

INVESTIGATING FOOD WASTE MANAGEMENT IN COLLEGE AND
UNIVERSITY FOODSERVICE OPERATIONS

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
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TEXAS WOMAN'S UNIVERSITY
COLLEGE OF HEALTH SCIENCES

BY

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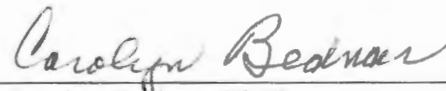
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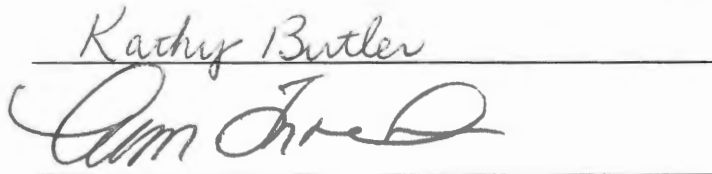
To the Dean of the Graduate School:

I am submitting herewith a thesis written by Sockju Kwon entitled "Investigating food waste management in college and university foodservice operations." I have examined this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science with a major in Food Systems Administration.



Carolyn Bednar, Ph.D.

We have read this thesis and recommend its acceptance:

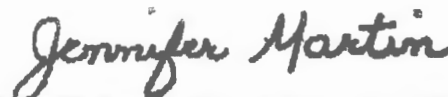






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ABSTRACT

SOCKJU KWON

INVESTIGATING FOOD WASTE MANAGEMENT IN COLLEGE AND UNIVERSITY FOODSERVICE OPERATIONS

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This study was designed to investigate foodservice administrators' attitudes and barriers regarding food waste management (FWM) in college and university foodservice operations. Research methods included focus group discussions and a national survey conducted both online and by mail. Survey questionnaires were e-mailed and/or mailed to delegates of the National Association of College and University Food Services, and 63 usable responses were received. Student t-tests and analysis of variance (ANOVA) were used to compare to test differences among groups. Educating customers about FWM was considered most likely to reduce food waste among suggested foodservice management activities. Composting was selected as most likely to reduce food waste among food disposal methods. Most respondents had positive attitudes regarding FWM, but limited space, lack of governmental enforcement and training employees were selected as three major barriers to FWM. Results varied depending on type of management, meal plans and production, residential dining halls, and source of information about FWM.

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CHAPTER I

INTRODUCTION

Sustainability has become an important concept in today's society. Ecological or environmental sustainability is defined as "the ability of an ecosystem to maintain ecological processes, functions, biodiversity and productivity into the future (Regional Ecosystem Office, 2003)." In 2007, the American Dietetic Association (ADA) also established a position statement on conservation of natural resources and ecological sustainability and suggested specific tips and procedures to keep the environment clean with emphasis on the food system. The specific ways to reduce food waste include the purchase of ready-prepared produce, accurate forecasting of food production, and donation of leftovers for human or animal feed (Harmon & Gerald, 2007).

Food waste has a serious effect on the environment because methane produced from land-filled food waste is 21 times more potent green house gases than carbon dioxide (EPA, 2007a). The literature includes several success stories about managing food waste from foodservice operations such as sending food waste to composting sites and reusing frying oil for utilities or delivery truck (Buchthal, 2006; Miller, 2007). However, most food scraps from homes and small foodservice operations are packed in garbage bags and sent to landfills. Large quantities of food waste from foodservice operations could be sent to processing sites more consistently, which is important when animal feeding and composting methods are used (Department of Hotel, Restaurant,

Institution Management and Dietetics, Kansas State University, 2002). Since production of food waste is inevitable in foodservice operations, most foodservice operations are aware of food waste management as an important factor in enhancing environmental sustainability. Food waste management is also important for foodservice operations because of possible reduction in cost for food purchases and waste disposal.

With well-educated staff and students, colleges and universities have great potential to influence campus communities. Trends toward sustainability in this area are apparent. Several colleges have been recognized for practicing resource conservation and effective waste management by the Association for the Advancement of Sustainability in Higher Education (AASHE, 2006). Many college and university foodservice directors are working to achieve the sustainability of their kitchens and dining halls. National leading college and university foodservice operations are offering fresh, organic, and sustainable foods in their facilities (Herrmann, 2007).

RecycleMania, a national waste management competition among colleges and universities, is another good example. RecycleMania was established in 2001 to decrease municipal solid waste (MSW) generated from residence and dining halls in campus. Results from 2008 competition showed that Mills College in California collected total 33.75 lb per person for 10 weeks. Total recycled food waste from Rutgers University that has 39,000 students and staff was estimated as 1.9 million lb, the equivalent of 900 tons (National Recycling Coalition, 2008).

Trayless dining, a recent innovation in foodservice operations, has been addressed by large corporations such as Aramark and Sodexo. Trayless dining showed effective reduction in food waste by 25-30% as well as savings in water and energy (Aramark, 2008; Meltzer & Stumpf, 2008).

The possibility of effective food waste management in college and university foodservice operations has been demonstrated. However, only a few college and university foodservice operations have actively participated in food waste management programs. Therefore, this research was designed to investigate current trends in food waste management and to determine attitudes and barriers of foodservice administrators when making decisions for food waste management program implementation.

Purpose and Objectives

The purpose of this study was to investigate the present status of food waste management in college and university foodservice operations, foodservice administrators' attitudes toward food waste management, and the barriers against making decisions regarding food waste management.

The objectives were:

1. to identify the key factors impacting decision making on whether or not to participate in food waste programs
2. to determine differences in attitudes and barriers regarding food waste management by type of management, existence of residential area, number of meals served, type of food production and source of information about food waste management

Null Hypotheses

1. H_0 : There will be no significant difference in foodservice administrators' attitudes regarding foodservice activities that could reduce amount of food waste for the following variables: type of management, existence of residential area, number of meals served, type of meal plan, type of food production, and source of information about food waste management.
2. H_0 : There will be no significant difference in foodservice administrators' attitudes regarding methods of food waste disposal for the following variables: age of foodservice administrators, type of management, existence of residential area, number of meals served, type of meal plan, type of production, and source of information about food waste management.
3. H_0 : There will be no significant difference in foodservice administrators' perception of barriers regarding food waste management for the following variables: type of management and number of meals served.

Assumption and Delimitations

The survey method was used to collect data from participants. Participants were foodservice administrators who were voting delegates of the National Association of College and University Food Services (NACUFS). The researcher assumed that the NACUFS administrators were qualified to provide reliable and adequate information about variables including solid waste and food waste management used in this research. Results from this research were limited to the college and university foodservice

operations where NACUFS administrators are employed. Therefore, the results cannot be generalized beyond those foodservice operations.

CHAPTER II

REVIEW OF LITERATURE

Sustainability

Sustainability has become important in food systems management as well as in many industries, communities, nations, and the world. The *Merriam-Webster Online Dictionary* (2005) defines sustainability as “the ability to keep in existence, maintain, or supply with necessities or nourishment”. The definition of sustainability may not sound critical, but it becomes a most important, necessary term for human life when combined with ecological or environmental factors.

Individuals have raised many concerns about ecological sustainability. After several weather-related natural disasters during the last few decades, greenhouse gases were named as one of the main factors affecting climate change that are related to recent extreme natural disasters (Helmer & Hilhorst, 2006). According to one report, the amount of carbon dioxide has doubled in the air over the last three decades, which has also doubled the frequency of category 4-5 severe cyclone outbreaks in the North Atlantic areas (Webster, Holland, Curry & Chang, 2005).

Carbon dioxide is mostly formed from burning fossil fuels including coals, gases, and oils. As production of fossil fuels is anticipated to hit a peak soon and demands are expected to grow 40% by 2020 (Bisk, 2007), voices concerning energy and environmental conservation have been raised concurrently from the public, educators,

researchers, business experts, and governmental agencies. Solid waste including food waste is another contributor to the greenhouse effect since it generates methane and carbon dioxide gases when it is combusted and dumped into landfills (EPA, 2006).

Two major areas for ecological sustainability in foodservice operations are energy conservation and waste reduction. Resource conservation is mostly related to energy and water. The kitchen is the highest energy demanding area in the building. It is known to consume five times more energy than retail, office, or lodging space. Huge amounts of energy are used for cooking, dishwashing, air conditioning, lighting, ventilating, and refrigeration. Richard Young, a senior engineer of PG&E Food Service Technology Center, stated that the foodservice operator is in the energy business during his webinar (Young & Cartwright, 2007). Resource conservation can be accomplished by choosing energy and water saving equipment and appliances, training employees, and implementing resource conserving practices.

The food system produces both food waste and non-food waste. Characteristics of each category are completely different. Food packaging, including dinnerware, tableware, glassware, and plastics, is visually very bulky, but contributes less weight to municipal solid waste than food wastes such as vegetable/fruit trims, plate wastes, and leftovers (Hackes, Shanklin, Kim & Su, 1997).

Food waste management is an important factor for improving environmental sustainability, because the amount of food waste directly and indirectly reflects the

efficiency and effectiveness of system management. In addition, food waste is negatively related to profit because it increases the input and decreases the output.

Municipal Solid Waste (MSW)

In the U.S., concerns about environmental protection were raised long ago. The U.S. Environmental Protection Agency (EPA) was established in 1970 to meet the public's demand for a safe and harmless environment. Since then, EPA has set up a solid structure to act as the representative agent for environmental issues, provide guidelines for environmental protection and improve environmental indices (EPA, 2007a).

Waste management is a key element in preserving our environment (air, water, and soil) as well as saving resources. The EPA emphasized that more than 10 billion gallons of gasoline would be saved by recycling 82 million tons of MSW, 1,655 gallons of gasoline by recycling 1 ton of aluminum cans, and 197 gallons of gasoline by replacing one ton of plastics (EPA, 2007b). Since 1990, the total amount of MSW has increased from 205.2 to 251.3 million tons (MT), whereas the daily per capita generation of MSW has kept in range within 4.50-4.60 lb/person. The percentage of recycled MSW has also doubled in the last two decades, and in 2006 about one third (32.5%) of total MSW was recycled.

Food Waste Management

The activity of the EPA has been expanding in the U.S. for several decades and has shown great progress. However, food waste management still remains a challenging problem. The seriousness of food waste was also addressed by the EPA. The EPA

considered food leftovers as a single-largest component of the waste stream by weight in the United States. The EPA also emphasized that more than 25% of prepared food was thrown away and the amount of wasted food were about 96 billion pounds each year in 2006. The EPA also emphasized that landfills produce 34% of methane emissions in the U.S. and that food waste in landfills produces methane which is 21 times more potent than carbon dioxide in boosting the greenhouse effect (EPA, 2007c).

Food waste is generated through the food flow from farms to consumers. Food manufacturers, processors, and supermarkets generate mostly preparatory food scraps, whereas others such as foodservice operations and households have both preparatory food scraps and leftovers/plate wastes (EPA, 2007a). Timothy W. Jones, an anthropologist in Arizona University spent 10 years measuring food loss under grants from the U.S. Department of Agriculture (Cole C, 2005). He determined that more than 50% of solid waste was food; 14% of food was wasted within expiration dates, and each family with four members wasted annually \$590 worth food, which is equal nationally to \$43 billion per year. It is not clear how many foodservice operations are implementing food waste programs or how much they donate or compost foods, although a few case studies are described by organizations including the EPA and the California Integrated Waste Management Board (CIWMB).

As environmental sustainability becomes a must, food waste management should also be a must. Vegetable trims and food scraps are major components in food waste. Food waste is a very unique output from the food system because it is the third heaviest

component among MSW (EPA, 2007b) and relatively dense (Hackes, Shanklin, Kim, & Su, 1997), which means it weighs much more per unit volume than other MSW. Food waste is 81.8% by weight and 14% by volume, whereas food package waste is 28% by weight and 85% by volume (Hackes et al., 1997).

Although the environmental protection movement has been expanding in the U.S. for several decades, little progress has been made regarding the management of food waste in foodservice operations. The amount of food waste has continuously increased, whereas the recovery rate has decreased. The total weight from food waste was 26.2 MT (11.4%) in 2001, 27.6 MT (11.7%) in 2003, 29.2 MT (11.9%) in 2005, and 31.3 MT (12.4%) in 2006. While the total MSW has been recovered from 29.7% in 2001 to 32.5% in 2006, the recovered weight from food waste was 0.7 MT (2.8%) in 2001, 0.75 MT (2.7%) in 2003, 0.69 MT (2.4%) in 2005, and 0.68MT (2.2%) in 2006 (EPA, 2007b).

The EPA suggests a food waste recovery hierarchy: reduce food waste generation, donate the leftover foods to shelters, feed the animals, compost the waste to nourish the soil, send it to landfills, or incinerate it. Source reduction and reuse are preferred methods of waste management, followed by recycling and composting.

Several states and local governments have implemented food waste recovery and recycling. Middlebury College in Vermont collected 288 tons of food waste and saved a net cost of \$27,000 in 1996 (EPA, 2007a). Delux Town Diner in Watertown, Massachusetts invested \$20,000 for a boiler using recycled vegetable oil and saved a net

cost of \$5,800 per year from the oil cost for heating and the disposal costs for waste (Buchthal, 2006).

The EPA urges food providers, including institutional foodservice operations, to participate in food waste programs because of the significant amount of food waste every day (EPA, 2007a). For food waste management, donations to the hungry and animals are the most common method and composting is second. California is one of the states that actively practices state-level food waste management. The CIWMB established the Waste Reduction Awards Program (WRAP) in 1993 to encourage more companies to practice environmental-friendly activities. The board recognized Dole Fresh Vegetables (1997), Kraft Foods Inc., Visalia (1999), and Westin San Francisco Hotels (2000) as winners for their food waste reduction efforts (CIWMB, 2007). Dole Fresh Vegetables and Westin San Francisco Hotels donated excess food to local food banks, and Kraft Foods sent byproducts to animal food manufacturers.

College and University Foodservice

The trends toward sustainability in colleges and universities are well documented. Colleges get recognized by practicing resource conservation and waste management. Education for Sustainability Western Network, the former organization of the Association for the Advancement of Sustainability in Higher Education (AASHE) was established in 2001 with a vision, to see higher education take a leadership role in preparing students and employees to achieve a just and sustainable society (AASHE, 2007). The association projected colleges and universities to be good models for leading

ecological sustainability among the community by creating integrative curriculum and practice.

With well-educated staff and students, colleges and universities have the potential power to affect environmental protection efforts. University of British Columbia (UBC) received an inaugural Campus Sustainability Leadership Award from AASHE in 2006. The major 2005-2006 accomplishments of UBC for sustainability are summarized as follows: (a) decreased energy use by 20%, carbon dioxide emission by 15,000 tons, and water use by 30%, (b) saved \$100,000 per year and expected carbon dioxide emission by 38,000 tons by ground water energy system in the next 20 years, (c) received Leadership in Energy and Environmental Design (LEED) certification for the Life Sciences Centre (gold), and Aquatic Ecosystems Research Laboratory (silver), (d) performed custodial service with certified green cleaning products, (e) reduced 2,000 tons of landfills (42% of total waste) by composting and recycling, (f) developed 300 undergraduate and graduate courses dealing with issues of sustainability, (g) incorporated sustainability training program for first year student orientation leaders, and (h) offered a residence sustainability coordinator program (AASHE, 2006).

Similar to WRAP for companies in California, RecycleMania is a national waste management competition among colleges and universities. The program was established in 2001 to decrease MSW generated by residence and dining halls in colleges and universities. Basically, all colleges can participate in this program, which requires participants to collect recyclable materials throughout the campus for a 10 week period.

This program mainly focuses on collecting paper, containers, and cardboard. However, foodservice organics including food waste can be collected separately to compete for specific targeted materials recognition. According to statistics from the National Center for Education, there are a total of 6,441 colleges and universities in the United States (National Center for Education Statistics, 2007). In 2007, a total of 201 colleges and universities (3.1%) participated in the competition and recycled about 18.7 thousand tons of waste through 10 weeks. Rutgers University won the organic waste division, recycling 7.1 lb/person/week (National Recycling Coalition, 2007).

The number of participating colleges and universities doubled and a total of 430 colleges and universities participated in 2008 RecycleMania. Among total participants, only about 10% of participants (n=43) collected foodservice organics. The 2008 competition results showed that Mills College in California collected a total of 33.75 lb of organic waste per person for 10 weeks. Total recycled food waste from Rutgers University which has 39,000 students and staff was estimated at 1.9 million lb, equivalent to 900 tons (National Recycling Coalition, 2008).

College and university foodservice operations are also very active in improving the sustainability of their kitchens and dining halls through using local and organic foods and composting food scraps. Stanford University is one of foodservice operations that focus on environmental sustainability practices. Stanford Dining received several awards due to its sustainability practices: an “A” rating for food and recycling from the Sustainable Endowment Institute’s 2007 College Sustainability Report Card, the 2007

Acterra Business Environmental Award for sustainability and green business practices, a 2007 Certificate of Special Congressional Recognition from the U.S. Congress, the 2006 Pacific Gas & Electric Company's award for Leadership in Applying Green Building Design, and Santa Clara County's Green Business Certification in 2004 (Friendland & Lawn, 2007). Stanford University held an 'Eat Local Celebration' week to increase the awareness of sustainable food in the campus dining in Spring 2007 (Stanford celebrates, 2007).

The University of Maryland has also set a good example practicing sustainability in its dining halls. Specific practices are waste reduction, extensive recycling programs, energy and water conservation, proper purchasing, a triple filtered water purification system, reusable mugs, and cook to order menus (Department of Dining Services, 2006). In addition to the University of Maryland, 14 more colleges and universities were selected as "Green" campuses by Grist Organization, a nonprofit environmental journalism organization in Seattle, Washington (15 green colleges, 2007).

Successful college and university foodservice operations frequently offer fresh, organic, or sustainable foods. Writing in *University Business*, Herrmann (2007) introduced seven successful college and university foodservice operations; Ohio Wesleyan University, Lehigh University, University of Mary Washington, University of Massachusetts, San Francisco State University, Florida State University, and Indiana University of Pennsylvania. Most are claiming that they put efforts toward ecological

sustainability. For example, the University of Massachusetts foodservice spent 20% of its budget for produce to local farms (Herrmann, 2007).

Composting is another method of effectively managing food waste. The dining halls at the Evergreen State College in Washington State collected food scraps from the residential areas, and delivered them to compost facilities or farmers that are a part of a massive composting program (15 green colleges, 2007). Portland State University in Oregon educated students about recycling and composting, implemented extensive recycling and composting programs and received Businesses for an Environmentally Sustainable Tomorrow Award from the city of Portland (Campus composts, 2006).

In summary, many American colleges and universities are aware of the importance of ecological sustainability and are implementing various environmental protection programs. The national leading college and university foodservices operations put significant efforts on creating eco-friendly environments and practicing recycling and/or composting programs.

Recent Sustainability Programs

Two big foodservice companies, Sodexo and Aramark, have implemented trayless dining with their college and university foodservice operations and observed tremendous effects on conserving energy and water as well as reducing food waste. According to a case study done by Aramark Higher Education at the University of Maine at Farmington, trayless dining implementation resulted in food waste reduction by 5 ounces per meal per person, equivalent to 46 pounds per person per year. In addition to food waste reduction,

trayless dining was estimated to conserve 288,288 gallons of water for washing trays. By minimizing the use of the dishmachines, trayless dining results in less use of energy, detergent and sanitizer. Not only did trayless dining affect environmental sustainability, it also created great awareness about food waste and improved the image of dining experience. Students also appreciated the sustainability initiative and reported they could experience a better visual dining experience without trays. As a result, total estimated annual economic savings was estimated up to \$57,000 (Aramark, 2008).

Sodexo also tested the effect of trayless dining on 150 colleges and universities. According to a GREENetwork document published by Illinois Wesleyan University, trayless dining could reduce plate waste by 48% although the report did not report any cost benefit of energy and water conservation (Sodexo, 2009). Interestingly, colleges and universities that have implemented trayless dining were listed on a Blog created by Jonathan Bloom, a freelance journalist who wrote a book on wasted food in America (Bloom, 2009), and the news release from each school is linked here. Many people who are interested in food waste reduction have joined this blog and have shared information about trayless dining trends in college and university foodservice operations.

Decision Making for Waste Management

Wie, Shanklin and Lee (2003) researched the cost-effectiveness of various waste disposal strategies for institutional foodservice operations. Four case studies were described: a central food processing center, a continuing-care retirement center, a university dining center, and a commercial chain restaurant. The study concluded that

the cost effectiveness of implementing various waste management strategies varied depending on the type of foodservice operation (Wie et al., 2003).

The university dining center in this study served 3,276 meals per day in its cafeteria and used animal feeding and garbage disposal for food scraps, landfills, and recycling for the packaging at the time investigated. The center had four strategies through the 10 years before the investigation: animal feeding, garbage disposal, and composting combined with garbage disposal. As a result, the cost effectiveness was greater when animal feeding (\$171,472) and composting combined with garbage disposal (\$175,073) were used than when only garbage disposal was used. Costs were mainly saved from reducing the charges for food waste (\$30/ton) and pickups (\$25/pickup).

According to study published by Wie, Shanklin and Lee in 2003, the researchers concluded that foodservice administrators should consider several factors when evaluating the cost effectiveness of implementing specific methods for waste management. These include (a) total amount of waste from the facility, (b) availability of farms, compost sites, food banks and shelters, (c) availability of space, labor, and hygiene, (d) cost for the labor, waste hauling and utility, and (e) regulations for tax deductions. Based on these considerations, the researchers suggested that foodservice administrators use a decision-making process for waste management. Cost effectiveness can be determined based on cost information (hourly wage, waste hauling cost, electricity rate, start up cost, rental fee, and surcharge) as well as non cost information (labor time for sorting, delivering, price index, and consumer's perception). However,

implementation of food waste management should consider not only cost effectiveness, but also effects on environments and communities (Wie et al., 2003).

Barriers for Making Decisions

The literature describes many successful stories concerning composting food waste and regenerating energy from it, but these stories also reveal some barriers. There is also little information about the awareness and willingness of foodservice administrators to implement food waste management.

The Evans McDonough Company investigated the Castro Valley Food Scrap Recycling Pilot Program and presented a focus group study. The study was completed in November 2001. Even though the study was collecting data from the residents of Castro Valley, CA, results carried a significant message to show reasons for not participating in the food scrap recycling program that was available. Both participants and non-participants of the food scrap program were interested and aware of its importance even though they could not clearly explain why they were participating in the program. They also had the same attitudes toward the program. However, non-participants tended to give up quickly as soon as they found any problems or inconvenience caused by food scraps. The problems were the lack of clear benefits and high concerns about hygiene, rodents, and odors (The Evans McDonough Co., 2002).

The Evans McDonough Company also collected telephone survey data from residents of four cities in Alameda County, CA where food scrap recycling programs were established 3-4 years before the survey (n=817) in 2004. The telephone survey was

performed for two weeks from April 29 to May 11, 2004. The main reasons for not participating in the program were inconvenience (30%), odor/smell (23%), rodents/flies/bugs (16%), yard compost (11%), hygiene issues (11%), and insufficient waste (10%). There were also residents who didn't know (10%) or didn't have enough information about the program (The Evans McDonough Co., 2004).

Another report was presented by The Center for Ecological Technology (CET) in collaboration with Massachusetts Department of Environmental Protection (DEP) three years before the Castro Valley County Focus group study. The CET in collaboration with Massachusetts DEP put efforts on food waste diversion including education, regulation, funding, and technical assistance. The study results addressed the opportunity to develop a food waste management program in the counties, primarily due to the limited disposal capacity and the economic benefits. However, there were also several barriers to executing the food waste programs. These included (a) lack of physical availability of the processing sites (including composting units) located a long distance from the waste generators, (b) high demands of labor, space and care, (c) high contamination of food waste for livestock with plastics or non-edible waste, (d) "Not In My Back Yard (NIMBY)" attitude of residents, (e) difficulty in handling wet, odorous food waste, (f) inconsistent governmental and financial support or incentives, (g) inconsistent supply of food waste to processing sites, and (h) no strong vision or proactive actions from state government (CET, 1999).

Results from the California and Massachusetts waste agencies were based on the consumers in their areas. College and university foodservice operations may produce a larger quantity of food waste and send it to processing sites more consistently than households. Having a consistent supply of a large quantity of foods is an important factor when using animal feeding and composting methods (Department of Hotel, Restaurant, Institution Management and Dietetics, Kansas State University, 2002).

Research Methods

Focus Group

Focus groups are a qualitative research method. A focus group typically consists of 8 to 10 qualified participants who have a face to face discussion on a specific topic. However, various types of focus groups can be developed using the technology of telephone, video or internet. The moderator of a focus group discussion should have the ability to learn quickly, experience, organizational skills, flexibility, good memory, good listening skills, strong probing skills, good speaking skills, and time management skills (Edmunds, 1999).

Focus group research is flexibly structured, but results are closely connected to the research objectives and in-depth understanding of a specific topic. Focus group discussion is often used to evaluate new marketing or research concepts, design survey questionnaires, generate hypotheses, and process brainstorming (Abusabha & Woelfel, 2003). However, it is not designed for drawing a final decision on specific topics, but for obtaining valuable feedback or quotations from the participants.

Survey

A survey is a cross-sectional research method used to obtain opinions, attitudes, and knowledge on a specific topic from a large group of individuals. The population can be stratified into several subgroups according to certain criteria such as size of facility and type of management. Results of a survey can be quantified from statistical data analyses without bias.

Researchers should have a certain amount of data in order to derive qualified and reliable results from survey. Power analysis is commonly used to determine the size of sample needed to evaluate the accuracy and reliability of statistical analysis and to detect the effect or significant difference between and/or among groups. A well qualified survey will use random samples and blinding to avoid bias. However, surveys can also be collected from all individuals in a certain targeted group (Abusabha & Woelfel, 2003).

CHAPTER III

METHODOLOGY

Institutional Review Board

All methods used in this study were reviewed and approved by the Institutional Review Board at Texas Woman's University prior to commencing research activities. A copy of an approval letter from the Institutional Review Board at Texas Woman's University is attached (See Appendix I).

Focus Group

Focus group methods were used to obtain qualitative background information on the issue of food waste management in college and university foodservice operations. The focus group process followed methods recommended by Edmunds (1999). First, foodservice administrators' contact information was collected from web site of colleges and universities that participated in the 2008 RecycleMania competition in Texas. In order to recruit participants, the researcher sent e-mails and called each candidate. Due to the short number of participants from the 2008 RecycleMania competition pool, researchers contacted foodservice administrators in colleges and universities in the North Texas area by telephone as well.

The researcher prepared a script with open ended questions and a suggested timeline (See Appendix II). The focus group script included five parts: opening with brief description of each participant's foodservice operation, introduction covering the purpose

and topics for the focus group discussion, transitional questions about past experience concerning food waste management, discussion of advantages and disadvantages of food waste management programs, and an ending question about future plans and additional comments about food waste management. A group of foodservice professionals and educators reviewed and evaluated the script and questions. The researcher modified the script and questions accordingly.

A total of seven participants were recruited from administrators at colleges and universities in the Dallas and Houston areas. Participants included three foodservice administrators who participated in the 2008 RecycleMania competition. Focus group discussions were held on two different dates. Each session was a directed 45 to 60 minute discussion of factors, attitudes and barriers impacting food waste management at colleges and universities. The first focus group which included foodservice administrators from both Denton and Houston was held by videoconference and recorded. The second focus group was held only on the TWU Denton Campus and the discussion was tape-recorded. Following each focus group discussion, each participant was mailed a \$50.00 gift certificate. The recorded discussions were transcribed, and analyzed to determine key messages.

Survey

Survey Instrument

Based on focus group results and a review of literature, the researcher developed a questionnaire that included (a) demographic information about foodservice administrators, (b) characteristics of foodservice operations, (c) operational factors affecting food waste such as use of disposables, forecasting, type of food production and service, menu and portion control, (d) use of various foodservice management activities to manage food waste, and (e) attitudes concerning food waste disposal methods and barriers to implementing them. A Likert-type 5 point-scale ranging from very unlikely to very likely was used to measure effectiveness of various foodservice activities for managing food waste. Another Likert-type scale ranging from strongly agree to strongly disagree was used to measure attitudes concerning food waste disposal. Questionnaires were validated by three foodservice educators for content validity and clarity of administrators.

The online pilot survey form was prepared and sent to 33 voting delegates of the National Association of College and University Food Services (NACUFS) in Texas and Oklahoma. A total of 11 participants attempted to participate in the online survey. At the end of the survey, participants were asked to indicate the time and/or any difficulties in completing the survey. A total of six surveys were collected and verified for clarity and feasibility of questionnaires. Cronbach's alpha test was applied to evaluate the inter-item reliability of Likert-type scale questions.

Sample Selection

College/university foodservice administrators who are voting delegates of the National Association of College and University Food Services (NACUFS) were included in the on-line and mail surveys. The mailing list for voting delegates of NACUFS which was purchased from NACUFS included foodservice administrators who reside in the U.S. and Canada. G* power was used to calculate minimum sample size. For initial estimation of 15 items and one predictor with two levels, a power of .95 and alpha of .05 and a moderate effect size ($F = .25$), a minimum sample size of 125 was needed.

Data Collection

The questionnaire was converted to an online survey using PsychData (State College, PA, PsychDataTM LLC) provided by Texas Woman's University. A cover letter that included a web page link to the survey was e-mailed to 591 NACUFS foodservice administrators who provided e-mail addresses. Two follow-up e-mails were sent in two weeks to increase the participation rate. At the same time, a cover letter (See Appendix III) and printed questionnaire (See Appendix IV) were sent to NACUFS foodservice administrators who had not yet responded. Three weeks after the postal mailing, a follow-up post card was sent to non-respondents to increase the participation rate.

Planned Data Analysis

The Statistical Package for the Social Sciences for Windows® (SPSS Inc, Chicago, IL, v 15.0) was used for data analyses. Descriptive statistics were used to summarize data related to demographics, foodservice operation characteristics,

operational factors, and food waste methods. Number of meals served was divided into four groups: $\leq 5,999$, 6000-14,999, 15,000-39,999 and $\geq 40,000$. Most foodservice administrators were in their 40s and 50s so age was also divided into two groups: ≤ 49 years and ≥ 50 years in order to have comparable number of data in each group. Analyses of variance (ANOVA) were performed to test for differences in attitudes and barriers among more than three categories including number of meals served. A student t-test was used to test differences in attitudes and barriers between selected and non-selected for variables such as use of traditional meal plan and use of information from government web page. Multivariate analysis of variance (MANOVA) was applied to test for differences in attitudes and barriers depending on number of meals and experience of foodservice administrators in foodservice operations.

CHAPTER IV

RESULTS

Focus Group Discussions

A total of seven college and university foodservice administrators participated in focus group discussion sessions, five in a first session at 1:30 pm on Sep 26, 2008 and two in a second session at 1:30 pm on Oct 3, 2008. Based on results of focus group discussions, the researchers modified the questionnaire by deleting questions on issues unrelated to food waste management and other questions that foodservice administrators might not have been able to answer. In addition, the focus group discussion reconfirmed foodservice management practices to reduce food waste, methods of food waste disposal, and barriers to food waste management.

The focus group discussion participants served from 4,000 to 35,000 meals per week. Three of them were working in contract managed foodservice operations and the rest them were working in self operated operations. Most foodservice administrators already implemented recycling programs for cardboard and paper goods, but had not extensively implemented food waste management programs.

Foodservice administrators shared information about several food waste management methods such as composting, donating food scraps to farmers for animal feeding, putting trash bins to collect food scraps, going trayless, and recycling vegetable

oil to generate energy. The participants agreed that there is no best method for all foodservice operations because each food waste disposal method has advantages and disadvantages. They also agreed that food waste management programs should continue because the advantages outweighed the disadvantages. Their attitude towards food waste management programs was very positive.

However, here are some interesting quotes related to barriers against implementing food waste management mentioned during focus group discussions.

Lack of Resources

“We can’t do it. We need to make a partnership with garbage collectors. However, no one in Dallas will pick up food waste for composting.”

“Our community would not allow sites for composting”

“A pulper is an expensive system for food waste management. It needs to be installed in a new building. Mostly, it does not work in an old building. Who’s going to pay for it?”

Complicated Governmental Regulations

“Composting for me? It is not even an option for a medical center because we are a research facility. There is a major FDA rule against it. I cannot do anything like that.”

“We had 55 gallons of food and hog farmers picked those up a long time ago. However, the Food Drug Administration and USDA put a little bit stricter guidelines on the farmers. They started to require them to boil the food scraps and kill the pathogens before they gave them to animals. Of course, small size farmers do not have any facility to be able to do this, and they quit collecting the food waste.”

Lack of Space in the Facility

“If you happen to get just one delivery over a week, you will have some waste or spoilage.”

Liability for Donated Leftover Foods

“All the Good Samaritan laws may shield you from some of them, but there is public opinion as well. All of sudden, somebody on television is saying that they got lunch from my operation and now everybody is sick.”

Pilot Survey

The response rate for the pilot online survey was 18.2% (6/33). According to pilot participants, the average time to complete the survey was 13.2 ± 5.36 min, and the main difficulty was questions that asked for too much detailed data about the foodservice operations.

Cronbach's alpha test was conducted to evaluate the reliability of the Likert type questions. Results showed that a set of questions for foodservice activities to reduce the amount of food waste was reliable (Cronbach's $\alpha=0.928$, $n=9$). Another set of questions regarding effective methods of food waste disposal was also reliable (Cronbach's $\alpha=0.860$, $n=7$).

However, the Cronbach's α test results varied in the set of Likert type questions for barriers in food waste management at each facility partly due to the small number of data for analysis. Considering difficulties to obtain sufficient number of data, any set of

questions with Cronbach's α value higher than 0.500 was accepted after researchers consulted with a statistician.

According to the Cronbach's α test, the researchers removed five of 23 questions for the section concerning barriers, but kept one question by itself concerning public image and food waste management. The removed questions were (a) we do not believe the nutrition quality of food waste is appropriate for animals, (b) there are no farmers who could use food waste for animals near our operation, (c) there are no composting sites near our operation, and (d) there are potential problems with food waste management programs such as odor, rodents, and insects.

The barriers section with 19 questions was separated into four parts for Cronbach's α analysis. The first part included eight questions regarding operational problems (Cronbach's $\alpha=0.641$, $n=8$), which are (a) the amount of food waste from our operation is not enough to implement a specific food waste management plan, (b) we are satisfied with our current food waste program, (c) lack of resources about food waste management discouraged us, (d) employees/customers do not like to separate food waste from soiled dishes and packaging, (e) we were overwhelmed with the complicated government requirements for food waste programs, (f) Our operation does not donate foods to nonprofit organizations because of potential liability issues, (g) we have very limited space to store food items for donation, and (h) food waste management is not a current priority issue in our operation.

The second part with four questions related to financial resources and administrative support included (a) we do not see the cost benefits of a food waste program (s), (b) we do not have the financial resources to initiate a food waste program in our operation, (c) my administrators (or headquarters) are not willing to support a food waste management program, and (d) we do not have enough staff to initiate a food waste management program (Cronbach's $\alpha=0.679$, $n=4$).

The third set of questions focused on difficulties with waste disposal methods. They were (a) composting affects the environment through contamination of water and air, (b) we do not want to have equipment such as a pulper because of equipment maintenance, and (c) we cannot use garbage disposals because of high sewer taxes and/or state law (Cronbach's $\alpha=0.535$, $n=3$).

The last group of questions covering lack of motivation included (a) we tried several methods to reduce food waste in the past, but none of them were successful, (b) the impact of food waste disposal on the environment is not our concern, and (c) government regulations do not require us to have a specific food waste management program (Cronbach's $\alpha=0.600$, $n=3$).

National Survey

This study used both online and mailed surveys. Among 632 voting delegates of NACUFS (the National Association of College and University Food Services), six were international delegates and 35 were in Texas and Oklahoma. E-mails were sent to 591 college and university foodservice administrators who had e-mail addresses on the

mailing list in the United States and Canada. After receiving 36 complete and 30 incomplete online surveys, a cover letter and printed survey form were mailed to the remaining 555 delegates who resided in the United States. Thirty six NACUFS delegates resided in Canada were not included in the mailed survey due to postage cost. Including 27 mailed surveys returned, there were a total of 93 surveys submitted (return rate = 15%), but only 63 data had complete data (usable data return rate = 10%). There were no returned envelopes due to wrong addresses.

Demographic Characteristics of Respondents

The majority of survey respondents were male (73%) and between ages 40 to 59. Their mean work experience was 13.8 years in college and university foodservice operations and 26.6 years in any foodservice operation. Approximately half of the respondents had a bachelor's degree. Other education included some college and a degree from a culinary institute. Respondents indicated that they obtained information about food waste management from various sources including college and university web pages, professional journals, trade journals, and waste management companies. Few used governmental web pages as a source of information (See Table 1). Respondents were asked to indicate their level of interest in both solid waste management and food waste management on a scale ranging from 1 (not interested) to 5 (very interested). Mean levels of interest were 4.06 ± 1.01 for solid waste management and 4.10 ± 1.07 for food waste management.

Table 1
Demographic Characteristics of Foodservice Administrators (N=63)

Gender	n
Male	46
Female	17
Age	n
20-29	2
30-39	7
40-49	24
50-59	25
≥ 60	5
Years of experience	Mean±SD
College and university foodservice	13.8±10.3
All foodservice	26.6±9.8
Education	n
Associate degree	7
Bachelor's degree	32
Master's degree	17
Doctoral degree	1
Other	6
Source of information about food waste management [*]	n
College and university web pages	41
Professional journals	39
Trade journals	37
Waste management company	24
Governmental web pages	8
I do not obtain any information about food waste management	6

SD=Standard Deviation

^{*} The total number of responses exceeds total N because respondents were asked to check all that apply.

Characteristics of Foodservice Operations

An average of 28,720 meals were served weekly at foodservice operations represented by respondents. The mean number of catering events per week was 48.5 which represented an average of 1,345 catered meals weekly. A total of 47 out of 63 foodservice administrators responded that they have residential dining halls.

About one-third of the respondents' foodservice operations were contract managed and the rest were self operated. Other types of foodservice operations were not clearly identified by the respondents. Meal plans were approximately evenly distributed between traditional, cash-based, and combination of traditional and cash based meal plans. Fifteen schools that had other meal plans stated that their meal plans were a mandatory unlimited meal plan, no meal plan, or all meals included in tuition. Nearly all respondents used cook to serve and cook to order production systems while approximately one fifth of respondents used cook-chill. One respondent listed in-store fast food restaurant under "other" methods of production (See Table 2).

The frequency of collecting food waste was 14.8 times per month which was similar to the frequency of collecting packaging waste (15.3times/month). The cost for collecting waste was also the same for package waste (\$1,317/month) and food waste (\$1,180/month). However, food waste was more than four times heavier in weight and one half the volume of package waste (See Table 3).

Table 2

Characteristics of College and University Foodservice Operations (N=63)

	Mean±SD
Average number of meals or meal equivalents served/week	28,720 ± 33,765
Average number of catering events/week	48.5 ± 94.5
Average meals served for catering/week	1,345 ± 2,710
Residential dining halls	n 47
Type of managements	n
Contract managed	20
Self operated	41
Others	2
Meal plans ^a	n
Traditional meal plan ^b	26
Combination of traditional and cash based meal plans	21
Cash-based meal plan ^c	19
Other	15
Type of foodservice production ^a	n
Cook to serve ^d	59
Cook to order ^e	56
Assembly serve ^f	40
Cook-chill ^g	12
Other	1

^a The total number of responses exceeds N because respondents were asked to check all that apply.

^b Traditional meal plan: set number of meals per week or per semester

^c Cash-based meal plan: cash deposit or credit card

^d Cook to serve: cook and hold food at serving line

^e Cook to order: receive order from customers and cook food right at serving line

^f Assembly serve: reheat and serve already prepared foods

^g Cook-chill: cook, cool, refrigerate, reheat and serve foods

SD=Standard Deviation

Table 3

Characteristics of Waste Produced in College and University Foodservice Operations (N=63)

	Package Waste	Food Waste
	Mean $\pm$ SD	Mean $\pm$ SD
Frequency of waste collection (times/month)	15.3 $\pm$ 12.6	14.8 $\pm$ 13.6
Cost for waste disposals (\$/month)	1,317 $\pm$ 2,524	1,180 $\pm$ 1,482
Waste by weight (lbs/month)	4,648 $\pm$ 6,942	19,598 $\pm$ 24,728
Waste by volume (cu ft/month)	12,707 $\pm$ 39,657	617.3 $\pm$ 543.5

SD=Standard Deviation

Foodservice Management Activities to Reduce Food Waste

Respondents were asked to rate how likely eight foodservice management activities would be to reduce food waste on a 5-point scale ranging from 1 (very unlikely) to 5 (very likely). The four activities receiving the highest likeliness ratings were: educate customers to reduce food waste (4.51 $\pm$ 0.69), modify food production practices (4.33 $\pm$ 0.98), use a computer program to have accurate forecasting and managing food production, (4.26 $\pm$ 1.05) and train employees to separate food waste and packaging (4.17 $\pm$ 1.08). Changing menu planning was considered the least likely to reduce food waste (3.61 $\pm$ 0.69). Others included that they had in practice all of the above, discussed with distributors to share concerns about excess packaging, and weighed food waste to manage food waste from the facilities (See Table 4).

Type of management and existence of residential area. A student t-test showed no significant difference in attitudes of respondents regarding likeliness of suggested foodservice management activities to reduce food waste between contract-managed and self-operated foodservice operations (See Table 5). There was also no significant difference in perceptions between administrators whose facilities had residential dining halls and those who did not (See Table 6).

Table 4
College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste

Foodservice Management Activities	n	Mean $\pm$ SD
Educate customers to reduce food waste	63	4.51 $\pm$ 0.69
Modify food production practices to reduce food waste (ex. change to small batch size, improve use of leftovers)	63	4.33 $\pm$ 0.98
Use a computer program to have accurate forecasting and managing food production	61	4.26 $\pm$ 1.05
Train employees to separate food waste and packaging (ex. animal feeds, composting)	60	4.17 $\pm$ 1.08
Change service methods to reduce food waste (ex. trayless, charge by item style cafeteria)	62	4.06 $\pm$ 1.23
Adjust portion sizes to reduce food waste	62	4.00 $\pm$ 1.06
Put a trash bin to collect food scraps for food waste program (ex. animal feeds, composting)	61	3.72 $\pm$ 1.27
Change menu planning to reduce food waste (ex. reduce number of menu items produced, reduce portion size)	62	3.69 $\pm$ 1.42
Other	18	3.61 $\pm$ 0.92

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely
SD = Standard Deviation

Table 6

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to the Existence of Residential Dining Hall (N=63)

Foodservice Management Activities	Likelihood according to Residential Dining Halls		t	P
	YES (n=47)	NO (n=16)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.57 $\pm$ 0.62	4.31 $\pm$ 0.87	1.314	0.194
Modify food production practices to reduce food waste	4.40 $\pm$ 0.90	4.13 $\pm$ 1.20	0.980	0.331
Use a computer program for accurate forecasting	4.39 $\pm$ 0.93	3.87 $\pm$ 1.30	1.712	0.092
Train employees to separate food waste and packaging	4.09 $\pm$ 1.03	4.38 $\pm$ 1.20	-0.903	0.370
Change service methods to reduce food waste	4.21 $\pm$ 1.14	3.60 $\pm$ 1.40	1.711	0.092
Adjust portion sizes to reduce food waste	4.11 $\pm$ 0.94	3.67 $\pm$ 1.35	1.178	0.254
Put a trash bin to collect food scraps for food waste program	3.78 $\pm$ 1.24	3.56 $\pm$ 1.37	0.581	0.564
Change menu planning to reduce food waste	3.62 $\pm$ 1.45	3.93 $\pm$ 1.34	-0.748	0.457

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

Statistical significance was analyzed by student t-test

SD = Standard Deviation

Number of meals served weekly. For purposes of statistical analyses, respondents were divided into four groups according to number of meals served: $\leq 5,999$, 6,000-14,999; 15,000-39,999, and $\geq 40,000$ meals per week. Analyses of variance for multiple comparisons using Scheffé's method showed that those who served a larger number of meals felt that food production modification and computer use for accurate forecasting would be more likely to reduce food waste (See Table 7).

Type of meal plan. Three types of meal plans were traditional meal plan, cash based meal plan and combination of traditional and cash based meal plans. A traditional meal plan is a plan with a set number of meals per week or per semester, whereas a cash-based meal plan is a plan with a cash deposit or credit card. Colleges and universities also frequently offer combination plans that allow students to eat a set number of meals per week and also have a cash-balance for additional meals. Foodservice administrators' perceptions of the likeliness of foodservice management activities to reduce food waste were not significantly different between those who offered a traditional meal plan and those who did not. However, administrators who offered a cash-based meal plan perceived that adjusting portion size, was significantly more likely ($p=0.033$) to reduce food waste than those who did not offer cash-based meal plans. There were no significant differences in perception of the likeliness of foodservice management activities to reduce food waste between those who offered a combined traditional and cash-based meal plan and those who did not (See Table 8).

Table 7

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Number of Meals Served Weekly (N=62)

Foodservice Management Activities	Number of Meals Served Weekly				F	P
	≤ 5,999 (n=14)	6,000-14,999 (n=16)	15,000-39,999 (n=17)	≥ 40,000 (n=15)		
Educate customers to reduce food waste	Mean ± SD 4.21 ± 0.70	Mean ± SD 4.69 ± 0.48	Mean ± SD 4.71 ± 0.47	Mean ± SD 4.33 ± 0.98	2.062	0.115
Modify food production practices to reduce food waste	3.50 ± 1.35 ^a	4.38 ± 1.03 ^b	4.82 ± 0.39 ^b	4.47 ± 0.52 ^b	5.995	0.001 [*]
Use a computer program for accurate forecasting	3.50 ± 1.40 ^a	4.13 ± 0.92 ^{ab}	4.75 ± 0.45 ^b	4.53 ± 0.92 ^b	4.771	0.005 [*]
Train employees to separate food waste and packaging	4.14 ± 1.17	4.25 ± 1.13	4.27 ± 1.10	3.93 ± 1.00	0.289	0.833
Change service methods to reduce food waste	3.50 ± 1.56	3.88 ± 1.20	4.59 ± 0.80	4.14 ± 1.17	2.290	0.088
Adjust portion sizes to reduce food waste	3.36 ± 1.28	4.00 ± 1.16	4.35 ± 0.70	4.14 ± 0.86	2.640	0.058
Put a trash bin to collect food scraps for food waste program	3.71 ± 1.33	3.56 ± 1.37	3.94 ± 1.06	3.57 ± 1.40	0.288	0.834
Change menu planning to reduce food waste	3.36 ± 1.50	3.63 ± 1.50	3.59 ± 1.58	4.14 ± 1.03	0.756	0.524

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

^{*} Statistical significance at P value ≤ 0.05 by ANOVA with multiple comparisons using Scheffé's method; Different alphabetic superscript letters are significantly different from each other (P ≤ 0.05 between groups, ANOVA); SD = Standard Deviation

Table 8

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Meal Plan (N=63)

Foodservice Management Activities	Traditional Meal Plan		t	P
	YES (n=26)	NO (n=37)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.38 $\pm$ 0.70	4.59 $\pm$ 0.69	1.189	0.239
Modify food production practices to reduce food waste	4.35 $\pm$ 0.89	4.32 $\pm$ 1.06	-0.086	0.932
Use a computer program for accurate forecasting	4.16 $\pm$ 0.99	4.33 $\pm$ 1.10	0.633	0.529
Train employees to separate food waste and packaging	3.92 $\pm$ 1.09	4.35 $\pm$ 1.04	1.551	0.126
Change service methods to reduce food waste	4.12 $\pm$ 0.99	4.03 $\pm$ 1.38	-0.275	0.784
Adjust portion sizes to reduce food waste	3.92 $\pm$ 0.84	4.06 $\pm$ 1.19	0.484	0.611
Put a trash bin to collect food scraps for food waste program	3.73 $\pm$ 1.19	3.71 $\pm$ 1.34	-0.050	0.960
Change menu planning to reduce food waste	3.54 $\pm$ 1.39	3.81 $\pm$ 1.45	0.727	0.470

	Cash-based Meal Plan		t	P
	YES (n=19)	NO (n=44)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.58 $\pm$ 0.69	4.48 $\pm$ 0.70	-0.532	0.597
Modify food production practices to reduce food waste	4.58 $\pm$ 0.61	4.23 $\pm$ 1.10	-1.310	0.195
Use a computer program for accurate forecasting	4.39 $\pm$ 0.98	4.21 $\pm$ 1.08	-0.608	0.546
Train employees to separate food waste and packaging	4.16 $\pm$ 1.07	4.17 $\pm$ 1.09	0.043	0.966
Change service methods to reduce food waste	4.17 $\pm$ 0.99	4.02 $\pm$ 1.32	-0.417	0.678
Adjust portion sizes to reduce food waste	4.44 $\pm$ 0.71	3.82 $\pm$ 1.13	-2.185	0.033*
Put a trash bin to collect food scraps for food waste program	4.00 $\pm$ 1.20	3.60 $\pm$ 1.29	-1.159	0.251
Change menu planning to reduce food waste	4.11 $\pm$ 1.28	3.52 $\pm$ 1.46	-1.495	0.140

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Table 8 (*continued*)

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Meal Plan (N=63)

Foodservice Management Activities	Combination of Traditional and Cash-based Meal Plans		t	P
	YES (n=21)	NO (n=42)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.67 $\pm$ 0.58	4.43 $\pm$ 0.74	-1.293	0.201
Modify food production practices to reduce food waste	4.43 $\pm$ 0.81	4.29 $\pm$ 1.07	-0.540	0.591
Use a computer program for accurate forecasting	4.40 $\pm$ 1.00	4.20 $\pm$ 1.08	-0.714	0.478
Train employees to separate food waste and packaging	4.39 $\pm$ 0.92	4.07 $\pm$ 1.14	-1.048	0.299
Change service methods to reduce food waste	4.24 $\pm$ 1.22	3.98 $\pm$ 1.24	-0.795	0.430
Adjust portion sizes to reduce food waste	4.14 $\pm$ 1.01	3.93 $\pm$ 1.08	-0.760	0.450
Put a trash bin to collect food scraps for food waste program	4.00 $\pm$ 1.16	3.60 $\pm$ 1.31	-1.159	0.251
Change menu planning to reduce food waste	4.10 $\pm$ 1.18	3.49 $\pm$ 1.50	-1.745	0.087

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Type of food production. College and university foodservice operations frequently use several types of food production systems including cook to serve, cook to order, cook-chill and assembly serve. With cook to serve production, foods are cooked and held at a serving line. With cook to order, servers receive an order from a customer and then cook foods right at the serving line. Cook chill is a food production method of cooking that includes cooking, refrigerating for one or more days, reheating and serving foods. Assembly serve production requires reheating and serving already prepared foods.

Table 9 shows results regarding the influence of cook to serve and cook to order on college and university foodservice administrators' perception of the likeliness of foodservice management activities to reduce food waste. No statistical analyses were performed because there were not enough foodservice operations that did not use cook to serve and cook to order for food production to make these analyses feasible. The foodservice administrators' perceptions of likeliness of foodservice management activities to reduce food waste showed no significant differences based on cook chill and assembly serve methods of food production (See Table 9).

Source of information about food waste management. Because of the small numbers of administrators who obtained no information about food waste management and those who obtained information from government web pages, statistical analyses was not conducted for this data. Student t-tests showed no significant difference in foodservice administrators' perception of likeliness of foodservice management activities to reduce food waste between those who obtained information from college and

Table 9

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Type of Food Production (N=63)

Foodservice Management Activities	Cook to Serve		Cook to Order	
	YES (n=59)	NO (n=4)	YES (n=56)	NO (n=7)
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Educate customers to reduce food waste	4.54 $\pm$ 0.68	4.00 $\pm$ 0.82	4.52 $\pm$ 0.71	4.43 $\pm$ 0.54
Modify food production practices to reduce food waste	4.34 $\pm$ 1.01	4.25 $\pm$ 0.50	4.30 $\pm$ 1.03	4.57 $\pm$ 0.54
Use a computer program for accurate forecasting	4.26 $\pm$ 1.03	4.25 $\pm$ 1.50	4.31 $\pm$ 1.01	3.86 $\pm$ 1.35
Train employees to separate food waste and packaging	4.23 $\pm$ 1.03	3.25 $\pm$ 1.50	4.17 $\pm$ 1.09	4.14 $\pm$ 1.07
Change service methods to reduce food waste	4.15 $\pm$ 1.16	2.33 $\pm$ 1.53	4.20 $\pm$ 1.15	3.00 $\pm$ 1.41
Adjust portion sizes to reduce food waste	4.02 $\pm$ 1.08	3.67 $\pm$ 0.58	4.00 $\pm$ 1.11	4.00 $\pm$ 0.58
Put a trash bin to collect food scraps for food waste program	3.81 $\pm$ 1.23	2.50 $\pm$ 1.29	3.74 $\pm$ 1.28	3.57 $\pm$ 1.27
Change menu planning to reduce food waste	3.78 $\pm$ 1.39	2.00 $\pm$ 1.00	3.82 $\pm$ 1.38	2.71 $\pm$ 1.50

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

SD = Standard Deviation

Table 9 (continued)

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Type of Food Production (N=63)

Foodservice Management Activities	Cook Chill		t	P
	YES (n=12)	NO (n=48)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.50 $\pm$ 0.80	4.52 $\pm$ 0.65	0.095	0.925
Modify food production practices to reduce food waste	4.08 $\pm$ 1.38	4.40 $\pm$ 0.89	0.965	0.339
Use a computer program for accurate forecasting	4.27 $\pm$ 0.79	4.23 $\pm$ 1.13	-0.108	0.915
Train employees to separate food waste and packaging	4.36 $\pm$ 1.03	4.11 $\pm$ 1.10	-0.699	0.488
Change service methods to reduce food waste	3.92 $\pm$ 1.31	4.11 $\pm$ 1.24	0.468	0.641
Adjust portion sizes to reduce food waste	3.75 $\pm$ 1.42	4.02 $\pm$ 0.97	0.784	0.436
Put a trash bin to collect food scraps for food waste program	3.55 $\pm$ 1.21	3.72 $\pm$ 1.30	0.414	0.680
Change menu planning to reduce food waste	3.83 $\pm$ 1.53	3.60 $\pm$ 1.42	-0.508	0.613
	Assembly Serve		t	P
	YES (n=40)	NO (n=22)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.58 $\pm$ 0.64	4.45 $\pm$ 0.74	-0.674	0.503
Modify food production practices to reduce food waste	4.30 $\pm$ 1.09	4.41 $\pm$ 0.80	0.412	0.682
Use a computer program for accurate forecasting	4.39 $\pm$ 0.92	4.05 $\pm$ 1.25	-1.241	0.220
Train employees to separate food waste and packaging	4.22 $\pm$ 1.16	4.14 $\pm$ 0.94	-0.274	0.785
Change service methods to reduce food waste	4.23 $\pm$ 1.11	3.77 $\pm$ 1.41	-1.400	0.167
Adjust portion sizes to reduce food waste	4.03 $\pm$ 1.14	3.95 $\pm$ 0.95	-0.248	0.805
Put a trash bin to collect food scraps for food waste program	3.79 $\pm$ 1.26	3.64 $\pm$ 1.33	-0.446	0.658
Change menu planning to reduce food waste	3.79 $\pm$ 1.47	3.50 $\pm$ 1.37	-0.770	0.445

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

SD = Standard Deviation

university web pages and those who did not. However, those administrators who obtained information about food waste management from a waste contract management company perceived that putting a trash bin ($p = 0.035$) to collect food scraps for a food waste program would be significantly more likely to reduce food waste. No significant difference in foodservice administrators' perceptions of likelihood of foodservice management activities to reduce food waste was found between those who obtained information from both professional journals and trade journals compared to those who did not (See Table 10).

Table 10

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Source of Information about Food Waste Management (N=63)

Foodservice Management Activities	I do not obtain any information about food waste management	
	YES (n=6)	NO (n=55)
	Mean $\pm$ SD	Mean $\pm$ SD
Educate customers to reduce food waste	5.00 $\pm$ 0.00	4.46 $\pm$ 0.70
Modify food production practices to reduce food waste	4.50 $\pm$ 1.23	4.32 $\pm$ 0.97
Use a computer program for accurate forecasting	5.00 $\pm$ 0.00	4.18 $\pm$ 1.07
Train employees to separate food waste and packaging	4.60 $\pm$ 0.89	4.13 $\pm$ 1.09
Change service methods to reduce food waste	5.00 $\pm$ 0.00	3.96 $\pm$ 1.25
Adjust portion sizes to reduce food waste	4.67 $\pm$ 0.82	3.93 $\pm$ 1.06
Put a trash bin to collect food scraps for food waste program	4.20 $\pm$ 1.79	3.68 $\pm$ 1.22
Change menu planning to reduce food waste	4.33 $\pm$ 1.63	3.63 $\pm$ 1.40

	Governmental Web Pages	
	YES (n=8)	NO (n=55)
Educate customers to reduce food waste	4.38 $\pm$ 0.74	4.53 $\pm$ 0.69
Modify food production practices to reduce food waste	4.25 $\pm$ 1.17	4.35 $\pm$ 0.97
Use a computer program for accurate forecasting	4.13 $\pm$ 1.46	4.28 $\pm$ 0.99
Train employees to separate food waste and packaging	4.43 $\pm$ 0.79	4.13 $\pm$ 1.11
Change service methods to reduce food waste	4.63 $\pm$ 0.74	3.98 $\pm$ 1.27
Adjust portion sizes to reduce food waste	4.25 $\pm$ 0.71	3.96 $\pm$ 1.10
Put a trash bin to collect food scraps for food waste program	3.86 $\pm$ 0.90	3.70 $\pm$ 1.31
Change menu planning to reduce food waste	4.50 $\pm$ 0.76	3.57 $\pm$ 1.46

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

SD = Standard Deviation

Table 10 (continued)

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Source of Information about Food Waste Management (N=63)

Foodservice Management Activities	College and University Web Pages		t	P
	YES (n=41)	NO (n=22)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.59 $\pm$ 0.67	4.36 $\pm$ 0.73	-1.216	0.229
Modify food production practices to reduce food waste	4.49 $\pm$ 0.78	4.05 $\pm$ 1.25	-1.729	0.089
Use a computer program for accurate forecasting	4.35 $\pm$ 1.00	4.10 $\pm$ 1.14	-0.901	0.371
Train employees to separate food waste and packaging	4.38 $\pm$ 0.90	3.75 $\pm$ 1.29	-1.941	0.062
Change service methods to reduce food waste	4.24 $\pm$ 1.07	3.71 $\pm$ 1.45	-1.631	0.108
Adjust portion sizes to reduce food waste	4.12 $\pm$ 0.90	3.76 $\pm$ 1.30	-1.277	0.206
Put a trash bin to collect food scraps for food waste program	3.95 $\pm$ 1.15	3.29 $\pm$ 1.38	-1.994	0.051
Change menu planning to reduce food waste	3.95 $\pm$ 1.22	3.19 $\pm$ 1.66	-1.856	0.073
	Waste Contract Management Company		t	P
	YES (n=24)	NO (n=39)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.46 $\pm$ 0.83	4.54 $\pm$ 0.60	0.443	0.659
Modify food production practices to reduce food waste	4.50 $\pm$ 0.59	4.23 $\pm$ 1.16	-1.218	0.228
Use a computer program for accurate forecasting	4.46 $\pm$ 0.78	4.14 $\pm$ 1.18	-1.287	0.203
Train employees to separate food waste and packaging	4.50 $\pm$ 0.80	3.97 $\pm$ 1.17	-1.863	0.067
Change service methods to reduce food waste	4.17 $\pm$ 1.03	4.00 $\pm$ 1.34	-0.536	0.594
Adjust portion sizes to reduce food waste	4.09 $\pm$ 0.90	3.95 $\pm$ 1.15	-0.495	0.622
Put a trash bin to collect food scraps for food waste program	4.13 $\pm$ 1.01	3.47 $\pm$ 1.35	-2.157	0.035*
Change menu planning to reduce food waste	3.96 $\pm$ 1.19	3.54 $\pm$ 1.54	-1.198	0.236

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Table 10 (continued)

College and University Foodservice Administrators' Perceptions of Likelihood of Foodservice Management Activities to Reduce Food Waste according to Source of Information about Food Waste Management (N=63)

Foodservice Management Activities	Professional Journals		t	P
	YES (n=39)	NO (n=24)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	4.54 $\pm$ 0.60	4.46 $\pm$ 0.83	-0.443	0.659
Modify food production practices to reduce food waste	4.31 $\pm$ 1.03	4.38 $\pm$ 0.92	0.262	0.794
Use a computer program for accurate forecasting	4.16 $\pm$ 1.14	4.42 $\pm$ 0.88	0.926	0.358
Train employees to separate food waste and packaging	4.26 $\pm$ 1.04	4.00 $\pm$ 1.14	-0.879	0.383
Change service methods to reduce food waste	4.00 $\pm$ 1.29	4.17 $\pm$ 1.13	0.518	0.606
Adjust portion sizes to reduce food waste	4.00 $\pm$ 1.07	4.00 $\pm$ 1.06	0.000	1.000
Put a trash bin to collect food scraps for food waste program	3.79 $\pm$ 1.17	3.59 $\pm$ 1.44	-0.601	0.550
Change menu planning to reduce food waste	3.76 $\pm$ 1.40	3.58 $\pm$ 1.47	-0.482	0.631
	Trade Journals		t	P
	YES (n=37)	NO (n=26)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Educate customers to reduce food waste	3.81 $\pm$ 1.31	3.52 $\pm$ 1.58	1.413	0.452
Modify food production practices to reduce food waste	4.16 $\pm$ 1.09	4.58 $\pm$ 0.76	1.779	0.100
Use a computer program for accurate forecasting	4.20 $\pm$ 1.11	4.35 $\pm$ 0.98	0.536	0.594
Train employees to separate food waste and packaging	3.86 $\pm$ 1.32	4.36 $\pm$ 1.04	0.243	0.120
Change service methods to reduce food waste	3.84 $\pm$ 1.17	4.24 $\pm$ 0.83	1.578	0.143
Adjust portion sizes to reduce food waste	4.41 $\pm$ 0.73	4.65 $\pm$ 0.63	1.486	0.163
Put a trash bin to collect food scraps for food waste program	4.14 $\pm$ 1.05	4.21 $\pm$ 1.14	-0.064	0.809
Change menu planning to reduce food waste	3.73 $\pm$ 1.22	3.71 $\pm$ 1.37	-0.759	0.949

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Methods of Food Waste Disposal

Foodservice administrators rated seven methods of food waste disposal on likeliness to be effective based on a 5-point scale ranging from 1 (very unlikely) to 5 (very likely). Sending food scraps to a composting site (4.06 ± 1.17) and using a food pulper to reduce volume of food waste (3.93 ± 1.20) were considered the most likely effective methods. Donating non-perishable food for the needy population (3.31 ± 0.95) was considered the least likely to be effective. Other methods that sixteen respondents listed likely to be effective included sending food waste to a vermiculture center and recycling non-food items (See Table 11).

Table 11
College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods

Food Waste Disposal Methods	n	Mean $\pm$ SD
Send food scraps to composting site (s)	53	4.06 ± 1.17
Use a food pulper to reduce the volume of the food waste	55	3.93 ± 1.20
Use garbage disposals to dispose food to sewage system	59	3.63 ± 1.41
Donate prepared food (ex. hot or cold foods) for the needy such as local food banks	58	3.41 ± 1.51
Send food waste to landfill along with other solid waste	61	3.33 ± 1.40
Donate food scraps to farmers for animal feed	55	3.11 ± 1.27
Donate non-perishable food (ex. canned products) for the needy	55	3.00 ± 1.47
Other	16	3.31 ± 0.95

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely
SD = Standard Deviation

Type of management and existence of residential area. There was no significant difference between administrators of contract-managed and self-operated college and university foodservice operations in perceptions of food waste disposal methods likely to reduce food waste (See Table 12). However, there were significant differences between college and university foodservice administrators who had residential dining halls compared to those who did not. College and university foodservice administrators who had residential dining halls felt that using a food pulper to reduce the volume of the food waste ($P=0.045$) was more likely to be effective in reducing food waste from the operations, whereas they considered sending waste to landfill along with other solid waste ($P=0.041$) less likely to be effective (see Table 13).

Number of meals served weekly. Analysis of variance was used to determine whether administrators' perceptions of effectiveness of food waste disposal methods varied according to the number of meals served weekly. No significant difference was found in college and university foodservice administrators' perceptions of effectiveness of food waste disposal methods (See Table 14).

Age of foodservice administrators. There were significant differences when college and university foodservice administrators' perceptions of food waste disposal methods were compared based on age. For purpose of statistical analyses, administrators were split into two groups, those 49 years and younger and those 50 years and older. College and university foodservice administrators 49 years and younger perceived that using garbage disposals to dispose food to the sewage system ($P=0.038$) and donating

food scraps to farmers for animal feed ($P=0.034$) were more likely to be effective methods of reducing food waste than those age 50 years and older (Table 15).

Table 12
College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Type of Management (N=61)

Food Waste Disposal Methods	Type of Management		t	P
	Contract-Managed (n=20)	Self-Operated (n=41)		
Send food scraps to composting site (s)	4.00 ± 1.24	4.09 ± 1.18	0.258	0.797
Use a food pulper to reduce the volume of the food waste	4.06 ± 1.16	3.86 ± 1.24	-0.563	0.576
Use garbage disposals to dispose food to sewage system	4.05 ± 1.40	3.45 ± 1.39	-1.568	0.122
Donate prepared food for the needy such as local food banks	2.89 ± 1.49	3.70 ± 1.43	1.974	0.053
Send food waste to landfill along with other solid waste	3.50 ± 1.24	3.25 ± 1.50	-0.687	0.496
Donate food scraps to farmers for animal feed	3.53 ± 1.35	2.94 ± 1.21	-1.625	0.110
Donate non-perishable food for the needy	3.05 ± 1.35	2.91 ± 1.55	-0.332	0.741

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely
SD = Standard Deviation

Table 13

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to the Existence of Residential Dining Halls (N=63)

Food Waste Disposal Methods	Residential Dining Halls		t	P
	YES (n=47)	NO (n=16)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.13 $\pm$ 1.13	3.86 $\pm$ 1.29	0.742	0.461
Use a food pulper to reduce the volume of the food waste	4.13 $\pm$ 1.09	3.40 $\pm$ 1.35	2.055	0.045*
Use garbage disposals to dispose food to sewage system	3.81 $\pm$ 1.37	3.13 $\pm$ 1.46	1.692	0.096
Donate prepared food for the needy such as local food banks	3.24 $\pm$ 1.48	3.88 $\pm$ 1.54	-1.449	0.153
Send food waste to landfill along with other solid waste	3.11 $\pm$ 1.43	3.94 $\pm$ 1.12	-2.085	0.041*
Donate food scraps to farmers for animal feed	3.21 $\pm$ 1.26	2.88 $\pm$ 1.31	0.872	0.387
Donate non-perishable food for the needy	2.88 $\pm$ 1.45	3.36 $\pm$ 1.50	-1.057	0.295

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value ≤ 0.05 by student t-test.

SD = Standard Deviation

Table 14

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Number of Meals Served Weekly(N=62)

Food Waste Disposal Methods	Number of Meals Served Weekly				F	P
	≤ 5,999 (n=14)	6,000-14,999 (n=16)	15,000-39,999 (n=17)	≥ 40,000 (n=15)		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		
Send food scraps to composting site (s)	3.75 ± 1.42	3.92 ± 1.26	4.36 ± 1.08	4.08 ± 0.95	0.621	0.605
Use a food pulper to reduce the volume of the food waste	3.46 ± 1.51	3.86 ± 1.03	4.53 ± 0.83	3.67 ± 1.23	2.275	0.091
Use garbage disposals to dispose food to sewage system	4.08 ± 1.26	3.63 ± 1.15	3.20 ± 1.70	3.57 ± 1.51	0.892	0.451
Donate prepared food for the needy such as local food banks	2.64 ± 1.55	3.56 ± 1.41	3.54 ± 1.56	3.79 ± 1.42	1.630	0.193
Send food waste to landfill along with other solid waste	3.25 ± 1.77	3.50 ± 1.16	3.18 ± 1.43	3.27 ± 1.39	0.155	0.926
Donate food scraps to farmers for animal feed	3.50 ± 1.57	2.80 ± 1.08	3.43 ± 1.09	2.62 ± 1.19	1.712	0.176
Donate non-perishable food for the needy	2.64 ± 1.50	3.13 ± 1.30	2.83 ± 1.70	3.23 ± 1.42	0.460	0.712

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

Statistical significance was analyzed by ANOVA with multiple comparisons using Scheffé's method

SD = Standard Deviation

Table 15

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Age of Foodservice Administrators (N=63)

Food Waste Disposal Methods	Age		t	P
	≤ 49 years (n=33)	≥ 50 years (n=30)		
Send food scraps to composting site (s)	4.00 ± 1.33	4.12 ± 0.97	-0.371	0.713
Use a food pulper to reduce the volume of the food waste	3.97 ± 1.30	3.88 ± 1.11	0.248	0.805
Use garbage disposals to dispose food to sewage system	4.00 ± 1.34	3.24 ± 1.41	2.123	0.038*
Donate prepared food for the needy such as local food banks	3.07 ± 1.57	3.79 ± 1.37	-1.850	0.070
Send food waste to landfill along with other solid waste	3.26 ± 1.59	3.40 ± 1.19	-0.395	0.694
Donate food scraps to farmers for animal feed	3.46 ± 1.26	2.74 ± 1.20	2.181	0.034*
Donate non-perishable food for the needy	2.86 ± 1.53	3.15 ± 1.41	-0.733	0.467

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value ≤ 0.05 by student t-test.

SD = Standard Deviation

Type of meal plan. There were no significant differences in college and university foodservice administrators' perceptions of effectiveness of food waste disposal methods according to traditional meal plan and cash-based meal plan. However, those administrators who offered a combination of traditional and cash-based meal plans felt that donating food scraps to farmers for animal feed ($P=0.004$) was significantly less likely to be an effective food waste disposal method than those who did not offer a combination plan (See Table 16).

Type of food production. Due to the small number of colleges and universities not using cook to serve and cook to order, statistical analysis was not conducted to compare college and university foodservice administrators' perceptions of food waste disposal methods based on use of these production methods. Student t-tests were used to compare perceptions of effectiveness of food waste disposal methods for college and university foodservice administrators between those who used cook chill and assembly serve type of food production and those who did not. Administrators who used cook chill production were significantly less likely ($P=0.007$) to feel that sending food waste to a landfill was an effective method of food waste disposal (Table 17).

Table 16

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Meal Plan (N=63)

Food Waste Disposal Methods	Traditional Meal Plan		t	P
	YES (n=26)	NO (n=37)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.09 $\pm$ 1.15	4.03 $\pm$ 1.20	-0.179	0.859
Use a food pulper to reduce the volume of the food waste	4.05 $\pm$ 0.95	3.85 $\pm$ 1.35	-0.635	0.528
Use garbage disposals to dispose food to sewage system	3.88 $\pm$ 1.30	3.46 $\pm$ 1.48	-1.147	0.257
Donate prepared food for the needy such as local food banks	2.96 $\pm$ 1.49	3.74 $\pm$ 1.46	1.978	0.053
Send food waste to landfill along with other solid waste	3.25 $\pm$ 1.23	3.38 $\pm$ 1.52	0.348	0.729
Donate food scraps to farmers for animal feed	2.91 $\pm$ 1.15	3.24 $\pm$ 1.35	0.951	0.346
Donate non-perishable food for the needy	3.00 $\pm$ 1.47	3.00 $\pm$ 1.48	0.000	1.000
	Cash-based Meal Plan		t	P
	YES (n=19)	NO (n=44)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.25 $\pm$ 1.07	3.97 $\pm$ 1.21	-0.790	0.433
Use a food pulper to reduce the volume of the food waste	4.19 $\pm$ 1.05	3.82 $\pm$ 1.25	-1.031	0.307
Use garbage disposals to dispose food to sewage system	3.88 $\pm$ 1.50	3.52 $\pm$ 1.38	-0.881	0.382
Donate prepared food for the needy such as local food banks	3.53 $\pm$ 1.66	3.37 $\pm$ 1.46	-0.372	0.711
Send food waste to landfill along with other solid waste	3.44 $\pm$ 1.38	3.28 $\pm$ 1.42	-0.418	0.677
Donate food scraps to farmers for animal feed	2.94 $\pm$ 1.44	3.18 $\pm$ 1.21	0.637	0.527
Donate non-perishable food for the needy	3.41 $\pm$ 1.46	2.82 $\pm$ 1.45	-1.406	0.166

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

Statistical significance was analyzed by student t-test; SD = Standard Deviation

Table 16 (continued)

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Meal Plan (N=63)

Food Waste Disposal Methods	Combination of Both Plans		t	P
	YES (n=21)	NO (n=42)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.19 $\pm$ 1.17	4.00 $\pm$ 1.18	-0.533	0.596
Use a food pulper to reduce the volume of the food waste	3.76 $\pm$ 1.25	4.00 $\pm$ 1.19	0.669	0.507
Use garbage disposals to dispose food to sewage system	3.88 $\pm$ 1.36	3.52 $\pm$ 1.44	-0.881	0.382
Donate prepared food for the needy such as local food banks	3.16 $\pm$ 1.39	3.54 $\pm$ 1.57	0.899	0.373
Send food waste to landfill along with other solid waste	2.60 $\pm$ 1.50	3.68 $\pm$ 1.21	3.024	0.004*
Donate food scraps to farmers for animal feed	3.44 $\pm$ 1.46	2.97 $\pm$ 1.18	-1.232	0.223
Donate non-perishable food for the needy	3.33 $\pm$ 1.33	2.84 $\pm$ 1.52	-1.181	0.243

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Table 17

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Type of Production (N=63)

Food Waste Disposal Methods	Cook to Serve		Cook to Order	
	YES (n=59)	NO (n=4)	YES (n=56)	NO (n=7)
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Send food scraps to composting site (s)	4.12 $\pm$ 1.15	3.00 $\pm$ 1.00	4.11 $\pm$ 1.15	3.67 $\pm$ 1.37
Use a food pulper to reduce the volume of the food waste	3.98 $\pm$ 1.21	3.25 $\pm$ 0.96	3.94 $\pm$ 1.23	3.86 $\pm$ 1.07
Use garbage disposals to dispose food to sewage system	3.67 $\pm$ 1.42	3.00 $\pm$ 1.41	3.67 $\pm$ 1.45	3.29 $\pm$ 1.11
Donate prepared food for the needy such as local food banks	3.42 $\pm$ 1.50	3.33 $\pm$ 2.08	3.49 $\pm$ 1.48	2.60 $\pm$ 1.82
Send food waste to landfill along with other solid waste	3.30 $\pm$ 1.40	3.75 $\pm$ 1.50	3.31 $\pm$ 1.40	3.43 $\pm$ 1.51
Donate food scraps to farmers for animal feed	3.10 $\pm$ 1.27	3.25 $\pm$ 1.50	3.06 $\pm$ 1.33	3.43 $\pm$ 0.79
Donate non-perishable food for the needy	3.06 $\pm$ 1.46	1.50 $\pm$ 0.71	3.08 $\pm$ 1.45	2.00 $\pm$ 1.41

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

SD = Standard Deviation

Table 17(continued)

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Type of Production (N=63)

Food Waste Disposal Methods	Cook Chill		t	P
	YES (n=12) Mean $\pm$ SD	NO (n=48) Mean $\pm$ SD		
Send food scraps to composting site (s)	4.20 $\pm$ 1.23	4.08 $\pm$ 1.10	-0.315	0.754
Use a food pulper to reduce the volume of the food waste	3.90 $\pm$ 1.37	3.95 $\pm$ 1.19	0.122	0.904
Use garbage disposals to dispose food to sewage system	3.27 $\pm$ 1.42	3.71 $\pm$ 1.43	0.916	0.364
Donate prepared food for the needy such as local food banks	3.17 $\pm$ 1.53	3.53 $\pm$ 1.49	0.755	0.454
Send food waste to landfill along with other solid waste	2.30 $\pm$ 1.34	3.58 $\pm$ 1.32	2.794	0.007*
Donate food scraps to farmers for animal feed	2.80 $\pm$ 1.23	3.24 $\pm$ 1.27	0.989	0.327
Donate non-perishable food for the needy	3.30 $\pm$ 1.34	2.95 $\pm$ 1.48	-0.678	0.501
	Assembly Serve		t	P
	YES (n=40) Mean $\pm$ SD	NO (n=22) Mean $\pm$ SD		
Send food scraps to composting site (s)	3.97 $\pm$ 1.24	4.22 $\pm$ 1.06	0.729	0.469
Use a food pulper to reduce the volume of the food waste	4.03 $\pm$ 1.24	3.80 $\pm$ 1.15	-0.673	0.504
Use garbage disposals to dispose food to sewage system	3.92 $\pm$ 1.42	3.14 $\pm$ 1.32	-2.083	0.042
Donate prepared food for the needy such as local food banks	3.29 $\pm$ 1.56	3.74 $\pm$ 1.41	1.054	0.296
Send food waste to landfill along with other solid waste	3.16 $\pm$ 1.42	3.59 $\pm$ 1.37	1.151	0.254
Donate food scraps to farmers for animal feed	3.29 $\pm$ 1.30	2.84 $\pm$ 1.21	-1.227	0.225
Donate non-perishable food for the needy	3.03 $\pm$ 1.46	3.00 $\pm$ 1.53	-0.065	0.949

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Source of information about food waste management. College and university foodservice administrators' perceptions of likely effectiveness of food waste disposal methods for those who did not use any source of information about food waste management and those who used government web pages is summarized in Table 18. Due to the small numbers of administrators who obtained no information about food waste management and those who obtained information from government web pages, statistical analyses was not conducted for that data.

Student t-tests showed that those who obtain information about food waste disposal methods from college and university web pages believed sending food waste to landfill along with other solid waste would be less likely to be an effective method ($P=0.001$) compared to those who did not get information from college and university web pages. Those administrators who obtained information about food waste from a waste contract management company considered sending food scraps to composting site(s) to be a more effective method than those who did not. There was no significant difference in college and university foodservice administrators' perceptions of food waste disposal methods based on source of information about food waste management from either professional journals or trade journals (See Table 18).

Table 18

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Source of Information about Food Waste Management (N=63)

Food Waste Disposal Methods	I do not obtain any information about food waste management		Governmental Web Pages	
	YES (n=6)	NO (n=55)	YES (n=8)	NO (n=55)
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Send food scraps to composting site (s)	5.00 $\pm$ 0.00	3.98 $\pm$ 1.18	4.00 $\pm$ 1.10	4.06 $\pm$ 1.19
Use a food pulper to reduce the volume of the food waste	4.80 $\pm$ 0.45	3.84 $\pm$ 1.22	3.67 $\pm$ 1.63	3.96 $\pm$ 1.15
Use garbage disposals to dispose food to sewage system	4.20 $\pm$ 1.79	3.57 $\pm$ 1.38	3.43 $\pm$ 1.72	3.65 $\pm$ 1.39
Donate prepared food for the needy such as local food banks	3.60 $\pm$ 1.95	3.40 $\pm$ 1.49	2.29 $\pm$ 1.60	3.57 $\pm$ 1.45
Send food waste to landfill along with other solid waste	4.17 $\pm$ 1.60	3.24 $\pm$ 1.36	3.57 $\pm$ 1.81	3.30 $\pm$ 1.36
Donate food scraps to farmers for animal feed	4.75 $\pm$ 0.50	2.98 $\pm$ 1.23	3.33 $\pm$ 1.51	3.08 $\pm$ 1.26
Donate non-perishable food for the needy	4.00 $\pm$ 1.73	2.90 $\pm$ 1.42	3.00 $\pm$ 1.27	3.00 $\pm$ 1.50

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

SD = Standard Deviation

Table 18(continued)

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods to Source of Information about Food Waste Management (N=63)

Food Waste Disposal Methods	College and University Web Pages		T	P
	YES (n=41)	NO (n=22)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.18 $\pm$ 1.11	3.73 $\pm$ 1.28	-1.275	0.208
Use a food pulper to reduce the volume of the food waste	3.97 $\pm$ 1.22	3.82 $\pm$ 1.19	-0.426	0.672
Use garbage disposals to dispose food to sewage system	3.46 $\pm$ 1.43	3.95 $\pm$ 1.36	1.263	0.212
Donate prepared food for the needy such as local food banks	3.33 $\pm$ 1.49	3.58 $\pm$ 1.58	0.578	0.566
Send food waste to landfill along with other solid waste	2.95 $\pm$ 1.41	4.05 $\pm$ 1.07	3.394	0.001*
Donate food scraps to farmers for animal feed	3.08 $\pm$ 1.28	3.18 $\pm$ 1.29	0.261	0.795
Donate non-perishable food for the needy	3.14 $\pm$ 1.42	2.72 $\pm$ 1.57	-0.980	0.332
Waste Contract Management Company				
	YES (n=24)	NO (n=39)	t	P
Send food scraps to composting site (s)	4.43 $\pm$ 0.68	3.81 $\pm$ 1.36	-2.190	0.033*
Use a food pulper to reduce the volume of the food waste	4.09 $\pm$ 1.15	3.82 $\pm$ 1.24	-0.824	0.414
Use garbage disposals to dispose food to sewage system	3.27 $\pm$ 1.55	3.84 $\pm$ 1.30	1.502	0.139
Donate prepared food for the needy such as local food banks	3.70 $\pm$ 1.22	3.23 $\pm$ 1.66	-1.230	0.224
Send food waste to landfill along with other solid waste	3.04 $\pm$ 1.43	3.50 $\pm$ 1.37	1.241	0.220
Donate food scraps to farmers for animal feed	3.27 $\pm$ 1.24	3.00 $\pm$ 1.30	-0.776	0.441
Donate non-perishable food for the needy	3.20 $\pm$ 1.24	2.89 $\pm$ 1.59	-0.762	0.449

Likelihood scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Table 18(continued)

College and University Foodservice Administrators' Perceptions of Effectiveness of Food Waste Disposal Methods according to Source of Information about Food Waste Management (N=63)

Food Waste Disposal Methods	Professional Journals		t	P
	YES (n=39)	NO (n=24)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Send food scraps to composting site (s)	4.03 $\pm$ 1.09	4.11 $\pm$ 1.33	0.225	0.823
Use a food pulper to reduce the volume of the food waste	3.86 $\pm$ 1.20	4.05 $\pm$ 1.22	0.559	0.578
Use garbage disposals to dispose food to sewage system	3.49 $\pm$ 1.43	3.90 $\pm$ 1.37	1.064	0.292
Donate prepared food for the needy such as local food banks	3.32 $\pm$ 1.47	3.60 $\pm$ 1.60	0.678	0.501
Send food waste to landfill along with other solid waste	3.26 $\pm$ 1.39	3.43 $\pm$ 1.44	0.461	0.646
Donate food scraps to farmers for animal feed	3.19 $\pm$ 1.22	2.95 $\pm$ 1.39	-0.682	0.498
Donate non-perishable food for the needy	2.94 $\pm$ 1.47	3.11 $\pm$ 1.49	0.384	0.703
Trade Journals				
	YES (n=37)	NO (n=26)	t	P
Send food scraps to composting site (s)	3.90 $\pm$ 1.30	4.27 $\pm$ 0.94	1.139	0.260
Use a food pulper to reduce the volume of the food waste	3.68 $\pm$ 1.30	4.25 $\pm$ 0.99	1.791	0.079
Use garbage disposals to dispose food to sewage system	3.66 $\pm$ 1.33	3.58 $\pm$ 1.56	-0.195	0.846
Donate prepared food for the needy such as local food banks	3.26 $\pm$ 1.54	3.63 $\pm$ 1.47	0.893	0.376
Send food waste to landfill along with other solid waste	3.19 $\pm$ 1.31	3.52 $\pm$ 1.53	0.892	0.376
Donate food scraps to farmers for animal feed	3.03 $\pm$ 1.34	3.23 $\pm$ 1.19	0.559	0.578
Donate non-perishable food for the needy	2.97 $\pm$ 1.45	3.05 $\pm$ 1.53	0.186	0.853

Likeliness scales: 1, very unlikely; 2, unlikely; 3, unsure; 4, likely; 5, very likely

Statistical significance was analyzed by t-test.; SD = Standard Deviation

Perceptions of Barriers Regarding Food Waste Management

College and university foodservice administrators were asked their level of agreement regarding 19 statements relating to barriers concerning food waste management based on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The statements on focus were divided into four groups: operational management, financial resources and administrative support, waste disposal methods, motivation and public image.

Overall, college and university foodservice administrators showed a tendency not to agree with these statements representing barriers to food waste management. Statements with the highest level of agreement were: (a) we have very limited space to store food items for donation (3.68 ± 1.16), (b) government regulations do not require us to have a specific food waste management program (3.49 ± 0.86), and (c) employees/customers do not like to separate food waste from soiled dishes and packaging (3.29 ± 1.07). Administrators also tended to agree with the statement “the public image of our organization is an important influence on how we manage our food waste” (3.75 ± 1.08) (See Table 19).

Type of management. Student t-tests showed that foodservice administrators working at contract managed foodservice operations had significantly higher level of agreement with the statement related to liability issues ($P=0.025$), “our operation does not donate foods to nonprofit organizations because of potential liability issues” than those working at self-operated foodservice operations. There were no significant differences

in foodservice administrators' perceptions for other barriers regarding food waste management based on type of management (See Table 20).

Table 19

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management

	n	Mean $\pm$ SD
Operational Management		
We have very limited space to store food items for donation.	60	3.68 $\pm$ 1.16
Employees/customers do not like to separate food waste from soiled dishes and packaging.	63	3.29 $\pm$ 1.07
Our operation does not donate foods to nonprofit organizations because of potential liability issues.	63	2.95 $\pm$ 1.28
We were overwhelmed with the complicated government requirements for food waste programs.	60	2.75 $\pm$ 0.88
Lack of resources about food waste management discouraged us.	63	2.71 $\pm$ 1.01
We are satisfied with our current food waste program.	63	2.57 $\pm$ 1.00
Food waste management is not a current priority issue in our operation.	63	2.25 $\pm$ 1.05
The amount of food waste from our operation is not enough to implement a specific food waste management plan.	63	2.13 $\pm$ 0.89
Financial Resources and Administrative Support		
We do not have the financial resources to initiate a food waste program in our operation.	63	2.94 $\pm$ 1.08
We do not have enough staff to initiate a food waste management program.	63	2.51 $\pm$ 1.01
My administrators (or headquarters) are not willing to support a food waste management program.	63	2.44 $\pm$ 0.93
We do not see the cost benefits of a food waste program .	63	2.37 $\pm$ 0.96

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree
SD = Standard Deviation

Table 19 (*continued*)*College and University Foodservice Administrators' Perceptions of Barriers
Regarding Food Waste Management*

	n	Mean $\pm$ SD
Waste Disposal Methods		
We do not want to have equipment such as a pulper because of equipment maintenance.	63	2.37 $\pm$ 1.07
We cannot use garbage disposals because of high sewer taxes and/or state law.	63	2.24 $\pm$ 0.98
Composting affects the environment through contamination of water and air.	60	2.12 $\pm$ 0.85
Motivation		
Government regulations do not require us to have a specific food waste management program.	63	3.49 $\pm$ 0.86
We tried several methods to reduce food waste in the past, but none of them were successful.	63	2.32 $\pm$ 0.69
The impact of food waste disposal on the environment is not our concern	63	1.60 $\pm$ 0.64
Public Image		
The public image of our organization is an important influence on how we manage our food waste.	63	3.75 $\pm$ 1.08

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree
SD = Standard Deviation

Table 20

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management according to Type of Management (N=61)

	Type of Management		t	P
	Contract-Managed (n=20)	Self-Operated (n=41)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Operational Management				
We have very limited space to store food items for donation.	3.84 $\pm$ 1.02	3.56 $\pm$ 1.23	0.852	0.367
Employees/customers do not like to separate food waste from soiled dishes and packaging	3.50 $\pm$ 1.15	3.17 $\pm$ 1.00	1.152	0.254
Our operation does not donate foods to nonprofit organizations because of potential liability issues	3.47 $\pm$ 1.31	2.67 $\pm$ 1.22	2.309	0.025*
We were overwhelmed with the complicated government requirements for food waste programs.	2.95 $\pm$ 0.78	2.56 $\pm$ 0.82	1.696	0.095
Lack of resources about food waste management discouraged us.	2.60 $\pm$ 1.00	2.76 $\pm$ 1.02	-0.566	0.574
We are satisfied with our current food waste program.	2.65 $\pm$ 0.99	2.46 $\pm$ 0.98	0.698	0.488
Food waste management is not a current priority issue in our operation	2.25 $\pm$ 1.07	2.29 $\pm$ 1.06	-0.148	0.883
The amount of food waste from our operation is not enough to implement a specific food waste management plan.	2.25 $\pm$ 1.07	2.29 $\pm$ 1.06	-0.594	0.555
Financial Resources and Administrative Support				
We do not have the financial resources to initiate a food waste program in our operation.	2.85 $\pm$ 1.09	2.98 $\pm$ 1.08	-0.424	0.673
We do not have enough staff to initiate a food waste management program.	2.45 $\pm$ 1.05	2.49 $\pm$ 1.00	-0.136	0.892
My administrators (or headquarters) are not willing to support a food waste management program.	2.30 $\pm$ 0.87	2.54 $\pm$ 0.98	-0.920	0.361
We do not see the cost benefits of a food waste program (s).	2.30 $\pm$ 0.98	2.41 $\pm$ 0.97	-0.431	0.668

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree

* Statistical significance at P value $\leq$ 0.05 by student t-test.

SD = Standard Deviation

Table 20 (continued)

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management according to Type of Management (N=61)

	Type of Management		t	P
	Contract-Managed (n=20)	Self-Operated (n=41)		
	Mean $\pm$ SD	Mean $\pm$ SD		
Waste Disposal Methods				
We do not want to have equipment such as a pulper because of equipment maintenance.	2.70 $\pm$ 1.13	2.24 $\pm$ 1.02	1.584	0.119
We cannot use garbage disposals because of high sewer taxes and/or state law.	2.20 $\pm$ 0.83	2.27 $\pm$ 1.07	-0.250	0.804
Composting affects the environment through contamination of water and air.	2.00 $\pm$ 0.88	2.08 $\pm$ 0.70	-0.359	0.721
Motivation				
Government regulations do not require us to have a specific food waste management program.	3.35 $\pm$ 1.04	3.56 $\pm$ 0.78	-0.889	0.378
We tried several methods to reduce food waste in the past, but none of them were successful.	2.15 $\pm$ 0.59	2.37 $\pm$ 0.70	-1.191	0.239
The impact of food waste disposal on the environment is not our concern	1.55 $\pm$ 0.61	1.61 $\pm$ 0.67	-0.339	0.736
Public Image				
The public image of our organization is an important influence on how we manage our food waste.	3.80 $\pm$ 1.11	3.76 $\pm$ 1.07	0.149	0.882

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree

Statistical significance was analyzed by student t-test.

SD = Standard Deviation

Number of meals served weekly. Analysis of variance using Scheffé's method showed several significant differences in college and university foodservice administrators' agreement on barrier statements regarding food waste management based on numbers of meals served weekly. College and university foodservice operations serving 5,999 or fewer meals per week had significantly stronger agreement with the statement, "our operation does not donate foods to nonprofit organizations because of potential liability issues" than those serving 40,000 or more meals served per week (See Table 21).

College and university foodservice administrators serving from 6,000 to 15,000 meals per week more strongly agreed with a statement related to financial resources, "we do not have the financial resources to initiate a food waste program in our operation" than those serving 40,000 or more number of meals served per week. Administrators at foodservice operations serving a smaller number of meals per week tended to have higher level of agreement with the statement related to lack of resources. On the other hand, college and university foodservice operations serving 40,000 or more meals per week more strongly agreed with a statement related to food waste disposal methods, "we cannot use garbage disposals because of high sewer taxes and/or state law" than those serving from 6,000 to 15,000 meals per week. There was no significant difference in college and university foodservice administrators' agreement with the statements related to motivation and public image related to number of meals served (See Table 21).

Table 21

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management according to Number of Meals Served Weekly (N=62)

	Number of Meals Served Weekly				F	P
	≤ 5,999 (n=14)	6,000-14,999 (n=16)	15,000-39,999 (n=17)	≥ 40,000 (n=15)		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		
Operational Management						
We have very limited space to store food items for donation.	3.86 ± 1.23	3.40 ± 0.99	3.87 ± 1.25	3.60 ± 1.24	0.534	0.661
Employees/customers do not like to separate food waste from soiled dishes and packaging	3.57 ± 1.16	3.50 ± 1.03	3.06 ± 1.14	3.13 ± 0.92	0.899	0.447
Our operation does not donate foods to nonprofit organizations because of potential liability issues	3.64 ± 1.15 ^a	3.00 ± 1.46 ^{ab}	3.07 ± 1.28 ^{ab}	2.27 ± 0.80 ^b	3.223	0.029 [*]
We were overwhelmed with the complicated government requirements for food waste programs.	2.86 ± 0.86	2.87 ± 0.83	2.60 ± 1.12	2.67 ± 0.72	0.333	0.802
Lack of resources about food waste management discouraged us.	2.79 ± 0.98	2.81 ± 1.05	2.59 ± 1.00	2.80 ± 1.01	0.182	0.908
We are satisfied with our current food waste program.	2.71 ± 1.14	2.56 ± 1.15	2.53 ± 0.62	2.33 ± 0.90	0.381	0.767
Food waste management is not a current priority issue in our operation	2.36 ± 1.28	2.37 ± 1.26	2.24 ± 1.03	2.13 ± 0.52	0.171	0.915
The amount of food waste from our operation is not enough to implement a specific food waste management plan.	2.07 ± 0.83	2.19 ± 1.05	2.24 ± 0.97	2.07 ± 0.70	0.137	0.938

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree

* Statistical significance at P value ≤ 0.05 by ANOVA with multiple comparisons using Scheffé's method; Different alphabetic superscript letters are significantly different from each other (P ≤ 0.05 between groups, ANOVA); SD = Standard Deviation

Table 21 (continued)

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management according to Number of Meals Served Weekly (N=62)

	Number of Meals Served Weekly				F	P
	≤ 5,999 (n=14)	6,000-14,999 (n=16)	15,000-39,999 (n=17)	≥ 40,000 (n=15)		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		
Financial Resources and Administrative Support						
We do not have the financial resources to initiate a food waste program in our operation.	3.21 ± 0.98 ^{ab}	3.44 ± 1.09 ^a	2.65 ± 1.12 ^{ac}	2.47 ± 0.92 ^b	3.070	0.035*
We do not have enough staff to initiate a food waste management program.	2.71 ± 0.99	2.81 ± 0.98	2.24 ± 1.03	2.40 ± 0.99	1.162	0.332
My administrators (or headquarters) are not willing to support a food waste management program.	2.71 ± 0.91	2.62 ± 0.89	2.24 ± 0.90	2.33 ± 0.98	0.961	0.417
We do not see the cost benefits of a food waste program (s).	2.36 ± 0.84	2.56 ± 1.03	2.18 ± 0.88	2.47 ± 1.06	0.491	0.690
Waste Disposal Methods						
We do not want to have equipment such as a pulper because of equipment maintenance.	2.14 ± 0.77	2.56 ± 1.15	2.00 ± 1.12	2.73 ± 1.10	1.679	0.182
We cannot use garbage disposals because of high sewer taxes and/or state law.	2.00 ± 0.56 ^{ab}	1.87 ± 0.62 ^a	2.29 ± 1.16 ^{ab}	2.80 ± 1.21 ^b	2.877	0.044*
Composting affects the environment through contamination of water and air.	2.21 ± 1.12	2.07 ± 0.80	2.07 ± 0.80	2.20 ± 0.68	0.132	0.941

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree

* Statistical significance at P value ≤ 0.05 by ANOVA with multiple comparisons using Scheffé's method; Different alphabetic superscript letters are significantly different from each other (P ≤ 0.05 between groups, ANOVA); SD = Standard Deviation

Table 21 (continued)

College and University Foodservice Administrators' Perceptions of Barriers Regarding Food Waste Management according to Number of Meals Served Weekly (N=62)

	Number of Meals Served Weekly				F	P
	≤ 5,999 (n=14)	6,000-14,999 (n=16)	15,000-39,999 (n=17)	≥ 40,000 (n=15)		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		
Motivation						
Government regulations do not require us to have a specific food waste management program.	3.57 ± 0.85	3.62 ± 0.96	3.47 ± 0.87	3.40 ± 0.74	0.211	0.888
We tried several methods to reduce food waste in the past, but none of them were successful.	2.36 ± 0.75	2.56 ± 0.63	2.12 ± 0.60	2.27 ± 0.80	1.179	0.326
The impact of food waste disposal on the environment is not our concern	1.86 ± 0.77	1.44 ± 0.51	1.47 ± 0.62	1.73 ± 0.59	1.601	0.199
Public Image						
The public image of our organization is an important influence on how we manage our food waste.	2.14 ± 0.77	2.56 ± 1.15	2.00 ± 1.12	2.73 ± 1.10	0.023	0.995

Scales: 1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree

Statistical analysis conducted by ANOVA with multiple comparisons using Scheffé's method; SD = Standard Deviation

CHAPTER V

DISCUSSION AND CONCLUSIONS

Discussion

This study was designed to investigate the current food waste management in college and university foodservice operations, foodservice administrators' attitudes toward food waste management, and the barriers in making decisions regarding food waste management. In order to determine differences in possible key factors impacting decision making on food waste programs, we examined the following independent variables: type of management, existence of residential area, number of meals served, type of meal plan, type of food production, and source of information about food waste management. Independent variables were categorized into (a) foodservice management activities to reduce food waste, (b) effective food waste disposal methods previously used and (c) barriers regarding food waste management.

Foodservice operations at which respondents were employed provided an average of 28,720 meals per week. Three of the operations served more than 100,000 meals per week, which increased the average number of meals served. The frequency and cost for collecting food waste was almost the same as frequency and cost for collecting package waste. However, the weight of food waste collected per month was four times heavier than package waste, whereas the volume of food waste collected a month was only one twentieth of the volume of package waste. The mean weight and volume for food and

package waste in this study was very similar to a previous study in a continuing care retirement community (Hacks, Shanklin, Kim et al. 1997). Pilot study participants also stated that they only counted the number of times the dumpster was emptied and the cost for a waste contract management company to collect waste.

Foodservice management activities to reduce food waste such as accurate forecasting of food production are considered effective ways to reduce food waste from foodservice operations (Harmon & Gerald, 2007). Among the activities listed in our survey, educating customers was thought most likely to reduce food waste from the foodservice operations. Previous research on trayless dining environments showed a significant reduction in food waste from foodservice operations (Aramark, 2008; Meltzer & Stumpf, 2008). During focus group discussions, participants from Aramark Corporation commented that consumer education should be planned to encourage trayless programs in foodservice operations. However, there was no significant difference in college and university foodservice administrators' perceptions for educating customers to reduce food waste related to any of the independent variables used in this study. This may be because trayless service is a relatively new concept in foodservice operations and not all focus group participants were delegates of the National Association of College and University Foodservice (NACUFS).

Modifying food production practices and using computer programs for accurate forecasting were perceived as the next most likely activities to reduce food waste by college and university foodservice administrators. These two foodservice management

activities were also emphasized in focus group discussion. Focus group discussion participants stated that frequent cooking of small batch size and accurate forecasting depending on either computer programs or history were also helpful in reducing food waste from the operations. In the national survey, these foodservice activities were considered more likely to reduce food waste by college and university foodservice administrators working at operations serving from 15,000 to 39,999 meals per week compared to those serving less than 5,999 meals per week. Interestingly, college and university foodservice administrators serving more than 40,000 meals per week showed a tendency of believing that most foodservice activities including these two were less likely to reduce food waste from the operations than those administrators at operations serving from 15,000 to 39,999 meals per week. It is possible that foodservice administrators at colleges and universities serving large number of meals might not be actively involved in food production at their campuses.

There was no significant difference in college and university foodservice administrators' perceptions of using employee training, service method change and menu adjustment to reduce food waste according to any of the independent variables used in this study. However, college and university foodservice administrators having cook to serve and cook to order types of food production showed a tendency of believing that changing service methods such as implementing trayless dining and charging by item in the cafeteria might be more likely to reduce food waste. Foodservice administrators at operations with residential dining halls also tended to believe changing service methods

might be more likely to reduce food waste. Foodservice administrators obtaining information about food waste management from government web pages were more likely to believe that menu adjustment would reduce food waste.

Adjusting portion sizes was perceived as a significant foodservice activity to reduce food waste by foodservice administrators who offered cash-based inclining/declining balance meal plans to their student customers. On the other hand, foodservice administrators offering traditional meal plans tended to believe that adjusting portion sizes might be less likely to reduce food waste from the operation. Traditional meal plans offer a certain number of meals per week, month or semester. Most college and university foodservice operations offering traditional meal plans provide an “all you can eat” type of cafeteria. “All you can eat” type of service allows customers to take as much food as they wish, which frequently results in a large amount of food waste from the operation. Students purchasing cash-based inclining/declining balance meal plans can also purchase meals at “all you can eat” type cafeteria, but they are not mandated to go to the cafeteria a certain number of times per week. They can also use their meal plans for a la carte menu items and to-go food items, which may allow foodservice operations to have better control over portion sizes.

Placing a trash bin to collect food waste was mentioned during the focus group discussion. However, survey results showed that use of a trash bin to collect food waste was perceived as more likely to reduce food waste only by foodservice administrators

who obtained information about a food waste management from a waste contract management company.

College and university foodservice administrators' perceptions of the effectiveness of food waste disposal methods ranged from 3.00 to 4.06 (unsure to likely), whereas their perceptions of likeliness of foodservice management activities to reduce food waste ranged from 3.61 to 4.51 (likely to very likely). Therefore, it appears that foodservice administrators were more knowledgeable and confident that foodservice management activities could reduce food waste than they were confident that food waste disposal methods could be effective.

Composting is one of the food waste disposal methods that has dramatically increased in the United States since 1985 (Miller, 2007). Although disadvantages of composting were mentioned such as possible contamination of water and air (Department of HRIM, 2002), foodservice administrators in this study did not agree that composting affects the environment through contamination of water and air (2.12 ± 0.85).

In the focus group discussions, composting was one of the recommended food waste disposal methods. In the national survey, college and university foodservice administrators also perceived composting as the most likely effective method of food waste disposal (4.06 ± 1.17). However, the limited space to hold food scraps in foodservice operations seemed to be a major barrier (3.68 ± 1.16). Interestingly, foodservice administrators who obtained information from a waste contract management company perceived sending food scraps to composting sites more likely to be effective in

reducing food waste. Waste contract management companies may be helpful in solving a major barrier related to limited space to store food waste by frequently picking up food scraps or providing containers for collecting food waste.

The EPA recommended a hierarchy of food waste management methods ranging from source reduction, feed hungry people, feed animals, industrial use, composting to landfill in order (EPA, 2009). Using a pulper or a garbage disposal was suggested as a method for source reduction. College and university foodservice administrators thought using a pulper and garbage disposal would be likely to reduce food waste in foodservice operations. In focus group discussions, however, using a pulper was not the first choice for foodservice operations because of the maintenance of equipment. Some foodservice administrators commented that pulper equipment requires high maintenance and they did not plan to use one again. Inconsistent to those comments, foodservice administrators who completed the survey thought that using a pulper and garbage disposal would be likely to reduce food waste (3.93 ± 1.20 and 3.63 ± 1.41 , respectively) and that problems possibly caused by these methods were less likely to be barriers regarding food waste management (2.37 ± 1.07 and 2.24 ± 0.98 , respectively).

College and university foodservice administrators who were 49 years of age or younger perceived food disposal as a more likely way to reduce food waste from the operations. On the other hand, those serving 40,000 or more meals per week tended to disagree less with the statement (2.80 ± 1.21), “we cannot use garbage disposals because of high sewer taxes and/or state law”, than those serving from 6,000 to 14,999 meals per

week (1.87 ± 1.07). This result may be related to the amount of food waste produced in college and university foodservice operations because a higher amount of food waste would result in additional cost for sewer fees. This result may also be related to the fact that a higher number of college and university foodservice administrators older than 50 years fell into the group serving a greater number of meals in their operations.

College and university foodservice administrators working in contract managed operations perceived that donating prepared food for the needy such as to local food banks was less likely to be an effective method of disposing of food waste. Consistent with these results, they also agreed more strongly with a statement regarding the liability issue related to donating foods, “our operation does not donate foods to nonprofit organizations because of potential liability issues”. The liability issues related to donating foods were also clearly stated in focus group discussion by one of foodservice administrators working at contract managed operations. Contract foodservice operations are managed by professional foodservice contract company such as Aramark, Sodexo and Compass. Due to the large volume of business and contract management, these contract companies tend to tightly monitor productivity and liabilities. Their activities are also closely related to their success in continuing contract management with colleges and universities where they have contracts (Aramark Risk Management, 2008).

Landfill is the least recommended waste disposal method by EPA (EPA, 2009). College and university foodservice administrators perceived landfills as less likely to be effective for food waste disposal than several other methods including composting, use of

food pulper, garbage disposal and food donation. College and university foodservice administrators working at operations with residential dining halls thought that landfill was less likely to be effective in reducing food waste than those operations with no residential dining halls. Landfill was also considered less likely to be effective in reducing food waste by foodservice administrators who used cook chill type of food production and obtained information about food waste management from college and university web pages than counterparts.

Unlike recycling programs for non-food items, food waste management has not been extensively implemented in foodservice operations. The previous report by the Center for Ecological Technology (CET) and Massachusetts Department of Environmental Protection (DEP) stated several barriers such as limited access to the processing site, training issues, the nature of food waste, inconsistent governmental and financial support and no proactive governmental requirements (CET, 1999).

Foodservice administrators in this study were asked their opinions about these barriers. Limited space to store food items for donation was more strongly believed to be a barrier out of eight statements describing barriers in operational management. The liability issue also was clearly considered as a barrier by foodservice administrators working in contract managed operations (3.47 ± 1.31) compared to self-operated operations (2.67 ± 1.22). The liability issues related to food donation were more strongly perceived as barriers by foodservice administrators serving less than 5,999 meals per week (3.64 ± 1.15) than those serving more than 40,000 meals per week (2.27 ± 0.80).

Foodservice administrators working in small size foodservice operations would not be able to receive much support for possible legal issues, and, therefore, do not want to be involved in a lawsuit (Aramark Risk Management, 2008).

Lack of financial resources to initiate a food waste program was more strongly perceived to be a barrier than other statements concerning financial resources and/or administrative support. Lack of resources to initiate a food waste program in foodservice operations was more strongly perceived as a barrier by foodservice administrators serving less than 5,999 meals per week (3.21 ± 0.98) compared to those serving more than 40,000 meals per week (2.47 ± 0.92). Compared to large size operations, those working in small size foodservice operations might not have enough financial resources to implement a new project such as a food waste disposal program, which would be a barrier regarding food waste management.

None of the three statements regarding waste disposal methods of a food pulper, garbage disposal and composting were considered barriers by foodservice administrators in this study. However, foodservice administrators serving 40,000 or more meals per week had neutral opinions (2.80 ± 1.21) regarding barriers such as use of garbage disposals, whereas those serving from 6,000 to 14,999 meals per week disagreed (1.87 ± 1.07) this was a barrier. This result might be related to the large amount of food waste produced in these foodservice operations resulting in higher expenses for sewer use.

Statements for motivation were related to government regulation, success or failure in the past and belief about impact of food waste disposal on environment. The difficulty of following the changes in government regulation was mentioned as a barrier in focus group discussions when donating food scraps to farmers for animal feed. A report from the Center for Ecological Technology in collaboration with the Massachusetts Department of Environmental Protection also mentioned that no strong vision or proactive actions from state government as one of barriers to executing food waste programs (CET, 1999). In this study, the statement related to governmental requirements, “government regulations do not require us to have a specific food waste management program” was strongly considered (3.49 ± 0.86) a barrier under the category of motivation.

Overall, college and university foodservice administrators tended not to agree with most statements on barriers regarding food waste management except those that focused on liability issue, lack of financial resources and high sewer fees regarding food waste management. However, foodservice administrators agreed that public image of foodservice operations was an important influence on how they managed food waste in their operations.

Conclusions

To the knowledge of the researchers, food waste management in foodservice operations is one of the least researched areas related to improving environmental sustainability even though food waste is closely related to the increased food costs in

operations. Through focus group discussions and a national survey, this study was able to determine opinions of a small group of college and university foodservice administrators regarding foodservice activities and methods of food waste disposal that could effectively reduce the amount of food waste in foodservice operations. Their perceptions regarding barriers to foodservice management were also investigated. Even though data from only a small number of respondents was available, this study was able to identify several foodservice activities and food disposal methods that administrators believed would be likely to reduce food waste at college and university foodservice operations. This study was also able to determine significant differences in foodservice administrators' perceptions of likeliness of foodservice activities and food disposal methods according to type of management, meal plan and food production, existence of residence area, number of meals served, and source of information about food waste management.

Limitations

The low response rate for this study with only 63 respondents was the biggest limitation. The initial estimation of minimum sample size was 125 data, but statistical analyses for several variables such as type of food production and source of information about food waste management were not made due to the small number of data collected for national survey. A second limitation was that voting delegates of the National Association of College and University Food Services (NACUFS) were not all foodservice directors or operating managers, which might have contributed to the low

response rate and possibly inaccurate information about characteristics of foodservice operations. For example, some of their titles were Associate Vice President of Business Operations, Associate Dean of Students, Contract Administrator, Vice President Student Affairs and Vice President of Finance and Administration. Researchers dealt with this possible problem by asking the recipient of the survey to pass it on to the foodservice director if they did not have knowledge of the foodservice operation. The NACUFS delegates can also not be considered a representative group for college and university foodservice operations. Of 6,441 colleges and universities in the United States (National Center for Education Statistics, 2007), only about 10% of college and university foodservice administrators join NACUFS. Therefore, the results from this study may not represent all college and university foodservice operations.

Recommendations

These study results may provide a glimpse into food waste management practices and waste disposal methods in college and university foodservice operations. Most foodservice administrators indicated they were interested in solid and food waste management. However, they appeared to have different attitudes regarding food waste management based on their demographic characteristics and that of their operations. Results from this study can provide guidelines for governmental or educational agencies to develop user friendly materials for foodservice operations.

Resources to support food waste disposal methods will vary according to the size of the college and university foodservice operation and type of management. The

feasibility of using some food waste disposal methods such as composting, donation of food scraps to farmers and donation of foods to the needy may depend upon size of operation and location. Therefore, foodservice administrators should be well informed prior to implementing any food waste management programs. Each administrator also should select effective methods of food waste management to suit their operation based upon available resources.

In future studies, researchers should simplify and clarify questions regarding foodservice management activities and food waste disposal methods in order to have a greater response rate for the survey. Also, the terms used for type of meal plan, type of food production and source of information about food waste management should be clearly defined in the survey so participants in the future study will understand questions well and answer them accordingly.

Further study with a larger number of colleges and universities should be conducted to verify and identify the accuracy and reliability of the results in this study. In order to have more participants, researchers will need contact information of foodservice directors who are more closely responsible for managing foodservice operations. Secondly, future study should focus on prioritizing foodservice activities, food waste disposal methods and barriers regarding food waste management. Thirdly, food waste management research should also be expanded to school and healthcare foodservice operations. The factors affecting the perceptions, practices and barriers regarding food waste management would likely be different in school or healthcare

foodservice operations compared to the factors in college and university foodservice operations.

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APPENDIX A

Approval of the Study from Institutional Review Board



Institutional Review Board

Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378 Fax 940-898-3416
e-mail: IRB@twu.edu

June 6, 2008

Dr. Sockju Kwon

Dear Dr. Kwon:

Re: Investigating Food Waste Management in College and University Foodservice Operations

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and appears to meet our requirements for the protection of individuals' rights.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. A copy of the approved consent form with the IRB approval stamp and a copy of the annual/final report are enclosed. Please use the consent form with the most recent approval date stamp when obtaining consent from your participants. The signed consent forms and final report must be filed with the Institutional Review Board at the completion of the study.

This approval is valid one year from June 6, 2008. According to regulations from the Department of Health and Human Services, another review by the IRB is required if your project changes in any way, and the IRB must be notified immediately regarding any adverse events. If you have any questions, feel free to call the TWU Institutional Review Board.

Sincerely,

Dr. David Nichols, Chair
Institutional Review Board - Denton

enc.

cc. Dr. Chandan Prasad, Department of Nutrition & Food Sciences
Dr. Carolyn Bednar, Department of Nutrition & Food Sciences
Ms. Jane Graham, Research Compliance Coordinator, Research & Sponsored Programs
Graduate School

APPENDIX B

Focus Group Questioning Route

Focus Group Questioning Route

“Investigating food waste management in college and university foodservice operations”

Objectives:

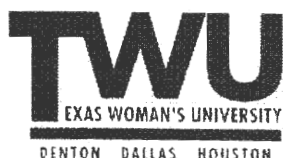
- to obtain the previous and present experience about food waste management
- to collect the pros and cons of each method from participants’ experience
- to evaluate the attitudes and barriers of foodservice directors regarding food waste management

Questions and time-line

Categories	Questions		Time-line
Opening	1. Tell us your name and briefly describe your foodservice operation.		5 mins
Introductory	2. How do you manage food waste from your operation now?		5 mins
Transition	3. Think back to your previous experience of food waste management. What method do you think was the most successful and why?	6. Think back to your previous experience of food waste management. What method do you think was not recommendable and why?	8 mins each
Discussion Questions	4. What were the advantages of the method? 5. What would you recommend to modify the method?	7. What were the disadvantages of the method? 8. What would you recommend to modify the method?	5 mins each
Ending Questions	9. If you have to implement a new food waste program, which method would you use and why? 10. Is there anything you want to make comments about food waste management?		8 mins

APPENDIX C

Cover Letter



Department of Nutrition and Food Sciences
P.O. Box 425888, Denton, TX 76204-5888
940-898-2636 Fax 940-898-2634

February 10, 2009

Dear Foodservice Administrator:

You are invited to participate in a national survey focusing on food waste management in college and university foodservice (CUFS) operations. This study is supported by a grant from the Foodservice Systems management Education Council (FSMEC). The purpose of this study is to investigate the present status of food waste management in CUFS, foodservice administrators' attitudes toward food waste management, and barriers against making decisions regarding food waste management.

We would like to obtain information on your foodservice operation including the type of food waste and packaging waste generated. We are also requesting your opinions on various practices that would affect food waste management. **If you do not have access to specific information on food waste management at your facility, please ask your foodservice manager to complete this survey.**

Your name, E-mail address, and operation were obtained from the members' directory of the National Association of College and University Food Service. Participation in this survey is completely voluntary, and you may withdraw your participation from the study at any time without penalty. Direct benefits of participating in the survey will be a \$5.00 gift certificate of either Target or Starbucks. Also a summary of the study results will be sent within 6 months of completion of the research project.

If you would like to participate, please complete this survey **by Feb 20, 2009** and send the result back to us. **An electronic version of questionnaire is also available at <https://www.psychdata.com/s.asp?SID=127724>.** You can register your e-mail for the questionnaire and come back to complete rest of the survey if you would. Completion of this survey should take no longer than 20 minutes.

If you have questions about this research study, you should ask the researchers; their phone numbers are at the bottom of this form. If you have questions about your rights as a participant in this research or the way this study has been conducted, you may contact the Texas Woman's University Office of Research and Sponsored Programs at 940-898-3378 or via e-mail at IRB@twu.edu.

Your participation will be highly appreciated.

Sincerely,

Sockju Kwon, Ph.D.
Graduate Student

Carolyn M. Bednar, Ph.D., R.D., L.D.
Professor

APPENDIX D

Mailed Survey Questionnaire

The return of your completed questionnaires is considered as your informed consent to act as a participant in this research.

Investigating Food Waste Management in College and University Foodservice Operations

Department of Nutrition and Food Sciences, Texas Woman's University

February 2009

Part A: Please answer these questions about your foodservice operation.

1. What is the average number of meals or meal equivalents served per week excluding catering events?
_____ meals/week

2. If you have catering service, what is the average number of meal events and meals per week?
_____ events/week or _____ meals/week

****Beginning with Question 3, please answer based on the number of meals produced (your answer above).**

3. Which one is predominantly used for your facility?

- ☐ Self-operated
- ☐ Contract managed
- ☐ Combination of self-operated and contract managed
- ☐ Other (Please specify): _____

4. Do you have a Residential dining area?

- ☐ Yes
- ☐ No

If yes, what is the estimated sales volume (%) from the residential dining area(s)? _____ %

5. What kind of meal plans do you provide for students?

(Please check all apply)

- ☐ Traditional meal plan (ex. set # of meals per week or per semester)
- ☐ Cash-based declining/inclining meal plan (ex. cash deposit, credit card)
- ☐ Combination of both plans
- ☐ Other (Please specify): _____

6. Please indicate types of production you have in your facility. (Please check all apply)

- ☐ Cook to serve
- ☐ Cook to order
- ☐ Cook-chill (Cook-freeze)
- ☐ Assembly serve
- ☐ Other (Please specify): _____

7. Please provide an estimated value for each question regarding waste from your facility.

	Food waste	Packaging waste
The frequency of waste collection	_____ times per week	_____ times per week
Estimated cost for waste removal	\$_____ per month	\$_____ per month
Estimated amount of waste per month	_____ lbs or _____ cu ft	_____ lbs or _____ cu ft

Part B: Please answer these questions about yourself as a foodservice director.

8. Gender: ☐ Male ☐ Female

9. Range of age ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 and higher

10. How long have you worked for this college/university operation? _____ Years _____ Months

11. How long have you worked in food service operations in total? _____ Years _____ Months

12. What is the highest level of education you have obtained?

- ☐ Associate Degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctoral degree
- ☐ Other (Please specify)

13. Where do you obtain information about food waste management options (please check all that apply)?

- ☐ I do not obtain any information about food waste management
☐ Governmental web pages ☐ College and university web pages
☐ Waste contract Management Company ☐ Professional journals
☐ Trade journals ☐ Other (Please specify): _____

14. How much are you interested in waste management in your facility? (please indicate 1 for not interested at all and 5 for very interested)

Not interested at all Very Interested
 Solid Waste Management: ----- 1 ----- 2 ----- 3 ----- 4 ----- 5 -----
 Food Waste Management: ----- 1 ----- 2 ----- 3 ----- 4 ----- 5 -----

Part C: Please answer these questions about food waste management at your facility.

15. The following foodservice activities could reduce the amount of food waste from a college/university foodservice operation. How likely would the following activities be to reduce food waste at your college/university foodservice operation. Please check appropriate one for each activity. (If you did not use these activities in the past or do not use now, please select N/A)

	Very unlikely	Unlikely	Unsure	Likely	Very likely	N/A
1) Change menu planning to reduce food waste (ex. reduce number of menu items produced, reduce portion size)	☐	☐	☐	☐	☐	☐
2) Modify food production practices to reduce food waste (ex. change to small batch size, improve use of leftovers)	☐	☐	☐	☐	☐	☐
3) Use a computer program to have accurate forecasting and managing food production	☐	☐	☐	☐	☐	☐
4) Change service methods to reduce food waste (ex. trayless, charge by item style cafeteria)	☐	☐	☐	☐	☐	☐
5) Adjust portion sizes to reduce food waste	☐	☐	☐	☐	☐	☐
6) Educate customers to reduce food waste	☐	☐	☐	☐	☐	☐
7) Train employees to separate food waste and packaging (ex. animal feeds, composting)	☐	☐	☐	☐	☐	☐
8) Put a trash bin to collect food scraps for food waste program (ex. animal feeds, composting)	☐	☐	☐	☐	☐	☐
9) Other (Please specify): _____	☐	☐	☐	☐	☐	☐

16. Based on your experience, which of the following are likely to be effective methods of food waste disposal for college/university foodservice operations? Please check appropriate one based on likeliness to be effective for each program. (If you did not use programs in the past or do not use currently at your facility, please check N/A)

	Very unlikely	Unlikely	Unsure	Likely	Very likely	N/A
1) Donate prepared food (ex. hot or cold foods) for the needy such as local food banks	☐	☐	☐	☐	☐	☐
2) Donate non-perishable food (ex. canned products) for the needy	☐	☐	☐	☐	☐	☐
3) Donate food scraps to farmers for animal feed	☐	☐	☐	☐	☐	☐
4) Send food scraps to composting site (s)	☐	☐	☐	☐	☐	☐
5) Use a food pulper to reduce the volume of the food waste	☐	☐	☐	☐	☐	☐
6) Use garbage disposals to dispose food to sewage system	☐	☐	☐	☐	☐	☐
7) Send food waste to landfill along with other solid waste	☐	☐	☐	☐	☐	☐
8) Other (Please specify): _____	☐	☐	☐	☐	☐	☐

Part D: Please answer these questions regarding the issues you may feel difficult in food waste management at your facility.

17. Please indicate your level of agreement with each statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1) The amount of food waste from our operation is not enough to implement a specific food waste management plan.	☐	☐	☐	☐	☐
2) We are satisfied with our current food waste program.	☐	☐	☐	☐	☐
3) Lack of resources about food waste management discouraged us.	☐	☐	☐	☐	☐
4) We do not see the cost benefits of a food waste program (s).	☐	☐	☐	☐	☐
5) We do not have the financial resources to initiate a food waste program in our operation.	☐	☐	☐	☐	☐
6) My administrators (or headquarters) are not willing to support a food waste management program.	☐	☐	☐	☐	☐
7) We do not have enough staff to initiate a food waste management program.	☐	☐	☐	☐	☐
8) Employees/customers do not like to separate food waste from soiled dishes and packaging	☐	☐	☐	☐	☐
9) We were overwhelmed with the complicated government requirements for food waste programs.	☐	☐	☐	☐	☐
10) Our operation does not donate foods to nonprofit organizations because of potential liability issues	☐	☐	☐	☐	☐
11) We have very limited space to store food items for donation.	☐	☐	☐	☐	☐
12) Composting affects the environment through contamination of water and air.	☐	☐	☐	☐	☐
13) We do not want to have equipment such as a pulper because of equipment maintenance.	☐	☐	☐	☐	☐
14) We cannot use garbage disposals because of high sewer taxes and/or state law.	☐	☐	☐	☐	☐
15) We tried several methods to reduce food waste in the past, but none of them were successful.	☐	☐	☐	☐	☐
16) The impact of food waste disposal on the environment is not our concern	☐	☐	☐	☐	☐
17) Government regulations do not require us to have a specific food waste management program.	☐	☐	☐	☐	☐
18) The public image of our organization is an important influence on how we manage our food waste.	☐	☐	☐	☐	☐
19) Food waste management is not a current priority issue in our operation.	☐	☐	☐	☐	☐

18. Please describe any difficulties that you may have had with food waste management activities in the past.

19. If your operation does not currently implement any of the following food waste management programs, which one would you prefer to start first? (please select only one):
- ☐ Donate cooked food to nonprofit organizations ☐ Donate canned or dry food to nonprofit organizations
☐ Donate food scraps to farmers for animal feed ☐ Send food scraps to composting site (s)
☐ Use a food pulper to reduce the volume of food waste ☐ Use garbage disposals to dispose foods to sewage system
☐ Other (Please specify): _____

20. Why did you choose this method as first? Please explain.

If you would you like to receive a \$5.00 gift card and summary of results, please fill out contact information.

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