shelters; thirdly, feeding animals, or providing food scraps to farmers; then industrial uses, which entails providing fats for rendering, oil for fuel, food discards for animal feed production, and soil amendment production; and finally, composting, of which food scraps are recycled into a nutrient rich soil amendment (EPA, 2012). Considering the EPA’s emphasis to reduce food waste from the source, it is interesting to note that most studies have been conducted on recycling and composting and few have been published articulating current economic figures related to production food losses and the potential for cost savings.

**Figure 2: Environmental Protection Agency’s “Food Recovery Hierarchy”**



Of the existing literature examining waste management in foodservice, it is apparent that cost factors are more important to directors than environmental considerations. In one study conducted by Bonnie Hackes and Carol Shanklin, researchers distributed a survey to 168 school foodservice directors in major cities in the U.S. to determine factors related to resource allocation decisions. In order of importance, labor, food safety, enrollment growth, compliance with U.S. Dietary Guidelines,

administrative cost shifting, utility costs, water quality, and waste hauling costs were the most important factors identified. Results from this study indicate that environmental issues were considered a low priority when making decisions involving resource allocation (Hackes & Shanklin, 1999). Programs such as LeanPath, a food waste tracking firm used by many institutions and commercial businesses in the U.S., suggests marrying economic and environmental considerations by making food waste tracking a typical and simple operating procedure. LeanPath offers the ValuWaste® Tracker, a touch-screen terminal and scale used to track food waste. Subscription to this service provides coaching, training, consulting, and ongoing reports of production and disposal activities and claims to reduce food waste by 47% and overall costs by 10% (LeanPath, 2012). The initial cost of this program may be too expensive for some foodservice outlets, however, often exceeding more than \$20,000 in installation fees (personal communication with LeanPath representative, 2010). Considering the high price of operating a foodservice outlet at an average of \$8 million per facility, with \$3.6 million in labor costs and \$3.2 million on food purchases (Foodservice Director, 2012), food waste management may be a low priority. One of the main drivers for this study was to find a potentially more affordable food waste tracking system for foodservice operators than LeanPath and other waste tracking software.

Unlike the minimal regard food waste management might receive in institutional operations, food safety practices have been considered highly important when making financial decisions (Hackes & Shanklin, 1999) in foodservice. Although only approximately 1% of total foodservice expenses can be incurred due to implementing plans such as HACCP (ERS, 2003), the true cost of a comprehensive food safety system is difficult to capture due to employee training, management of time and temperature tracking logs, and possibly employing a HACCP coordinator (Khandke & Mayes, 1998). As foodservice directors and managers are willing to spend time and money on food safety concerns to keep customers safe, creating a successful food waste tracking and reduction plan that complements and enhances the efficacy of the food safety system could also improve the economic, environmental, and health costs associated with food waste.

### *Food Waste in U.S. Institutions*

Foodservice departments of U.S. universities account for 6.5% of total meal and snack consumption away from home (ERS, 2012), representing a potential reduction in total food waste if the landscape of foodservice changes towards a more sustainable operation. Employee participation in food waste tracking allows for creative empowerment and an increased awareness of current economic, environmental, and social concerns (Lam, 2010). Explanation of outcomes (money and time saved,

decreased natural resource use) at the initial phase of implementation has the potential to motivate full participation of staff members (Peregrin, 2011).

Potential for improvements specific to dining at large universities and institutions is significant. A 2008 article published in a popular magazine reported that campus foodservice departments take up to five times more water, five times more energy, and five times more waste than dorm rooms according to a consultant from the foodservice consulting firm, Sodexo (Curry, 2008). Commitment to sustainability in universities appears to be growing, first driven by an assessment tool created by the Sustainable Endowments Institute, a special project of Rockefeller Philanthropy Advisors, evaluating public and private colleges and universities in 2007 with their Green Report Card. This assessment tool highlighted successful environmental initiatives undertaken by universities and also spawned many others, including compost management systems (60% of schools), food diversion, local sourcing, and in some cases, improved food waste management (Sustainable Endowments Institute, 2012). The Association for the Advancement of Sustainability in Higher Education (AASHE) is now the leader in university sustainability tracking with their STARS program, a self-reporting framework used by many colleges and universities to measure and compare initiatives and practices (AASHE, 2012).

Research that focuses on these initiatives is abundant. One particular study took place at Southern Illinois University, with 4,000 dining plan holders equating to 7,000 meals provided per day by university dining halls (Babich & Smith, 2010). The researchers of this study utilized three dining halls to implement a three phase “cradle to grave” analysis to indicate how sustainable their practices were from vendor to disposal to decomposition. Phase one measured miles from food vendor to the particular dining hall for each food item and then used an online calculator (carbonfund.org) to quantify resulting CO<sub>2</sub> emissions from each food item, later organized into food group categories. Results from this phase indicate that produce (21.93%), meat (18.15%), and dressings (14.29%) emitted the most CO<sub>2</sub> given the distance the product traveled and the amount of this type of food purchased. Phase two measured post-consumer food waste, or food that was left on consumers plates and discarded in the pot wash area. It was found that 1.04 oz of food waste per student each day was wasted. Phase three tested a vermi-composting system for efficiency, entailing the creation of an organic by-product by way of worms. Results show that this method was not as efficient as intended, as it took 5 weeks to prepare the material prior to introducing the worms, two weeks longer than the intended 3 week period. One area of significance was an observation made by researchers during phase two that 50 pounds of food waste was being generated at the food production level. The authors recommended better forecasting methods to reduce this hidden food waste generator (Babich & Smith, 2010).

University of California-Berkeley conducts a program called, “Eat the World but Save the Earth,” in which student volunteers collect edible food waste from the dish room and display it in clear buckets in the middle of the dining hall. They have witnessed a drastic decrease in food waste at each demonstration (Lawn, 2005). Another example of decreased food waste can be found at both Oberlin College in Ohio and Portland State University (Biocycle, 2008). Each has eliminated trays, finding similar results to a study conducted at Virginia Tech, which equated to an 18.4% reduction in consumer food waste and a 27.9% reduction in producer food waste during a 1-week trayless study (Sarjahani & co-workers, 2009). This aligns with past evidence suggesting trayless dining results in a 25-30% reduction in total food waste (Aramark Higher Education, 2008). Nearly 75% of U.S. colleges reporting to the Sustainable Endowments Institute have also instituted trayless dining programs as of 2012 (Sustainable Endowments Institute, 2012).

Although the trayless initiative certainly contributes to a reduction in waste, a potentially more impactful point in food production—pre-consumer waste—is often overlooked because of fears that reducing the amount of food produced may affect service and overall quality of food (Ryu & co-workers, 2003). Since the food system has increasingly become consumer-driven instead of producer-driven (Johns, 2002), a focus on consumer preference for cost and convenience has lead foodservice professionals to increase production schedules (Glanz, 1998). Both availability of food and expectations for faster foodservice from consumers may make a substantial impact on the amount of food waste that can accrue due to over-production and lapses by pressured employees (Johns, 2002).

Given the considerations made by foodservice establishments to fulfill the needs of their customers, whether by cost, convenience, safety or preference for more sustainable business decisions, foodservice handlers may need to think beyond improved food waste disposal methods employed by many “green” universities (Sustainable Endowments Institute, 2012). Two examples of disposal methods currently used in institutions are composting organic materials to be used as a soil amendment or as a medium to grow plants (EPA, 2011), and food diversion, or the donation of non-perishable and unspoiled perishable food to local food banks, soup kitchens, pantries, and shelters (EPA, 2012). While composting and food diversion are excellent ways to reduce landfill usage, they are inefficient ways to reduce the production of waste in foodservice operations. By focusing on source reduction of food production, purchasing inventories, utilities, and labor costs can be reduced, as well as fuel for transportation of both food to the source and waste from the source (Shakman, 2009).

### *Summary*

A sustainable food system, one that will endure and supply a healthful diet for all humans is necessary to better manage the entire food process – harvesting, processing, transportation, distribution, receiving, storing, production, serving and disposal (Heller and Keoleian, 2003; Edelstein, 2009). Improved management of each step, especially at the source of food production, will provide more meaning to our food system and potentially reduce the wasted resources that our system currently expels. Specifically, little is known about the impacts of food waste reduction in universities, in regards to volume and types of food wasted. With 4,495 colleges in the United States with foodservice programs, the potential for significant reductions in waste sent to landfills from institutional food production is essential for further research considerations (IES, 2010).

## **Chapter II: Pre-Consumer Food Waste at Three Dining Facilities at a Large University**

### **ABSTRACT**

This 8-week study served to assess the volume (weight) of pre-consumer food waste in three dining facilities at a large university and identify major contributors of food waste (i.e. food categories, types of waste). Facility managers and waste coordinators (WCs) were voluntarily recruited to oversee food waste data collection (weighing and using a tracking log) and database entry by staff. Total and average food waste results indicate high food waste in the meats/beans and bread/grains categories. Overall, the tracking system motivated self-selected corrective action to reduce food waste. A number of challenges were also noted, including additional time and space required, employee compliance, and lack of communication between front and back of the house food production. Implications from these results indicate ability to help guide policy and practice in institutional dining programs.

### **INTRODUCTION**

According to the U.S. Economic Research Service (ERS), the United States produced 3900 calories per person in 2006, a significant 24.5% increase from 1970 (ERS, 2010). Most of these calories are of low nutritive quality, supplying 9.5% more grains (mostly refined), 9% more fats and oils, and 4.7% more sugars in 2000 than in 1970. Of these 3900 calories, an estimated 1100 calories or 28.2% is wasted due to spoilage, plate waste, and cooking loss (ERS, 2003); of which fruits and vegetables are wasted the most, at 19.6% of total food loss (Kantor & co-workers, 1997). Considering 14.5% or 17.2 million U.S. households were food insecure in 2010, improved food waste management that includes food diversion or gleaning may be in order (ERS, 2011). The EPA, for instance, recently began promoting their “Feeding People, Not Landfills” campaign, providing resources for food banks and other food recovery programs (EPA, 2012). Initiatives and campaigns such as this may improve distribution of calories in the U.S. and possibly reduce hunger and promote community food security (Hamm & Bellows, 2003).

Food safety is also an important consideration for the food supply. Estimates of 31 known major pathogens in the United States have caused 9.4 million episodes of food borne illness, 55,961 hospitalizations, and 1,351 deaths each year (Scallan, 2011), and thus remains motivation for even tighter safety controls. The United States Department of Agriculture (USDA) enacted a Pathogen Reduction/Hazard Analysis and Critical Control Point regulatory standard that was to be mandated by all foodservice handlers by 2000 (Olinger, 2003). Since unsafe food at any point in production is unfit for



human consumption, food waste and therefore nutrient loss, is a direct result of food handling techniques important for health and consumer safety (FSIS, 2012; FAO, 2011).

The environmental impacts of food waste are also of high concern, in that waste from schools, institutions, and businesses constitute between 35 and 45% of total MSW in the United States and will continue to rise (EPA, 2007). MSW contributes, in part, to the emission of greenhouse gases (GHG) - water vapor, carbon dioxide, methane gas, and nitrous oxide - that are channeled into the atmosphere and result in slow temperature increases. The building of atmospheric carbon dioxide and other GHG as catalytic factors have been largely debated in regards to effects such as rising sea levels, causing drastic flooding; depletion of mountain glaciers and snow cover reduction, thereby diminishing fresh water sources; loss of biological diversity and eco-system collapse; and agricultural shifts impacting crop yields and productivity (EPA, 2006). An increase in the proliferation of infectious diseases and increased heat-related mortality due to higher temperatures that promote infectious diseases, along with projected droughts and possible food shortages from eco-system changes, may also take place (Godfray & co-workers, 2010). Over the last century, atmospheric temperature has already risen one degree Fahrenheit (EPA, 2006). Global anthropogenic emissions of methane, 20 times more effective at trapping heat than carbon dioxide, has grown from 14% in 2004 to 18% in 2008 (Bogner & co-workers, 2008). Food waste is the fastest growing contributor to MSW collected in landfills, the third-largest source of total U.S. methane emissions and the primary source of anthropogenic methane emissions (EPA, 2012). Thus, a potentially worthwhile climate mitigation strategy should include food waste reduction (Gentil & co-workers, 2011).

The high price of waste disposal, estimated at \$1 billion, is a top concern for most industries, especially in the foodservice sector (EPA, 1999). National tipping fees have risen to \$34.29 per ton, a 23% increase from \$8.2 per ton in 1985 (Chartwell, 2005). The EPA has developed a cost calculator specific to food waste disposal methods, including source reduction, donation, composting, and recycling (EPA, 2009), and also has published materials that specifically emphasize source reduction and diversion, such as the Food Recovery Hierarchy (EPA, 2012). Considering the EPA's emphasis to reduce food waste from the source, it is interesting to note that most studies have been conducted on recycling and composting and few have been published articulating current economic figures related to production food losses and the potential for cost savings.

As the landscape of foodservice changes towards a more sustainable operation, participation allows for creative empowerment of staff members and an increased awareness of current economic, environmental, and social concerns (Lam, 2010). Explanation of outcomes (money and time saved,

decreased natural resource use, etc.) at the initial phase of implementation has the potential to motivate full participation (Peregrin, 2011). Improvements specific to dining at large universities and institutions are significant, especially in regards to compost management systems, food diversion, local sourcing, and in some cases, improved food waste management (Sustainable Endowments Institute, 2012). While composting and food diversion are excellent ways to reduce landfill usage, they are inefficient ways to *actually reduce waste* in foodservice operations. By focusing on source reduction of food production, purchasing inventories, utilities, and labor costs can be reduced, as well as fuel for transportation of both food to the source and waste from the source (Shakman, 2009).

Little is known about the impacts of food waste reduction in universities, in regards to volume and types of food. The goal of this study was to assess the volume (weight) of pre-consumer food waste at three dining facilities at a large university with 18,000 meal plan holders. Secondary goals were to: 1) identify major contributors of food waste (i.e. food categories, types of waste) in order to outline possible strategies for reducing food waste and related costs and environmental impacts; and 2) test an online tracking system to develop a long-term and sustainable food waste tracking system, modeled on HACCP (Hazard Analysis and Critical Control Points) a management system used to control biological, chemical and physical hazards in order to ensure food safety from the raw material production to procurement, handling, manufacturing, distribution, and consumption (FDA, 2011). Differentially, the objective of this study is to create a food waste management system that has the potential to reduce overall food production levels in foodservice facilities at institutions by encouraging immediate corrective action by staff and using historical waste trends to provoke the development of more efficient food production schedules.

## **METHODS**

### **STUDY DESIGN**

Food waste data were gathered for 8 weeks at three dining facilities at a large university. The goal of this study was to test the feasibility of a food waste tracking log and corresponding database. This study was approved by the Institutional Review Board of [Blinded.]

### **SETTING**

This university is located in a large town in Southwest Virginia. The university houses more than 125 buildings with more than 30,000 full-time students and 1,368 full-time faculty members [blinded].

## DINING SERVICES AND SUSTAINABILITY PROGRAM

This University's Dining Service Program provides meals for approximately 18,500 dining plan holders at any of the twelve dining centers available on-campus. Annual gross sales total \$9.5 million, serving 6.2 million meals per year. This dining program also is the largest single employer on campus, with over 1,500 full and part-time employees [blinded].

The Sustainability Program of the University's Dining Services department was initiated in 2008 to "promote a sustainable dining and food system at [blinded] and therefore the greater community." Outcomes from this program include the creation of a Sustainability Coordinator position, composting and diversion programs, the start of a university garden that supplies some produce on campus, and sustainable food purchasing, such as local food sourcing and buying from distributors that follow Monterey Seafood Watch guidelines.

## DESCRIPTION OF PARTICIPATING FACILITIES

### ALL-YOU-CAN-EAT (AYCE)

The AYCE facility functions as an all-you-can eat buffet with a set meal price for student meal plan holders, but is open to the public at a higher price. There are approximately 1,150 seats and 2,752 patrons served per day, so pre-consumer food production is often conducted in large batches to accommodate high volume patronage. This dining hall is open during three shifts, morning, lunch and dinner, for two hours at a time. There are seven different serving stations. Pre-consumer composting (every day) and food diversion (varied frequency) are utilized here. Methods utilized by AYCE to implement this tracking system included a seven compost bin disposal system located in a central location in the food production area. Each bin represented a different food category, in which employees disposed of a certain type of food in the appropriate bin to be weighed as an aggregate total per food category at the end of the day. Reason for waste codes, identified on the tracking form, were not utilized at this facility because of the use of aggregate totals versus itemized foods.

### A LA CARTE: FOOD COURT (FC)

The FC facility uses an a la carte menu and seats 700 customers with an average number of daily transactions of 5,275. Structured like a cafeteria or food court, there are 12 specialty shops that offer international and American cuisines all in one location of the facility. Prices are on a per food item basis. Patrons purchase their food at a centralized kiosk area. Food scraps are collected every day and picked

up for compost two times per week. This facility utilized methods that included an itemized food list aligned with the food waste tracking form and corresponding online database, therefore reason for waste codes were appropriated.

#### A LA CARTE: MARKETPLACE-STYLE (MS)

A marketplace-style facility seating 400 and average daily transactions of 6,670, the MS facility offers seven “restaurants” with capabilities for made-to-order items. Meal prices are based on each food item and are purchased at individual “restaurants.” The only disposal method is trash. Methods utilized at this facility were exactly the same as those employed at FC, and thus codes identifying reason for waste were used per food item wasted.

### **MATERIALS/INSTRUMENTS**

#### FOOD WASTE STATIONS

Food waste stations were employed at each facility, with scales and tracking forms placed in convenient locations based on heavy traffic areas, convenience, safety, and other factors with input from WC’s and staff. Employees were trained on weighing and tracking any food or beverage that was to be composted, thrown away, or diverted.

#### FOOD WASTE TRACKING FORM

Food waste was assessed at dining facilities using a tracking form, completed by staff at each dining facility at designated waste stations. The original tracking form and corresponding WC built upon the current HACCP (Hazard Analysis and Critical Control Points) program utilized at this university, including the designation of a HACCP coordinator who would oversee compliance of the HACCP tracking form that keeps record of time and temperature of food products. The food waste tracking form and corresponding WC position were pilot-tested at a small chain restaurant at the university. Information gathered on this tracking form included: date; time; internal location; initials of staff member entering data; product description; food type code; reason for waste; container size; weight of food (lbs); disposal method (compost/food scraps; diverted; or trash); and any related comments. Reasons for waste and corresponding codes were provided for each type of food waste to be entered on the form: overproduction, over-merchandised, spoilage, expired, dated, trim waste, contamination, burned/dropped, quality control, customer left, time/temperature abuse, and closing/end of night.

## ONLINE DATA ENTRY

An online database was created by an in-house software developer to parallel the waste tracking form with the intent of the forms being entered then aggregated and analyzed. The database was developed to be user-friendly with drop down menus. Staff could also upload Excel documents directly to the database.

## DATA COLLECTION

### STAFF TRAINING

Each unit manager was requested to recruit a staff member to be the designated Waste Coordinator (WC) in December 2010. The role of the WC was to be responsible for the training and motivation of onsite staff on weighing the food waste and completing the food waste tracking sheet. Compliance by staff members was a critical element to this study for continual testing of the tracking system. Entering the data into the online database was also an important function of the WC. Any operational tasks that were necessary in the implementation of this study were decided upon by the WC. In all facilities, the Head Chef was chosen as the WC. In January 2011, training was conducted by the Dining Services Sustainability Coordinator and the research team for all dining facility managers and WCs. The training provided an overview and rationale for the project, food waste tracking sheet, and online tracking system.

## IMPLEMENTATION

Food waste data were gathered using the tracking sheet and online tracking system for eight weeks, from February 14 to April 17, 2011, in three distinct dining facilities (AYCE, FC, MS). These dates were chosen, as they represented a fairly static time during the semester where large fluctuations in food waste were not expected (versus the beginning or end of the semester). Also, because the study period took place in the middle of the semester, employees were given ample time to incorporate food waste tracking into their normal employee tasks. The dining facilities were chosen to represent different dining experiences and facilities.

## ATTITUDES AND PERCEPTIONS TOWARD FOOD WASTE

To gather feedback on the food waste tracking system, focus group discussions were conducted with six to ten staff from each dining facility. Ten questions were asked, including overall thoughts,

benefits/challenges, procedural changes, ease/difficulty, frequency of “estimation” versus actual weighing, current tracking, and suggestions for compliance and future waste tracking programs. Discussions were recorded in an enclosed or private area of the cafeteria of each dining facility, and lasted between 40 and 60 minutes. To gauge the perceptions of facility managers and waste coordinators, structured interviews were conducted and recorded in each manager’s private office. Interviews lasted between 22 and 50 minutes. Questions were similar to those asked in focus groups, but also included perceived number and percentage of hours managers or the WC spent facilitating the project or entering data into the online tracking system as well as motivations to initiate the program. Informed consent was completed by all participants of focus groups and structured interviews.

## **DATA ANALYSIS**

Descriptive statistics were computed for food waste, including total waste at each facility; waste by food category, aligned with MyPlate (grains, protein, fruits, vegetables, dairy oils, and discretionary calories); and waste by reason of disposal. The research team then created tables and charts that were shared with each WC from the study on a weekly basis and organized as a complete report at the end of the study for facility records. Focus group discussions and structured interview responses were transcribed and then coded in an iterative fashion, to identify convergent major and minor themes.

## **RESULTS**

### **Food Waste**

Food waste data were computed based on waste disposal method and then presented as mean waste (lbs) per patron count (Table 1) and food category (Table 2), which was indicated by staff members on facility tracking logs.

**Table 1:** Total Food Waste by Disposal Method and Mean Waste (lbs) per Patron

Facility	Trash	Compost	Diversion	Total	*# of patrons per day	Patrons for 8-week period	Mean waste (lbs) per Patron
AYCE	0	30,112	3,706	33,818	2,752	154,112	0.2194
FC	657.16	7,795	0	8,452.12	5,275	295,400	0.0286
MS	14,802.15	66	10	14,878	6,670	373,520	0.0398
<b>Totals</b>	15,459.31	37,973	3,715	57,148	14,697	823,032	0.2878

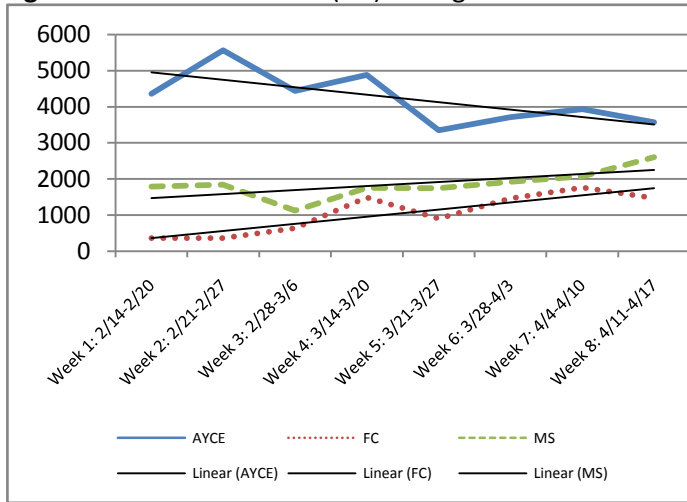
\*Patron count information provided by university dining services

Total food wasted over the 8-week period amounted to 57,148 pounds; with disposal rates of 27.1% trash, 66.4% compost, and 6.5% diversion post-production. Given the average number of total patrons during the 8-week study, 0.2878 pounds of waste were generated per person, with most wasted food per patron occurring at AYCE, the buffet-style establishment.

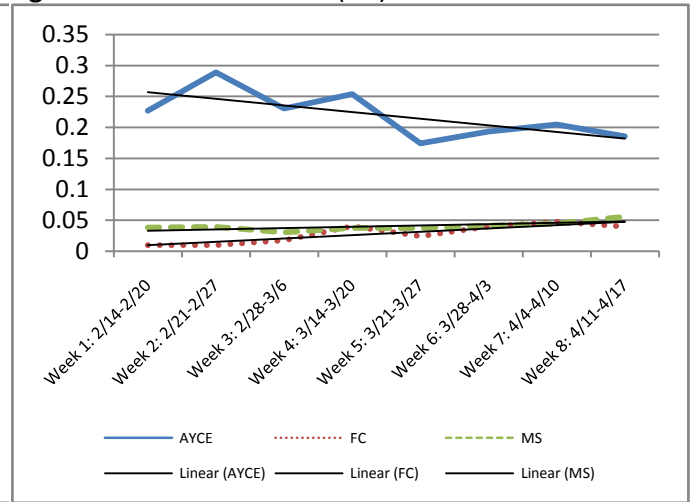
Trends throughout the 8-week study indicate a decrease in collected food waste data at the facility using the seven food category bin system (AYCE) and an increase in aggregate food waste in the other two facilities (FC, MS) (Figure 3). The decrease in volume for AYCE is still apparent when patrons are accounted for; however, the trend lines for FC and MS appear more static over time (Figure 4). This may have been due to compliance in tracking, especially in the beginning of the study vs. actual increase or decrease of aggregate food waste.

The highest amount of food waste was accounted for at AYCE; however, due to the accessibility of compost bins, most food waste was disposed of by compost instead of trash (Table 1). Grains and proteins represented the most wasted food categories, at 35.4% and 35.5% respectively, and fruits and oils and discretionary calories were the lowest, at 4.7% and 3.1% respectively. Wasted dairy products made up 6.4% of total waste (lbs) and total vegetable waste (lbs) amounted to 14.8% (Table 2).

**Figure 3: Total Food Waste (lbs) during 8-Week Period**



**Figure 4: Total Food Waste (lbs) Per Patron**



**Table 2: Food Waste by Food Category of MyPlate**

Facility	Protein (lbs)	Grains (lbs)	Dairy (lbs)	Vegetables (lbs)	Fruits (lbs)	Oils (lbs)
AYCE	10,826.40	11,375.38	2,381.65	5,163.81	2,521.19	1,493.10
FC	3,544.01	2,752.96	408.02	1,649.25	42.51	55.37
MS	5,912.87	6,118.33	895.00	1,632.70	96.03	222.89
<b>Total</b>	<b>20,283.28</b>	<b>20,246.67</b>	<b>3,684.67</b>	<b>8,445.76</b>	<b>2,659.73</b>	<b>1,771.36</b>

The reason for waste was included for analysis, but only for two of the three dining facilities. AYCE did not use reason for waste codes since they were weighing an aggregate of compost by category versus an itemized food list used by FC and MS. Acronyms were used on tracking logs to indicate each of the 12 codes used during the study (Table 3). Shown in Table 4, it is apparent that some codes were used most of the time, whereas others were used very little, if at all. Results indicate that the most often reason for waste at FC was food going out of date, with a total of 3126.99 pounds for eight weeks the total volume of food waste. At MS, the highest reason for waste was what food was leftover at the end of the night, 10,099.99 pounds.

**Table 3: Reason for Waste Codes**

<b>OV</b>	Overproduction	<b>CT</b>	Contamination
<b>OM</b>	Over Merchandized	<b>BD</b>	Burned/Dropped
<b>SP</b>	Spoilage	<b>QC</b>	Quality Control
<b>EX</b>	Expired	<b>CL</b>	Customer Left
<b>DA</b>	Dated	<b>TT</b>	Time/Temp Abuse
<b>TW</b>	Trim Waste	<b>CE</b>	Closing/End of Night



**Table 4:** Food Waste Total (lbs) by Reason for Waste

Facility	OV	OM	SP	EX	DA	TW	CT	BD	QC	CL	TT	CE
<b>FC</b>	1,343.30	0.00	235.95	285.59	<b>3,126.99</b>	844.85	276.71	87.61	28.03	0.00	94.48	2,126.84
<b>MS</b>	2,578.27	0.00	221.42	689.98	81.20	10.45	329.69	465.27	54.93	7.33	339.38	<b>10,099.90</b>

### **Motivations to Track Food Waste**

Economic factors were the most important motivations for initiating or continuing food waste, with an overall score of 4.83 out of a total 5 points (Table 3). Environmental, followed by social factors, were also major themes. In facilities where social and environmental concerns were ranked lower, staff reported that lack of general knowledge about food waste consequences contributed to their values toward food waste. Evaluation of their performance at work was not found to be a major concern or motivator. Some participants were vocal about their personal feelings about waste management at work and at home, whether in a positive (“I am conscientious of it”) or negative (“I do not know much about it”) manner, as noted under individual considerations, mentioning personal financial concerns.

**Table 5: Motivations to Track Food Waste: Perceptions from Unit Managers, Waste Coordinators, and Staff**

Theme	*AYCE	*FC	*MS	Average	Quotes
<b>Economic</b>	4.5	5	5	4.83	<p><i>"I wanted my food cost to be affected." (AYCE, Male, Unit Manager, Interview)</i></p> <p><i>"Right, so I think money-wise, it's a good thing to see." (MS, Male, Staff, Focus Group)</i></p>
<b>Environmental</b>	2.5	4.5	5	4	<p><i>"I'd have to say for me it was a 2, because I'd have to be educated on that more." (AYCE, Male, Unit Manager, Interview)</i></p> <p><i>"I think it's a good idea to have less going to the landfills." (FC, Female, Staff, Focus Group)</i></p>
<b>Social</b>	5	2	5	4	<p><i>"At that point in time we didn't have a diversion system in place. Now we do, and I would rate it higher." (FC, Male, Unit Manager, Interview)</i></p> <p><b>Not a major theme in focus groups.</b></p>
<b>Operational</b>	5	3	2	3.33	<b>Not a major them in interviews or focus groups.</b>
<b>Performance Evaluation</b>	1	2	3	2	<p><i>"We are rated on food cost, so on a personal evaluation level, it helped. I mean, our food cost, was always good, but this made it a little better, but as far as that goes, there wasn't really anybody saying hey, you need to do this." (FC, Male, Unit Manager, Interview)</i></p> <p><i>"[...]with supervisors looking at it of course, I think some people were a little timid about actually writing down how much waste, thinking that there would be some consequence to it. I did talk to a few people who sort of thought, if I write down what I wasted, ya know because I burned something or whatever, that it would have an effect on their job, so it got to the point where maybe they didn't record things for that purpose." (FC, Female, Staff, Focus Group)</i></p>
<b>Individual Considerations</b>	NA	NA	NA	NA	<p><i>"Personally, it hits home to me because it bothers me to see how much waste usually a big production kitchen, let alone a kitchen in general, that be it a restaurant or whatever [...] to be able to be a part of this was a very positive thing." (FC, Male, Waste Coordinator, Interview)</i></p> <p><i>"You know, we are all on a budget...this is a state job, we all don't get paid very much so it did help with our personal at least, knowing to go ahead and eat it and not waste. And to bleed the refrigerator completely down before you go out and buy more." (FC, Female, Staff, Focus Group)</i></p>

\*Participants were asked to rank different motivational factors with 1 being the lowest, and 5 being the highest. WC's and unit managers ranked economic factors the highest, followed by environmental and social factors. Operational requirements and performance evaluations ranked the lowest of the 5 factors, at an average of 3.33 and 2, respectively.

## REACTIONS TO 8-WEEK FOOD TRACKING SYSTEM

A few procedural changes were required to implement this program in each dining hall. Still, most focus group and interview participants claimed many benefits to the program, as well as challenges.

## IMPLEMENTATION CHALLENGES

In general, the participants found the overall procedures difficult at first, but easier as the system became habitual.

*“Like I said, at first it took some time. I know we had had some discussions on how to get it organized to make it work in the building but once it got working, it became an everyday habit, the thing to do, and the staff really did buy in to it and want to make a success out of it.” (AYCE, Male, Waste Coordinator, Interview)*

One facility implemented a seven bin category system that presented different challenges and benefits than what was experienced at the other two dining halls.

## BENEFITS OF FOOD WASTE TRACKING

Major themes across dining halls from UM, WC, and staff were that the tracking system increased awareness and conscientiousness of employees, while also provoking immediate self-initiated corrective action by all when necessary (Table 4). This may have made an impact on food cost, as employees were rearranging food production schedules and becoming more efficient, given more specificity as a result of using reason for waste codes.

They also reported improved accountability around food waste. Prior attempts at tracking in two of the dining halls did not specify who was responsible for an error in food production or which shop food waste was exceeding normal limits. Focus group participants felt that the tracking system perpetually reminded them of their actions and therefore made them more responsible, especially since they had to initial the logs with chefs or managers reviewing on a routine basis. This was not felt by participants of the seven bin system, of which employees noticed a reduction of initialing responsibilities due to aggregate weighing versus individual line item tracking.

**Table 6:** Benefits to Tracking Food Waste: Perceptions from Unit Managers, Waste Coordinators, and Staff

Major Themes	Quotes
Awareness/ Behavior Change	<p><i>"[...] it was also a teaching tool for them, because they weighed it. They saw how much was in there, they had to physically look at it ya know, and they had to physically take this down to the, downstairs, to be taken away...they got to see what they were overproducing." (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><i>"I even overheard conversations about them, once we had something to do between the composting and waste tracking and all that, I had some of them talking about producing their own composting piles at home" (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><i>"It did make you more conscientious about what you were producing and it kinda made you want to not...to kind of hold off a little just to make sure that you needed the food before you produce it." (FC, Female, Staff, Focus Group)</i></p>
Corrective Action	<p><i>"But, we micro batch some things, so you look at the waste logs, and say, oh ok, I can tweak some of that in some of the shops." (MS, Male, Waste Coordinator, Interview)</i></p> <p><i>"[...]It helped as far as some of our productions that we knew, ok we are throwing so much of this and this away. Don't make so much." (AYCE, Male, Staff, Focus Group)</i></p>
Economic	<p><i>"Once we got on board and then with yours, we saw a significant decrease in food cost." (FC, Male, Unit Manager, Interview)</i></p> <p><b>Not a major theme in focus groups.</b></p>
Specificity/Efficiency	<p><i>"So with your study, really needing specific weight quantities [...]It got us working towards being more accurate." (MS, Male, Unit Manager, Interview)</i></p> <p><b>Not a major theme in focus groups.</b></p>
Accountability	<p><i>"Yeah, we have to operate a business. We have to be good stewards of the meal plan money, so we purchase using student money, so we need to make sure it's being held accountable." (MS, Male, Unit Manager, Interview)</i></p> <p><i>"...Generally [the Waste Coordinator] is a catch-all; if there is a big amount wasted, he'll come back to you and say, what happened?" (MS, Female, Staff, Focus Group)</i></p> <p><i>"So the sheet [food waste log] was probably set up for that, which was also a reminder to your staff when they were weighing and throwing something out, they had to write down what they did with it, to remember, oh, I have to compost this, and not trash it." (MS, Female, Staff, Focus Group)</i></p>
Culture Change	<p><i>"I think sometimes it's been, 'oh, if I make my job easier, and make bigger batches, and ya know, just don't pay attention...' Ya know, that's just the way it's been. But I see the culture changing, I see things happening, and when you have things like this that can bring that to bear, you get more and more buy-in with your staff." (AYCE, Male, Unit Manager, Interview)</i></p> <p><i>"Ever since yours had started, the one question that I lacked before but get now is, "well if there is a leftover, do I divert it or do I compost it?" ya know, and there was never any real question before. Ya know, it was, divert it or throw it in the trash, kind of thing. So, now they're asking questions just to take care of any leftover." (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><b>Not a major theme in focus groups.</b></p>

Buy-in from the staff increased as the study progressed, according to interview participants. As seen earlier, this was a motivating factor for the unit manager and waste coordinator to maintain waste tracking post-study. It appeared that the staff was finding purpose where it once was lacking in their jobs and that habits or questions were beginning to change.

#### CHALLENGES OF FOOD WASTE TRACKING

Barriers were a stronger focus of questioning for focus groups, however obtaining and finding space for scales and logs were consistent themes in both interviews and focus groups (Table 5). Other major challenges noted, particularly by focus group participants, were about the added time constraint of the tracking system, especially when tracking different types of food; compliance; comprehension; and communication, mostly between the “front” and “back” employees. Interview participants noted a perceived “learning curve” initially, whereby managers and waste coordinators had to continually train and remind employees of proper tracking behaviors. In focus groups, the staff mentioned that high turnover and lack of concern from student employees was also a reason for persistent training.

While accountability was considered one of the major benefits, it was also considered one of the disadvantages, with fear of possible retribution, especially for food waste as a result of errors or mistakes. Accountability was the largest concern in AYCE, using the seven category bin system, since food waste was an aggregate number instead of a line item that could be traced back to an individual food handler or shop. Idiosyncrasies such as high waste volume or a diversion complication, for example, could not be attributed to any moment in time or location in the dining facility. The other two dining facilities, using line item tracking sheets, did not find this to be a challenge.

Another challenge of the program was the inability to generate an immediate report, once the data were entered. Many participants of focus groups reported that the lack of report did not occur, and this presented a challenge for corrective action to take place. Some employees mentioned that they “felt alone” when coming up with a good way to remediate waste issues alongside their normal tasks. Similar to focus group opinions, waste coordinators addressed the same concern in interviews, declaring that an immediate report was needed to provoke proper corrective action by employees.

**Table 7: Challenges to Tracking Food Waste: Perceptions of Unit Managers, Waste Coordinators, and Staff**

Space	<p><i>“Room. Like I said, there were more sheets for recording, more compost bins needed to be distributed throughout the kitchen. Other than that, it was...just space” (FC, Male, Unit Manager, Interview)</i></p> <p><i>“Yeah, it is really limited in space back there. You have things that you are trying to cook and prep at the same time.” (FC, Female, Staff, Focus Group)</i></p>
Time	<p><b>Not a major theme in interviews.</b></p> <p><i>“Yeah I mean its just the amount of time and effort put into it is a lot. Ya know, especially when it comes to weighing those things and taking...when we were doing the itemized lists, I would say, at least 45 minutes out of the day was dedicated to that. You are already short on time...45 minutes is a lot.” (AYCE, Female, Staff, Focus Group)</i></p>
Type of Product	<p><b>Not a major theme in interviews.</b></p> <p><i>“It depends on what was expired...each day is different. But, again I think if you are doing fried product, like French fries, and hamburgers, and cookies, and things vs. liquids, you’re going to be able to measure your dry products, or loose products more quicker than soups and things.” (MS, Male, Staff, Focus Group)</i></p>
Compliance/Comprehension	<p><b>Not a major theme in interviews.</b></p> <p><i>“It’s just when you get one person that doesn’t understand, then you’ve gotta explain the whole thing over.” (FC, Female, Staff, Focus Group)</i></p>
Communication	<p><b>Not a major theme in interviews.</b></p> <p><i>“...We’re inevitably running out there to see what they have. They’re not real good at knowing...they’re full of students and they change in the afternoon. So whatever communication you had with them at 2:00 is useless at 4:00. Because they don’t tell each other, and I don’t think, no matter what you do, that you can change that. They’re just simply not going to communicate.” (FC, Male, Staff, Focus Group)</i></p>
Training/Learning Curve	<p><i>“Yeah, I remember it was a learning curve for filling out the form. That was a little bit of a barrier because of the codes. I remember one night in one of the shops, there was a little confusion. They say, well it was dropped, and id be like, well theres a little code for that, you know?” (MS, Male, Waste Coordinator, Interview)</i></p> <p><b>Not a major theme for focus groups.</b></p>
Accountability	<p><b>Not a major theme in interviews.</b></p> <p><i>“People are kind of afraid of writing down waste because they don’t want to get in trouble, so they’re going to hide it.” (AYCE, Male, Staff, Focus Group)</i></p>
Online Tracking System	<p><i>“The only one last road bump, or barrier that we have is, you know trying to find a way to take the information that we are trying and make it more effective, I guess. Something that I could sit here and track a little closer, individual. For instance, I could say that we took out this week that we took out X amount of poundage, whether it went to diversion or composting...” (AYCE, Male, Waste Coordinator, Interview)</i></p> <p>[When asked if see logs] P1: <i>“We don’t see it again. (repeated by several others)</i> P2: <i>“Unless they have to go back and track it.” (MS, Staff, Focus Group)</i></p>

## FREQUENCY OF WEIGHING

In all three dining facilities, focus group participants expressed that physical weighing occurred most often in the beginning of the study, mostly during the morning or night shifts when there was more time to do so.

*“I think the only place that you probably weren’t seeing tracking was the during shift, like again, if somebody burned something, or something like that, they didn’t, but the totals at night were pretty accurate.” (FC, Female, Staff, Focus Group).*

## CREATION OF STANDARDS

During focus groups, the majority of employees said that they used self-created standards instead of weighing. For example, one staff member (FC, Female) stated, “Well we did get down to the point where we knew a pan of mac and cheese weighed x amount, and then we had seven pans of mac and cheese left, all you do is multiply, so after awhile we weren’t thoroughly weighing properly.” The use of “standards” was never addressed by Unit Managers or Waste Coordinators during interviews.

## CUSTOMER DEMAND

In both interviews and focus groups, participants commented on the challenge of balancing customer demand with overproduction and waste.

*“For customer service we want to have items readily available, we just don’t want an abundance or an excess. So its really difficult finding that middle of the road.” (MS, Male, Unit Manager, Focus Group)*

*“And there’s a general concept, don’t run out. Other than the last 5 minutes, we are very uncomfortable about running out.” (FC, Male, Staff, Focus Group)*

## PERCEIVED COMPLIANCE

The decrease in weighing was not mentioned in interviews with Unit Managers and Waste Coordinators. Instead, these individuals perceived weighing and tracking compliance to be high.

*“I’d be looking at 95% somewhere in that range.” (AYCE, Male, Waste Coordinator, Interview)*

*“Probably in the 90% range.” (FC, Male, Unit Manager, Interview)*

*“But even during the day, when something got ruined, damaged, or overcooked, or dropped on the floor, or something like that, they’re already in the habit of doing that. So, I think for the most part, we are above 98% as far as compliance.” (MS, Male, Unit Manager, Interview)*

During focus groups, however, it was noted that staff felt that coming up with their own weight standards was an appropriate replacement for actual weighing, and, thus, also felt that compliance was particularly high.

*“I think you’re getting compliance, unless you want everything weighed every night, and subtract it from the containers...” (FC, Male, Staff, Focus Group)*

One focus group participant (AYCE, Female) mentioned a decrease in compliance when operations were particularly more demanding, “I mean we even had schedules posted and we would just get busy doing everything else and everybody would forget or they just didn’t want to.”

Improving compliance was only a major theme in focus groups (Table 6). Employees had many suggestions on how to improve employee compliance, whether by establishing habits, improving communication from the “front” of the house to the “back”, to educating one another during a shift or as a University-lead course, and increasing buy-in.

**Table 8:** Suggestions to Improve Compliance: Perceptions of Unit Managers, Waste Coordinators, and Staff

Tracking is Habitual	<p><b>Not a major theme in interviews.</b></p> <p><i>“So they’ll adapt with it and a couple of years rolls by and get all the people that weren’t used to it around people that are used to it and it becomes part of the routine.” (MS, Male, Staff, Focus Group)</i></p>
Improved Communication	<p><b>Not a major theme in interviews.</b></p> <p><i>“Yes it would have to be comprehensive with the front and the back and to know how much we produce.” (FC, Female, Staff, Focus Group)</i></p>
Education	<p><b>Not a major theme in interviews.</b></p> <p><i>“...The people that are already working pass on instructions to the new hires. One, because it’s the way things go and there’s no time or resources to sit down and teach new people. Its on the job training most of the time, like, don’t put the food in the trash...” (FC, Male, Staff, Focus Group)</i></p> <p><i>“...where they have all these other classes where they send us to, whether it be the hours in class or stuff like that where you can go and sign up to take it, they should do one for waste and composting.” (AYCE, Female, Staff, Focus Group).</i></p>
Increase Buy-In	<p><b>Not a major theme in interviews.</b></p> <p><i>“I think you really have to get their interest in something like this before it will take hold. Some people just come in, and they say, well it’s a job, ya know, they just show up to work and that’s all they want to do. But, then if you ask someone to do something and they really don’t have an interest in you know all of the things that this can show..you have to get a supervisor involved or staff or somebody to get them to follow the procedure.” (MS, Male, Staff, Focus Group)</i></p>



## SUGGESTIONS TO IMPROVE FOOD WASTE TRACKING

The most significant suggestion presented by both focus group and interview participants was the development of a university-wide protocol that would give managers and employees the support needed to create an effective waste management system at each dining facility (Table 7). Other major themes across the two research mediums were to employ permanent waste coordinators, whether per facility or per shop, and individualizing tracking per food outlet within the larger facility.

The seven category bin system that was utilized at one facility was mentioned by the participants of the other two interviews that did not use this system during the study. Hearing about the efficiency and high compliance of the system was what intrigued the other two dining hall managers and waste coordinators to suggest this for their own waste tracking systems.

A minor suggestion made by interview participants was to implement a well-known and successful program, such as LeanPath in order to organize waste data using a recognizably efficient system, even though it is expensive. Other minor suggestions, specifically in focus group participants were to manipulate employee schedules and to eventually alter customer perception based on employee-driven food production decisions, such as holding off on producing more food within 15 minutes of closing.

**Table 9:** Suggestions to Improve Food Waste Tracking: Perceptions of Unit Managers, Waste Coordinators, and Staff

<p>University-wide guidelines, policies, or expectations</p>	<p><i>"It needs to be more centralized and say ok, right here, we are tracking this, this is how were doing it, this is the program that they've given us and this is the feedback that that program will give us, ya know?" (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><i>"...and if we make it uniform across all the dining halls that everybody has to do this and this is whats expected of you from dining services, not each hall separately, itll probably go over a whole lot better." (AYCE, Male, Staff, Focus Group)</i></p>
<p>Employ Permanent Waste Coordinator</p>	<p><i>"[...] you know someone who was sitting there saying ok, how much product do you need today? Or, this is how much product you have left, allotted today for that particular shop." (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><i>"It's just we are really really busy and adding something else that is going to take almost an hour every day per shop is a big undertaking. You're looking at somebody, full-time, one day, I mean every day adding an extra person." (AYCE, Male, Staff, Focus Group)</i></p>

**Table 9, continued:** Suggestions to Improve Food Waste Tracking: Perceptions of Unit Managers, Waste Coordinators, and Staff

Tracking by Individual “Shop”	<p><i>“I’m sure if we treated each individual shop as an individual restaurant and each individual as an individual manager and they would sit here and have to do inventory count and this thing every day.” (AYCE, Male, Waste Coordinator, Interview)</i></p> <p><i>“It seems like it’s the managers place in each shop to make sure they know and then our boss holds us accountable for the training. They train, how they want it, off their paper, and we take it and train it through our people.” (AYCE, Male, Staff, Focus Group)</i></p>
Improve or Implement Bin System	<p><i>“In a busy, busy production kitchen like ours, it wouldn’t have to weighed out one little thing at a time, then jot it down. It’d be, into the protein bin it goes and you take that bucket and tear it and boom it’s done at the end of the day.” (FC, Male, Waste Coordinator, Interview)</i></p> <p><i>“Well I mean if we did one bucket per shop and just all the waste go in that bucket and then we were each...then, its per shop, you know what’s in that shop and what kind of waste is in there. Weigh that, shop keep a record for that and then dump it into the big cans that get weighed at the end of the night and then you are getting an overall count for the building as well as how much is coming out of each shop.” (AYCE, Female, Staff, Focus Group)</i></p>
Implement Waste Tracking Program, such as LeanPath	<p><i>“Yeah, something like [LeanPath] would just be amazing. Yeah, the more efficiency every time you look at something, instead of doing paperwork or whatever.” (MS, Male, Waste Coordinator, Interview)</i></p> <p><b>Not a major theme in focus groups.</b></p>
Manipulate Schedules	<p><b>Not a major theme in interviews.</b></p> <p><i>“We come in at 12:30 and without lunch break, 8 hours. And we are not really supposed to work over so if we close at 8, that gives us an hour to do all of our closing duties and weigh everything too. So if they wanted to give us that extra half hour, we would come in at 1 until 9:30 and give us an extra half hour to close instead of just an hour.” (FC, Female, Staff, Focus Group)</i></p>
Customer Perception	<p><b>Not a major theme in interviews</b></p> <p><i>“If you really want to make a serious reduction in waste, you would have to change the way of thinking to the point where you can take more chances. Because that’s what you’re doing. Every day you are making choices of should I make this or should I not? Either I’m going to have a load of this every hour or I’m going to run out every night. Ya know, it could be those extremes and I mean, if we want to take a chance where all of a sudden its 6:30 and we’re going to be out of something in 5 minutes, what are we going to do?” (FC, Male, Staff, Focus Group)</i></p> <p><i>“I think it would be better to be out of food 15 minutes before. I feel like being out 15 minutes before I close; I’m OK with that. It would be better just to prepare some more than to just throw it in the trash.” (FC, Male, Staff, Focus Group)</i></p>

## CONTINUATION OF FOOD WASTE TRACKING

During interviews and focus groups, it was expressed that waste tracking was now a “daily tool,” and that it would continue into the future. Most had very little to say other than, “yes, we are still tracking,” however it was addressed that physical weighing and tracking with the online database has been reduced to some extent, either because of the introduction of weight standards, employee turnover, or decreased motivation. Another reason was the need for a useful waste aggregate report in order to move forward with this waste tracking system with effective tools needed for corrective action.

## DISCUSSION AND CONCLUSIONS

Due to the dynamic nature of foodservice establishments (Ingram, 1998), the difficulty in quantifying food waste data can be significant, often requiring tremendous amounts of physical weighing and direct examination of different types of food wasted (Hall & co-workers, 2009; Griffin & co-workers, 2009; Kantor & co-workers, 1997; Muth & co-workers, 2007; Ventour, 2007). Yet, as the economic and environmental implications of food waste become more apparent, foodservice professionals in various institutions are beginning to recognize the importance of proper food waste management, particularly from food production, since this is the stage that is most controllable by the foodservice operator (Shakman, 2010). The most recent study to date that examined food waste from storage to consumption in institutional foodservice revealed that handling and preparation waste – production or pre-consumer waste - ranged from 4 to 11%, and plate waste – or post consumer waste – 11 to 13% (Engstrom, 2004). To date, only studies that focus on plate waste have been conducted with post-consumer waste reduction at universities (Sarjahani, 2008), in elementary schools (Getlinger, 1996), restaurants (Engstrom, 2004), hospitals and prisons (Griffin, 2009). This study filled a gap on pre-consumer food waste at universities.

Methods employed for this study involved three distinct waste management strategies for three university dining facilities, given the physical and procedural environments of each. Results indicate that the way in which the food waste tracking system is employed has a direct implication on the effectiveness of aggregating food waste data. Aggregate food waste decreased over the 8-week study period for facility AYCE, whereas an increase in total food waste was found at facilities FC and MS. AYCE utilized a categorical bin system in their kitchen, allocating a compost bin for each of seven different food categories. Only one food waste station with an industrial standing scale was implemented here, with employees weighing compost bins three times per day. Field notes taken during the study with the AYCE WC indicate that the bin system employed was quickly adopted by employees and was relatively

easy to begin tracking food waste right away. These notes also reveal that AYCE employees began to moderate production schedules as a corrective action strategy due to the visual effects of waste aggregation in the kitchen where there is heavy foot traffic by staff. This may be the reason for the reduction in food waste found over time at AYCE, compared to the other facilities. Waste tracking strategies employed by FC and MS were similar in that food waste stations with smaller scales were placed in several places around the kitchen (i.e. dishwashing and preparation areas, etc.). WC's from FC and MS both express in weekly meeting field notes that compliance was considered lower in the beginning of the study, but grew as it went on. Therefore, while AYCE had time to enact corrective action strategies due to a more understood or approachable system, FC and MS may not have gotten to that point as a result of adaptability. Future food waste tracking strategies to reduce food production waste by way of corrective action may want to consider ease of implementation and overall efficiency of the tracking protocol, shown more successful with aggregate compost bins at AYCE, compared to the itemized lists used at FC and MS. Per the results, however, one major challenge of using categorical bins and weighing one time per day versus several times during the day may eliminate accountability. Foodservice managers and directors will need to test and appropriate food waste tracking strategies that best fit the needs of the facility and its employees.

Across all three dining halls, the protein and grain food categories were reported to be the most wasted types of foods. The volume of food wasted in the grain category is not necessarily surprising considering it is one of the highest food types wasted by American households and foodservice establishments (Kantor and co-workers, 1997). Protein foods, such as beef, chicken and poultry, on the other hand, have considerably high nutritional values, are more expensive and have significant environmental costs (18.15% of total CO<sub>2</sub> emissions from food) (Babich & Smith, 2010). As a result, the researchers hypothesized that this would be a low food waste category. Since results are presented by way of weight and not individual food items, we can only assume that decisions about production related to food category did not occur prior or during this study. From field notes conducted during weekly meetings, however, it was noted on several occasions that the amount of waste in the protein category was "surprisingly high" each week and that perhaps the high fat percentage of less expensive meat cuts may be the cause. Since the WC was the head chef for each facility, and has the responsibility of making food purchasing decisions with the manager, reconsidering the quality and type of food products may be an area of suggested corrective action for food waste reduction. Including all person(s) responsible for forecasting and purchasing food will be important for implementation of these strategies at other facilities. In terms of results pertaining to food waste per person, around 0.29 pounds, this

amount was not surprising since total weight from this study does not account for under-reporting by employees and post-consumer food waste, which has been found to result in more than 1 pound per person in university foodservice (Babich & Smith, 2010; Sarjahani and co-workers, 2009).

Reason for waste codes were beneficial for facilities FC and MS that used itemized food waste lists. Results indicate that foods dated internally, expiration dates, and overproduction were the main causes for disposal. Discussion from field notes and focus groups in the two dining halls utilizing reason for waste codes point to miscommunication and inability to check food storage during service as the main causes for such high percentages of waste generated for these reasons. Encouraging improved communication between the serving and production stages of the kitchen may be an important corrective action strategy to consider. Additionally, employees noted that quality and accessibility of food were also factors that contributed to overproduction. Due to the perceived expectations of the consumer, these foodservice facilities continued to produce food items until the last minute of service, consequently resulting in food waste. When noticing this behavior, several employees chose to independently manipulate production schedules to decrease this area of food waste, as per focus group discussions.

Several logistical challenges should be noted with tracking food waste. First, proper training is critical to effectively implement the food waste tracking protocol despite the fact that training time is difficult to schedule. Employees may find it undesirable and/or challenging to weigh the food in addition to other responsibilities, which was made apparent during focus groups conducted with staff post-study. Also during focus groups, employees stated that the majority of student employees were apathetic towards programs such as this and may not have been as compliant as full-time staff. There were also discrepancies with compliance that unit managers and WC's believed that full compliance was achieved throughout the study, whereas staff noted that it was much lower. Since participating in this protocol did not directly affect the performance evaluation of employees, WC's, or managers, there should not have been a compliance concern, yet, some employees felt that they would be penalized for tracking food disposed of for overproduction, or noting food that is burned or dropped, for example. A future consideration in food waste tracking would be to emphasize a system similar to the use of standard HACCP logs, or creating an institutionalized protocol that is regarded for consumer health and less on obligation. When expecting behavior change in foodservice, it appears that operationalizing tasks instead of merely enforcing them, results in a higher success rate.

Given the challenges, participants were however generally concerned about food waste and were glad to take part in a food waste management program. Unit managers and waste coordinators

claimed that this food waste tracking system resulted in increased staff buy-in, especially throughout the study, and caused whatever prior concern for high food waste volume to rise. Employees themselves remarked on the program being beneficial and even influenced their food waste management behaviors at home. The effects of food waste tracking appear to be an overall positive experience for participants and has the potential to result in source reduction, as noted by CEO and President, Andrew Shakman, of the automated food waste tracking program, LeanPath (Shakman, 2009). Unit managers and WC's also mentioned a reduction in food costs on some occasions when food purchases were manipulated given noticeable food waste trends. An institutionalized food waste tracking system has the potential to witness even more food cost savings, especially when considering minimal indirect costs of utilizing this protocol, instead of a more costly venture, such as LeanPath. The researchers of this study chose to implement the food waste tracking system discussed here due to the low cost of purchasing scales, utilizing the web services of an in-house software developer to organize the tracking system, and minimal training requirements. The difference in expenditures between this tracking system and that of LeanPath for example, is mostly in regards to physical logging versus an automated system. Conducting a cost-benefit analysis to identify the best form of food waste tracking would be advantageous for foodservice professionals. As stated previously, the EPA's Food Waste Management Cost Calculator would also be an important tool to identify costs related to food waste tracking and disposal methods (EPA, 2009).

## **LIMITATIONS**

There are several limitations that should be noted with this study. Structured interviews with unit managers and waste coordinators claimed a 90-100% employee compliance of the program at all three facilities, yet comments during the focus groups revealed conflicting results, however this may have been due to under-reporting or a misunderstanding of staff expectations. The dining facilities were each unique in terms of set-up and leadership, so contrasts and comparisons should be viewed with some caution. Also, while this study provided an opportunity for waste coordinators and unit managers to cater the tracking program to their facility, variation in operationalizing food waste across dining halls was noted. This was especially apparent by the frequency of weighing versus the use of standards, which were variable throughout the study and used to varying degrees by each facility. Consequently, researchers were unable to create a comprehensive waste tracking protocol that fit the needs of every participating operation, and thus results are often limited to a particular facility. Other limitations during the study include the inability to gauge full compliance of the program on a daily basis while researchers

were not present, high employee turnover, and a short study period (8 weeks) for training and implementation. In addition, no other dining facilities from this university were identified as a “control” facility to compare food waste volume without a tracking system in place. Since there are currently no existing scientific reports on the economic and environmental costs of food waste on a national scale, comparison of our micro-level results for conclusive macro-evidence was another limitation.

## **STRENGTHS**

Beyond reviews of potential strategies to reduce food waste, no studies have been conducted to date on implementing a waste tracking protocol specific to pre-consumer waste at large institutions. By applying this food waste tracking program in three distinct dining facilities, this study provides insights into the tremendous amount of pre-consumer food wasted regardless of facility type, food waste categories that are wasted the most during production, and the benefits and challenges of implementing a waste tracking protocol given the environment and culture of a facility. Also, suggestions for future food waste tracking from study participants can be used by interested foodservice establishments when adopting this and other waste management protocol.

## **CONCLUSIONS**

Further research in developing more comprehensive tracking models would benefit universities or large institutions aiming to standardize food waste reduction. Other beneficial research could include analyzing different methods of waste tracking dependent on facility type, the psychological factors involved in the initial motivation to track waste and the increasing buy-in of employees, and testing efficiencies of operations with the introduction of weight standards for individual food items versus weighing in a facility.

In conclusion, food waste tracking, specifically at the pre-consumer stage of production, has the potential of making a significant impact on reducing overall food waste. Most notable in this study, food waste tracking raises awareness of foodservice employees about the benefits of waste reduction, and resulted in personalized corrective action strategies, and, in one facility, confidence in manipulating production schedules throughout the day. Further research and practice is warranted to test and identify successful models of food waste reduction.

## CHAPTER 3: DISCUSSION

### Summary

To date, few studies have been conducted to measure the volume of food waste, let alone pre-consumer food waste. According to an international review of literature conducted by Parfitt and colleagues, there is a “dearth of data on food waste” (Parfitt, 2010). Current emphasis on research related to post-consumer food waste, or “plate waste,” indicates a perceived blame on the food purchases and appetites of diners (Lenzen & co-workers, 2007). While there is significant evidence to suggest trimming high rates of food waste volume at the consumption point of the food chain (Sarjahani, 2008; Getlinger, 1996; Engstrom, 2004; Griffin, 2009), a focus on reduction of pre-consumer waste may be just as impactful and involves influential behavior change of food producers and handlers, especially since university and school cafeterias comprise 6.5% of the total foodservice industry (ERS, 2012). Further, tracking in foodservice has proven successful. For example, more foodservice operators recognize how tracking Hazard Analysis and Critical Control Points (HACCP) is important for prevention of foodborne illness (FDA, 2006). In terms of food waste, tracking methods may make a significant impact on the forecasting, purchasing, and preparation decisions of foodservice managers, and therefore reduce chances of food waste accrual such as from purchasing in excess or overproduction.

The methodology for this study involved testing a food waste tracking protocol in three dining facilities during the spring semester of 2011 over an 8-week period at a large university. Waste Coordinators (WC's) were designated by the unit manager of each facility, of whom held the responsibility of designing a cohesive plan of action in terms of location of scales and logs, developing a schedule for weighing and entering data, and staff training in order to implement and sustain the program. Weekly meetings took place with the WC of each facility, in which researchers offered suggestions and answered questions about the food waste tracking protocol and its appropriateness for the specific dining hall; based on spreadsheets of total volume food waste separated into food categories based on the US dietary guidance. After the 8-week period, data were aggregated and analyzed for the purposes of this paper and also to provide each dining hall with their respective results. Structured interviews with unit managers and WC's, and focus group discussions with staff members also took place at each facility in order to identify major and minor themes.

Several notable findings were highlighted through this research. First, a food waste tracking system can be tailored to fit the needs of the specific unit. Second, the tools created specifically for this project are feasible. Qualitative results from this study indicate that managers and designated WCs felt



comfortable working with the food waste tracking log and supplemental materials (bins if necessary, scales, and the online database), and experienced increased buy-in from staff to participate and be a part of the decision-making process. This was brought up as a major theme in both structured interviews and focus groups. Third, while it is apparent that large volumes of food waste are being disposed of, whether by trash, composting, or diversion, proper corrective action procedures, similar to food safety tracking (HACCP), could be a viable option to elicit reductions in production food waste. Finally, the data demonstrate food groups that are wasted more than others, suggesting disparate attitudes toward these foods and/or inequitable quality standards for these foods. For this study, protein foods and grains were the biggest contributor by weight, similar to the highest wasted food categories in total food waste in the United States. More insight on why this is happening is warranted. The data also presents potential reasons for food waste generation. Results from this study indicate that foods dated internally, expiration dates, and overproduction were the main causes for disposal. This may have been due to lack of employee communication between the serving and production stages of the kitchen, causing more food to be produced than necessary for service. Miscommunication and inability to check food storage during service were noted by staff in field notes and focus groups in the two dining halls utilizing reason for waste codes, suggesting the importance of training programs to reduce this occurrence.

One of the outcomes and invariably, a limitation of this study was the inability for researchers to create a comprehensive waste tracking protocol to fit the needs of every participating operation. The dynamic nature of foodservice operations is in itself a limitation to this study and future research pertaining to this topic. Training was also a limitation in the beginning and throughout, in that schedules, layout of facilities, high employee turnover and the staff themselves were also distinct across facilities. Given this, the development and management of the program fell heavily on the designated WC. While a positive outcome for increased buy-in, this also questioned the ability for researchers to fully gauge compliance of the protocol.

In view of our current need to focus on global and domestic food security and availability of resources, each rung of the food supply chain should be considered a potential point of impact in reducing total food waste. Food waste tracking in foodservice facilities not only raises staff awareness of the impacts of food production by physical interaction with weighing and logging food waste, but also encourages personalized corrective action strategies that may actually reduce total food waste. The next phase of the food supply chain—consumption—will be impacted by a food production system that fulfills the present demand for higher responsibility standards that considers social, environmental and economic factors, particularly if combined with educational efforts to inform consumers of food waste

generated by their standards. Greater efficiency in foodservice may lead to deflected production and disposal costs that can be used to purchase higher quality, more nutritious foods, and practice improved distribution methods, given leftover edible food.

### **Implications for Research and Practice**

The need for further research to examine foodservice operations will be essential for the future of the food supply, considering the growing number of diners who choose to eat away from the home. Studies that focus on the economic and environmental impacts of the current food supply chain, specifically at the production step, may help those that forecast to make more responsible purchasing decisions. Food waste tracking, that includes consistent monitoring and corrective action procedures may make considerable reductions in total food waste, along with improving employee morale and the overall foodservice environment.

This study, in particular, presents a starting point for foodservice professionals, including managers, directors, and researchers to engage in the prospects of proper food waste management at the production level. The protocol tested in this study can be manipulated to fit the needs of diverse foodservice facilities; however, there are certain considerations that should be made. Firstly, testing a tracking log and corresponding program in just one facility may be more conducive to the needs of the individual establishment. Since the three dining halls in this study were so distinct, even though similar in some cases, a streamlined analysis to create a comprehensive system was challenging. An internally focused study, that recognizes the layout of the facility, normal operating procedures, staff environment, current disposal methods utilized, and others, may provoke implementation of a consistent tracking system catered to the facility in question and possibly incite actual food waste reduction once corrective action procedures are put into place. Secondly, food waste practices may be analyzed inclusive of one another; for instance, preparation versus production versus consumption food losses. This study identified production food waste as any food that was disposed of before consumer purchase, but future analysis may need to include differences in food waste generated at various stages of production. Finally, the introduction of a Waste Coordinator position does facilitate internal training and continued practice, but hiring an employee from within may be the most appropriate for compliance and success in tracking. This individual will most likely hold the most knowledge of a kitchen space and employee environment. Considering a food waste team may also be a beneficial way to allocate one or more employees to facilitate tracking in certain parts of the kitchen, and promote

collective management. As shown from this study, food waste tracking increases staff buy-in and may provide motivation for employee participation in this and future initiatives.

Raising awareness of the increase in food waste and the need for proper management of the food supply will be critical for food producers and consumers alike. Potential research and initiatives, other than waste tracking, are numerous. Introducing a cost calculator pertaining to social, economic, and environmental factors related to the needs of university dining facilities; that, for example, provides easily accessible charts about waste related to food production scheduling, food group categories, transportation costs, and disposal methods, may encourage higher understanding of individual impact. Truly understanding the costs attributed to each decision from farm to fork may significantly transform current discrepancies in food production, distribution, and disposal. Further research should also include examination of the link between production and consumer food waste in terms of what is desired by customers and the capacity of the food handler. Expectations and attitudes of the away-from-home dining experience should be analyzed from both accounts. In addition, gauging the level of consumer understanding of availability and access to nutritious food may also encourage improved practices at every step of the food supply, either by manipulating current behaviors of the food handler or altering consumer perceptions. Programs, campaigns, and interventions designed to put these motions into practice may make an impact on overall expectations and decisions made in foodservice.

#### **Institutional Recommendations to Address Food Waste**

- Research current practice in food waste tracking at foodservice establishments, including programs such as LeanPath.
- Conduct a cost analysis to determine the most appropriate food waste tracking system for the facility in question.
- Encourage communication with directors, managers, supervisors, and staff to implement a program that fits the needs of the operation as a whole.
- Design an easy to use tracking system to increase compliance.
- Consider hiring a part-time or full-time Waste Coordinator to facilitate the food waste tracking system. A food waste management team may also be a beneficial addition to the program.
- Include an electronic organizational tool that aggregates food waste volume and provides analysis of data.
- Communicate results from the tracking system with employees in weekly or monthly meetings in order to enact corrective action procedures.

## Literature Cited

1. American Dietetic Association. Position of American Dietetic Association: Food insecurity in the United States. *J Am Diet Assoc*; 2010: 110:1368-1377.
2. American Public Health Association. Toward a healthy, sustainable food system. *Policy Statement Database*. Available at <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1361>. Accessed May 15, 2012.
3. Aramark Higher Education. The business and cultural acceptance case for trayless dining. Available at <http://www.aramarkhighered.com>. Accessed September 21, 2011.
4. The Association for the Advancement of Sustainability in Higher Education (AASHE). About AAESHE. Available at <http://www.aashe.org/about>. Accessed June 1, 2012.
5. Babich R, Smith S. "Cradle to Grave": An analysis of sustainable food systems in a university setting. *Journal of Culinary Science & Technology*; 2010: 8(4):180-190.
6. Biocycle World. Campus dining halls eliminate trays, aim for zero waste. Available at <http://content.ebscohost.com.ezproxy.lib.vt.edu:8080/pdf9/pdf/2008/BCY/01Nov08/35580691.pdf?T=P&P=AN&K=35580691&S=R&D=a9h&EbscoContent=dGJyMMTo50SeqLE40dвуOLCmr0mep7BSrqy4TLCWxWXS&ContentCustomer=dGJyMPGsr1CyqbNNuePfgex44Dt6flA>. Accessed April 19, 2011.
7. Blair D, Sobal J. Luxus consumption: Wasting food resources through overeating. *Agriculture and Human Values*; 2006: 23(1):63-74.
8. Bogner J. Mitigation of global greenhouse gas emissions from waste: conclusions and strategies from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Working Group III (Mitigation). *Waste Management*; 2008: 26(1):11-32.
9. Brothers KJ, Krantz PJ, Mcclannahan E. Office paper recycling: A function of container proximity. *Journal of Applied Behavior Analysis*; 1994: 27(1):153-160.
10. C.S. Mott Group of Michigan State University. Food connections: capital area community food profile. Available at: <http://www.mottgroup.msu.edu/portals/mottgroup/downloads/CACfoodprofile.pdf>. Accessed May 16, 2012.
11. Curry M. The war on college cafeteria trays. Available at <http://www.time.com/time/nation/article/0,8599,1834403,00.html> Accessed September 21, 2011.
12. Edelstein S. Food and nutrition at risk in America: Food insecurity, biotechnology, food safety, and bioterrorism. Jones and Bartlett Publishers, LLC. 2009: 72.
13. Engstrom R, Carlsson-Kanyama A. Food losses in foodservice institutions examples from Sweden. *Food Policy*; 2004: 29:203-13.
14. Food and Agriculture Organization of the United Nations Corporate Documentary Repository. Post-harvest losses in perishable crops. *Food loss prevention in perishable crops*; 1981.
15. Feenstra GW. Local food systems and sustainable communities. *American Journal of Alternative Agriculture*; 1997: 12(1).
16. Gardner GT, Stern PC. *Environmental Problems and Human Behavior*. Boston: Allyn & Bacon; 1996.
17. Gentil E C, Gallo D, Christenson T. Environmental evaluation of municipal waste prevention. *Waste Management*; 2011. doi:10.1016/j.wasman.2011.07.030.
18. Getlinger MJ, Laughlin VT, Bell E, Akre C, Arjmandi BH. Food waste is reduced when elementary-school children have recess before lunch. *J Am Diet Assoc.*; 1996: 96:906-908.

19. Glanz K, Basil M, Maibach E, Goldberg J, Dan S. Why Americans eat what they do: Taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *J Am Diet Assoc*; 1998; 98:1118-1126.
20. Godfray H, Charles J. The future of the global food system. *Phil Trans R Soc B*; 2010: 365, 2769-2777. Doi: 10.1098/rstb.2010.0180
21. Griffin M, Sobal J, Lyson TA. An analysis of a community food system. *Agric Hum Values*; 2009: 26:67-81. doi 10.1007/s10460-008-9178-1.
22. Gustavsson J, Cederberg C, Sonesson U, van Otterdijk R, Meybeck A. Global food losses: Extent, causes, and prevention. Rome: Food and Agriculture Organization of the United Nations; 2011.
23. Hackes BL, Shanklin CW. Factors other than environmental issues influence resources allocation decisions of school foodservice directors. *J Am Diet Assoc*; 1999: 99:944-949.
24. Hall KD, Guo J, Dore M, Chow CC. The progressive increase of food waste in America and its environmental impact. *PLoS ONE*; 2009: 4(11):e7940. Doi:10.1371/journal.pone.0007940.
25. Hamm M, Bellows A. Community food security and nutrition educators. *Journal of Nutrition Education and Behavior*; 2003: 35(1):37-43.
26. Heller M, Keoleian G. Assessing the sustainability of the US food system: a life cycle perspective. *Agricultural Systems*; 2003: 76: 1007-1041.
27. Ingram H, Jones S. Teamwork and the management of foodservice operations. *Team Performance Management*; 2004: 4(2):67. Available at <http://proquest.umi.com.ezproxy.lib.vt.edu:8080/pqdlink?Ver=1&Exp=04-25-2017&FMT=7&DID=86923003&RQT=309>
28. Institute of Education Services. Digest of education services, Table 275: Degree-granting institutions, by control and type of institution: Selected years, 1949-50 through 2009-10. Available at [http://nces.ed.gov/programs/digest/d10/tables/dt10\\_275.asp](http://nces.ed.gov/programs/digest/d10/tables/dt10_275.asp). Accessed May 9, 2012.
29. Johns N, Pine R. Consumer behavior in the foodservice industry: a review. *Hospitality Management*; 2002: 21:119-134.
30. Jones T. *The Value of Food Loss in the American Household: A Report to Tilia Corporation*. Bureau of Applied Research in Anthropology. San Francisco, California; 2004.
31. Jones T. What a waste! Interview: The Science Show. 4 December, 2004. Available at <http://www.abc.net.au/radionational/programs/scienceshow/what-a-waste/3433276>
32. Kantor SL, Lipton K, Manchester A, Olivier V. Estimating and addressing America's food losses. *Food Review*; 1997:1-11. Available at <http://www.ers.usda.gov/Search/?qt=municipal+waste+report>. Accessed September 21, 2011.
33. Khandke SS, Mayes T. HACCP implementation: a practical guide to the implementation of the HACCP plan. *Food Control*; 1998:103-109.
34. Kim S, Popkin BM. Commentary: Understanding the epidemiology of overweight and obesity: a real global public health concern. *International Journal of Epidemiology*; 2006: 35:60-67.
35. Kirschenman F. *Food as Relationship. In Cultivating an Ecological Conscience: Essays from a Farmer Philosopher*. Lexington, KY: University of Kentucky Press; 2010: 214-225.
36. Lam Y. Why do UC Berkeley students waste food at dining halls? Available at [http://nature.berkeley.edu/classes/es196/projects/2010final/LamY\\_2010.pdf](http://nature.berkeley.edu/classes/es196/projects/2010final/LamY_2010.pdf). Accessed September 21, 2011.
37. Lawn J. Going green. Available at [www.food-management.com](http://www.food-management.com). Accessed September 21, 2011.
38. Lehman PK, Gellar S. Behavior analysis and environmental protection: Accomplishments and potential for more. *Behavior and Social Issues*; 2004: 13, 13-32.
39. Lenzin M, Murray J, Sack F, Wiedmann T. Shared producer and consumer responsibility: theory and practice. *Ecological Economics*; 2007: 61:27-42.

40. Muth MK, Kosa KM, Nielsen SJ, Karns SA. Exploratory research on estimation of consumer-level food loss conversion factors. Available at [http://www.rti.org/pubs/0210449\\_food\\_loss\\_report\\_7-07.pdf](http://www.rti.org/pubs/0210449_food_loss_report_7-07.pdf). Accessed May 16, 2012.
41. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *American Medical Association*; 2006: 295(13).
42. Parfitt J, Barthel M, Macnaughton S. Food waste within food supply chains: quantification and potential for change to 2050. *Phil Trans R Soc B*; 2010: 365:3065-3081. Doi:10.1098/rstb.2010.0126.
43. Peregrin T. Sustainability in foodservice operations: An update. *J Am Diet Assoc*; 2011: 111(9):1286-1294. doi: 10.1016/j.jada.2011.07.017.
44. Repa EW. NSWMA's 2005 tip fee survey. Available at <http://environmentalistseveryday.com/docs/Tipping-Fee-Bulletin-2005.pdf>. Accessed June 1, 2012.
45. Ryu K, Jang S, Sanchez A. Forecasting methods and seasonal adjustment for a university foodservice operation, *Journal of Foodservice Business Research*; 2003; 6(2):17-34.
46. Sarjahani A, Serrano EL, Johnson R. Food and non-Edible, compostable waste in a university dining facility, *Journal of Hunger & Environmental Nutrition*; 2009: 4(1):95-102.
47. Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, Roy SL, Jones, JL, Griffin PM. Foodborne illness acquired in the United States—Major Pathogens. *Emerg Infect Dis*; 2011:1-21. DOI: 10.3201/eid1701.P11101.
48. Shakman A. Food waste management-emerging trends, *The Consultant Magazine*, First Quarter. Available at [http://www.leanpath.com/docs/FCSI\\_Waste\\_Emerging\\_Trends.pdf](http://www.leanpath.com/docs/FCSI_Waste_Emerging_Trends.pdf). Accessed September 21, 2011.
49. Shakman A. Introduction to food waste tracking. What you need to know. *The Americas Quarterly: A Publication for the Foodservice and Hospitality Industry*; 2010: 1(1):31-34. Available at <http://digital.olivesoftware.com/Olive/ODE/FCSI//DownloadPdf.aspx?dochref=FCSI%2F2010%2F01%2F01&pageno=30&pdf-download-item=document&physical-path=true&contentsrc=pdf-download&Type=Content&For=PdfDownload>
50. Stern PC. Psychology, sustainability, and the science of human-environment interactions. *American Psychologist*; 2000: 55:523-530.
51. Sustainable Endowments Institute. Food and Recycling. Available at <http://www.greenreportcard.org/report-card-2011/categories/food-recycling>
52. Sustainable Endowments Institute. The college sustainability report card. Available at <http://www.greenreportcard.org/> Accessed September 21, 2011.
53. The Foodservice Director. Surveying the college foodservice market; 2012. Available at [http://www.foodservicedirector.com/sites/default/files/2012\\_C&U\\_Census\\_Report.pdf](http://www.foodservicedirector.com/sites/default/files/2012_C&U_Census_Report.pdf). Accessed May 8, 2012.
54. United Nations Department of Economic and Social Affairs. The millennium development goals report. Available at [http://www.un.org/millenniumgoals/11\\_MDG%20Report\\_EN.pdf](http://www.un.org/millenniumgoals/11_MDG%20Report_EN.pdf). Accessed May 16, 2012.
55. United Nations Department of Economic and Social Affairs. World population prospects. The 2004 revision. Available at [http://www.un.org/esa/population/publications/WPP2004/2004Highlights\\_finalrevised.pdf](http://www.un.org/esa/population/publications/WPP2004/2004Highlights_finalrevised.pdf). Accessed May 16, 2012.
56. United States Department of Agriculture Economic Research Service. Food availability (per capita) data system; 2010. Available at <http://www.ers.usda.gov/Data/FoodConsumption/>. Accessed June 1, 2012.

57. United States Department of Agriculture Economic Research Service. Foodborne illness cost calculator; 2011. Available at <http://www.ers.usda.gov/Data/FoodborneIllness/>. Accessed May 8, 2012.
58. United States Department of Agriculture Economic Research Service. Food CPI and expenditures; 2012. Available at [http://www.ers.usda.gov/Briefing/CPIFoodAndExpenditures/Data/Expenditures\\_tables/table15\\_dollar.htm](http://www.ers.usda.gov/Briefing/CPIFoodAndExpenditures/Data/Expenditures_tables/table15_dollar.htm). Accessed May 8, 2012.
59. United States Department of Agriculture Economic Research Service. Food security in the United States: Key statistics and graphics. Available at [http://www.ers.usda.gov/Briefing/FoodSecurity/stats\\_graphs.htm](http://www.ers.usda.gov/Briefing/FoodSecurity/stats_graphs.htm) Accessed September 23, 2011.
60. United States Department of Agriculture Economic Research Service. Ollinger M, Mueller V. Managing for safer food: The economics of sanitation and process controls in meat and poultry plants. Available at <http://www.ers.usda.gov/publications/aer817/>. Accessed May 8, 2012.
61. United States Department of Agriculture Economic Research Service. Profiling food consumption in America. In: *USDA Agricultural Fact Book: 2001-2002*. Available at <http://www.usda.gov/factbook/2002factbook.pdf>. Accessed April 1, 2012.
62. United States Department of Agriculture Economic Research Service. Projecting the costs of HACCP from the costs of SPCPs. *Managing for Safer Food*; 2003. Available at <http://www.ers.usda.gov/publications/aer817/>. Accessed May 8, 2012.
63. United States Department of Agriculture Economic Research Service. Table 1: Key statistical indicators of the food & fiber sector. Available at <http://www.ers.usda.gov/Publications/AgOutlook/AOTables/>. Accessed June 1, 2012.
64. United States Environmental Protection Agency. 2012 U.S. Greenhouse Gas Inventory Report. Available at <http://epa.gov/climatechange/emissions/usinventoryreport.html>. Accessed April 12, 2012.
65. United States Environmental Protection Agency. Basic information about food waste. Available at <http://www.epa.gov/osw/conserves/materials/organics/food/fd-basic.htm>. Accessed April 13, 2012.
66. United States Environmental Protection Agency. Basic information: Composting. Available at <http://www.epa.gov/epawaste/conserves/rrr/composting/basic.htm>. Accessed May 9, 2012.
67. United States Environmental Protection Agency. EPA food waste management cost calculator. Available at <http://www.epa.gov/osw/conserves/materials/organics/food/tools/index.htm>. Accessed April 15, 2012.
68. United States Environmental Protection Agency. Food donation: Feed people—not landfills. Available at <http://www.epa.gov/wastes/conserves/materials/organics/food/fd-donate.htm>. Accessed May 9, 2012.
69. United States Environmental Protection Agency. Generators of food waste. Available at <http://www.epa.gov/osw/conserves/materials/organics/food/fd-gener.htm>. Accessed June 1, 2012.
70. United States Environmental Protection Agency. Municipal solid waste generation, recycling and disposal in the United States: facts and figures for 2010. Available at <http://www.epa.gov/wastes/nonhaz/municipal/msw99.htm>. Accessed April 1, 2012.
71. United States Environmental Protection Agency. Municipal solid waste in the United States: 2007 Facts and figures. Available at <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw07-rpt.pdf>. Accessed September 23, 2011.
72. United States Environmental Protection Agency. Solid waste management and greenhouse gases: A lifecycle assessment of emissions and sinks. Available at

- <http://www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf>. Accessed September 23, 2011.
73. United States Environmental Protection Agency. Waste not, want not. Available at <http://www.epa.gov/wastes/conserve/materials/organics/pubs/wastenot.htm>. Accessed April 13, 2012.
74. United States Environmental Protection Agency. What is sustainability? Retrieved from <http://www.epa.gov/sustainability/basicinfo.htm#sustainability>. Accessed September 21, 2011
75. United States Food and Drug Administration. Hazard analysis & critical control points (HACCP). Available at <http://www.fda.gov/food/foodsafety/hazardanalysiscriticalcontrolpointshaccp/default.htm>. Accessed April 18, 2012.
76. Ventour L. The food we waste. Available at <http://www.ns.is/ns/upload/files/pdf-skrar/matarskyrsla1.pdf>. Accessed May 16, 2012.
77. Winne M. Community food security: Promoting food security and building healthy food systems. Available at <http://www.foodsecurity.org/PerspectivesOnCFS.pdf>. Accessed May 12, 2012.



## Appendix A: IRB Approval

### Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Does Feedback with Corrective Action Have an Effect on Food Waste in Dining Facilities?

Investigator: Kati Span

Primary PI: Elena Serrano

#### I. Purpose of this Research/Project

The goal of this project and related study is to explore the most effective way to encourage employee-driven corrective action following the identification of major contributors to production waste. The project builds upon the HACCP model already employed by VT Dining Services. For this project, there would be a Waste Coordinator who would provide leadership to the collection and entering of waste logs that document the amount, type of, and reason for waste, which would then be aggregated by the VT Dining Services Sustainability Coordinator and research team to provide feedback. Through weekly feedback, recognition of potential problem spots will be made, potentially eliminating or reducing the specific waste issue. Type of feedback, including environmental, economic, or social aspects will be considered in identifying which stimulates the highest reduction of waste. The results will help VT Dining Services and other dining facilities consider how to reduce waste through managerial and communication methods that include tracking, feedback, and corrective action.

#### II. Procedures

As a Waste Coordinator at your designated Virginia Tech dining facility, you will be asked to aid in the application and management of the waste tracking system created by the researchers of this 8-week project.

#### III. Risks

There are no more than minimal risks associated with your participation in this project.

#### IV. Benefits

Results of this study will help identify problematic areas of waste in an institutional dining facility and help reduce overall waste, which may result in food-related cost savings at VT Dining Services. This study has the potential to create a comprehensive waste management system for Virginia Tech and other foodservice operations to identify areas to reduce waste, and therefore save money and create a more environmentally responsible food system.

#### V. Extent of Anonymity and Confidentiality

No VT Dining employees' personal identifiers will be used throughout the project. Only food waste in pounds will be collected and recorded for publication.

VI. Compensation

No compensation will be provided.

VII. Freedom to Withdraw

You are free to withdraw from the study at any time.

IX. Subject's Responsibilities

I voluntarily agree to participate in this study. Following are my responsibilities:

- Attend training on January 14.
- Train dining employees about waste tracking protocol.
- Follow waste tracking protocol specific to your facility.

X. Subject's Permission

I have read and understand the Informed Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Participant Signature

\_\_\_\_\_  
Date

Should I have any pertinent questions regarding this research or its conduct, the research subjects' rights, or whom to contact in the event of a research-related injury to the subject, I may contact:

Kati Span  
Investigator

540-664-8320/kspan@vt.edu  
Telephone/e-mail

David Moore  
Chair, IRB  
Office of Research Compliance  
Research & Graduate Studies

540.231-4991 / moored@vt.edu  
Telephone/e-mail

As required, the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University has approved this research project.



**MEMORANDUM**

**DATE:** December 30, 2010

**TO:** Elena L. Serrano, Kati Span

**FROM:** Virginia Tech Institutional Review Board (FWA00000572, expires October 26, 2013)

**PROTOCOL TITLE:** Does Feedback with Corrective Action Have an Effect on Food Waste in Dining Facilities?

**IRB NUMBER:** 10-795

Effective December 30, 2010, the Virginia Tech IRB Administrator, Carmen T. Green, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at <http://www.irb.vt.edu/pages/responsibilities.htm> (please review before the commencement of your research).

**PROTOCOL INFORMATION:**

Approved as: **Expedited, under 45 CFR 46.110 category(ies) 7**

Protocol Approval Date: **12/30/2010**

Protocol Expiration Date: **12/29/2011**

Continuing Review Due Date\*: **12/15/2011**

\*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

**FEDERALLY FUNDED RESEARCH REQUIREMENTS:**

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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## Appendix B: Food Waste Tracking Form

**Dining Unit:**

Instructions: Fill out the date, time and internal location within the dining hall. This can include the kiosk name or service area (i.e. sandwich counter at Au Bon Pain). For the Reason for Waste and Disposal Method columns, please refer to the codes above to fill out the appropriate columns. In the Comments column, include any notes you would like to add or information not listed under the other columns.

**CODES:**

**Disposal Method:**

**COM** – Compost: Food Scraps  
**DIV** – Diverted: Ready-to-eat or other foods that can be diverted to a hunger relief agency  
**TRA** – Trash: Food that cannot be composted or diverted

**Reason for Waste:**

**OV** – Overproduction: Any food produced in excess  
**OM** – Over Merchandised  
**SP** – Spoilage: Visual microbial growth  
**EX** – Expired: Past expiration date of product  
**DA** – Dated: Past date labeled in-house  
**TW** – Trim Waste: Ends of fruits and vegetables

**CT** – Contamination: Inedible due to any food safety concern  
**BD** – Burned/Dropped: Burned or dropped foods  
**QC** – Quality Control: Items not up to quality serving standards  
**CL** – Customer Left: Forgotten made to order items  
**TT** – Time/Temp Abuse  
**CE** – Closing/End of Night

Date	Time (AM/PM)	Internal Location	Staff Initials	Product Description	Reason for Waste	Weight (lbs)	Disposal Method	Comments
3/22/10	12:30 PM	Frank's Deli	KS	Wheat bread loaves	SP	1.9	COM	mold on 2 wheat loaves

Signature of Manager: \_\_\_\_\_ Signature of Waste Coordinator: \_\_\_\_\_

# Appendix C: Food Waste Tracking Database

waste Tracking
2011 06:58 PM Logout

Entries Users/Permissions

**View**

Start Date  End Date

**Entries**

	Date	Time
+		
x	09-25-2011	08:48AM
x	09-25-2011	1:03PM
x	09-25-2011	1:08PM
x	09-25-2011	1:37PM
x	09-25-2011	3:30PM
x	09-25-2011	3:33PM
x	09-25-2011	4:19PM
x	09-25-2011	4:38PM

**Add Record**

Upload CSV File

Dining Location:

No file chosen

not uploaded

Waste Information

Date:

Time:

Dining Location:

Internal Location:

Staff Init:

Product:

Waste Reason:

Weight:

Disposal Method:

Weight	Disposal Method
0.19	TRA
2.31	TRA
0.74	TRA
1.10	TRA
62.69	TRA
9.00	TRA
0.31	TRA
0.31	TRA

## Appendix D: Interview Script

### Tracking Pre-Consumer Food Waste at Three Dining Facilities

#### Introduction

Hello. Welcome, my name is Kati and I'm going to interview you today. Thank you for coming and taking the time to give your thoughts and opinions. We asked you to participate because you were a participant in the food waste tracking system that occurred last Spring, 2011 in one of three dining halls examined for this study. We will be recording today's interview using a digital recorder. Names will not be used in any records of the discussion. A code number will be used in place of your name. Any information shared in this room will be kept confidential and only for this study. No names will be used in any reports.

Today we are going to talk about the food waste tracking system that was employed at your dining facility. We have gathered food waste data, but really want your opinions and thoughts on successes, challenges, etc. There are no right or wrong answers, so please feel free to say what you think. Do you have any questions about the interview process before we begin?

#### Begin Recording

We are going to test the tape recorder. Please say your name and I will then say mine. We will then play the recording to ensure proper functioning.

Let's begin the interview. I understand that you were a participant in the food waste tracking study that was conducted Spring 2011 in your dining facility.

Can you provide any basic comments about the food waste tracking system before I ask you some specific questions?

Prior to implementing this food waste tracking system, how did you track food waste?

#### **Rate from 1 being "not at all important" and 5 being "extremely important"**

How important were the following factors in motivating you to track food waste at your facility:

- Social concerns (i.e. hunger, food security)
- Financial/economic (i.e. save money on food and waste disposal)
- Environmental (i.e. fuel usage, emissions from transportation of food and waste)
- Operational requirements (i.e. "you had to")
- Performance evaluations (i.e. "you may be evaluated based on food waste or tracking")

Were there any other motivational factors that influenced your decision to track food waste?

What procedural changes were made to utilize this food waste tracking system in your dining facility?

Using this food waste tracking system, what were the benefits for you, your dining facility, your staff?

- The barriers?

How much of your time was necessary for the implementation of this food waste tracking system?

**Rate from 1-100% and provide a number of hours per week**

During the study,

What percentage of total weekly responsibilities did YOU devote to waste tracking?  
 Hours per week?

What percentage of total weekly responsibilities did YOUR STAFF devote to waste tracking?  
 Hours per week?

**Rate from 1-100%**

What was the perceived compliance related to:

Weighing food (what percentage of food waste was weighed?)

Entering food waste onto the tracking sheet (what percentage of food waste was written on the tracking sheet?)

Transferring information from tracking sheet to online database (what percentage of food waste was transferred to the online database?)

Do you plan to continue tracking food waste? If no, why?

Do you have any suggestions on how to track food waste in a different manner?

**Closing Statement**

Thank you for taking the time to participate in this interview. Feel free to contact me if you would like to add any additional comments.

## **Appendix E: Focus Group Discussion Script**

### **Tracking Pre-Consumer Food Waste at Three Dining Facilities**

#### **Introduction**

Hello. Welcome, my name is Kati and I'm going to facilitate the discussion today. Thank you for coming and taking the time to give your thoughts and opinions. We asked you to participate because you were a participant in the food waste tracking system that occurred last Spring, 2011, in one of three dining halls examined for this study. We will be recording today's focus group using a digital recorder. Names will not be used in any records of the discussion. A code number will be used in place of your name. Any information shared in this room will be kept confidential and only for this study. No names will be used in any reports.

Today we are going to talk about the food waste tracking system that was employed at your dining facility. We have gathered food waste data, but really want your opinions and thoughts on successes, challenges, etc. There are no right or wrong answers, so please feel free to say what you think. Do you have any questions about the discussion process before we begin?

#### **Group Rules**

The following rules are in effect for today's focus group:

- Everything that is discussed during the focus group should remain confidential.
- The identities of the focus group participants should remain confidential.
- Respect the opinions of others, even if they differ from your own.
- Participate in the focus group discussion.
- Listen to the contributions of others in the focus group.

#### **Introductory Activity**

Each member of the group will introduce him/herself to the other group members and will briefly describe his/her experience using the food waste tracking system.

#### **Questions**

- Last spring, a waste tracking system was started at your dining facility. What were your overall thoughts about the program?
- To what degree had you thought about food waste before this project?
- What were some of the benefits to waste tracking and weighing?
  - Increase in knowledge
  - Resulted in positive changes
- What changes did you see take place where you work from weighing and tracking food waste?



- What stories do you have to share about food wasted at your facility?
  - In what ways did it influence what you did at home?
- What were some of the challenges to tracking and weighing food waste?
  - Lack of interest
  - More work
  - Employees' attitudes
  - Other
- How easy was it to add waste tracking to your normal work day?
- How difficult was it to add it to your normal work day?
  - How much more time did it add to each of your shifts?
- How often did you “just estimate” a food weight or throw food out/compost without weighing?
- To what degree are you tracking food waste now at work?
- Any suggestions on how to decrease food waste at dining facilities?

**Closing Statement**

Thank you for taking the time to participate in this discussion. Again, no names will be used for any reports related to this study.