

AN INVESTIGATION OF COLLEGE AND UNIVERSITY FOODSERVICE ADMINISTRATORS' PERCEPTIONS OF FOOD WASTE REDUCTION ACTIVITIES AND FOOD WASTE DISPOSAL METHODS

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ABSTRACT

This study was designed to investigate foodservice administrators' perceptions regarding food waste management (FWM) in college and university foodservice operations. Research methods included focus groups and a national survey. The survey questionnaire was developed based on focus groups and validated and pilot-tested before posting online. Sixty-three voting delegates of the National Association of College and University Food Services completed the survey. Educating customers about FWM and composting were selected as most likely to reduce food waste among food waste reduction activities and among food disposal methods, respectively. Results varied depending on management types, operation types, and information source about FWM.

Keywords: food waste management, college and university foodservice operations, composting, food waste disposal

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INTRODUCTION

Sustainability has become an important concept in today's society, and trends toward sustainability in colleges and universities 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 (Association for the Advancement of Sustainability in Higher Education [AASHE], 2009). RecycleMania, a national waste management competition among colleges and universities, is an example of a project that recycles municipal solid waste (MSW) generated from residence and dining halls on campuses (National Recycling Coalition, 2009). Trayless dining, a recent innovative concept in college and university foodservice operations, showed an effective reduction of 25 to 30% in food waste as well as savings in water and energy (Aramark Higher Education, 2008; Meltzer & Stumpf, 2008). Sarjahani, Serrano and Johnson (2009) recently reported that going trayless in an all-you-can-eat university dining facility serving 2,862 meals per day generated 5,829 pounds less of food waste and 1,111 pounds less of package waste in one week.

Since 1960, the total amount of MSW in the U.S. has increased dramatically. However, in 2008, less MSW was generated than in 2007. In 2008, about one third of MSW was, but only 2.5% of food waste was recycled (Environmental Protection Agency [EPA], 2009a). Unlike recycling programs for non-food items, food waste management has not been extensively implemented in foodservice

operations. A previous report by the Center for Ecological Technology and Massachusetts Department of Environmental Protection 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 (Center for Ecological Technology, 1999).

Land-filled food waste can produce methane gas that results in 21 times greater impact on global warming than carbon dioxide (EPA, 2009b). Unfortunately, most food scraps from homes and small foodservice operations are discarded in garbage bags and sent to landfills. A large quantity of food waste is generated from college and university foodservice operations, and such operations can offer the opportunity for other recommended methods of food recycling such as composting, donation of food to local food banks, or sale of food waste to farmers for animal feedings.

Due to the direct relationship between food waste and reduced profit in foodservice operations, most foodservice administrators are aware of the importance of food waste management in minimizing food expenditures (Gregoire, 2010). They may also be aware of its impact on enhancing environmental sustainability and the public image of operations. The literature includes several success stories about managing food waste from foodservice operations such as sending food waste to composting sites and recycling frying oil for biodiesel fuel (Buchthal, 2006; Miller, 2007).

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 study was designed to investigate college and university foodservice administrators' perceptions of management activities to reduce food waste and food waste disposal methods.

METHODS

Study Approval from Institutional Review Board

All methods used in this study were reviewed and approved by the Institutional Review Board at a University prior to commencing research activities.

Focus Group

Focus group methods (Edmunds, 1999) were used to obtain qualitative background information on the issue of food waste management in college and university foodservice operations. Foodservice administrators' contact information was collected from public web sites of colleges and universities in the Dallas, Fort Worth, and Houston areas. Foodservice administrators were recruited by e-

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mails and phone calls with priority placed on recruiting directors who had participated in the RecycleMania program. During the 45-60 minute focus group sessions, foodservice administrators were asked questions about practices and attitudes on food waste management. Participants were rewarded with a gift certificate for a national retailer following focus group discussions. Two focus group discussion sessions with a total of seven participants were conducted, recorded, transcribed verbatim, and analyzed to determine key messages.

Survey

Based on focus group results and a review of literature (Harmon & Gerald, 2007), the researchers developed a questionnaire that focused on (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, and (d) use of various food waste reduction activities to manage food waste. According to focus group results, questions were reduced to eight food waste management activities and seven food disposal methods. Some activities and methods were more strongly supported by some focus group participants than others, but due to the qualitative nature of the data, no attempt was made to draw further conclusions from the results. A likert-type 5-point scale ranging from 1 (very unlikely) to 5 (very likely) was used to measure administrator perceptions on the effectiveness of various foodservice activities to reduce food waste and waste disposal methods. In order to determine differences in possible key factors impacting decision making on food waste programs, the following independent variables were examined: type of management, existence of a residential dining area, number of meals served, type of meal plan, type of food production, and source of information about food waste management. The questionnaire was validated by three foodservice educators and two university foodservice administrators for content validity and readability. It was revised according to their suggestions and converted to an online survey form using PsychData (PsychData™ LLC, 2008, State College, PA).

A pilot-study was conducted with a convenience sample of 33 voting delegates of NACUFS in Texas and Oklahoma. Six administrators completed the online survey and verified the clarity and feasibility of the questions. Cronbach's alpha test was applied to evaluate the reliability of likert-type scale questions and those with alpha value higher than 0.8 were accepted. Cronbach's alpha test showed that sets of questions for foodservice activities to reduce the amount of food waste (Cronbach's $\alpha=0.928$) and questions regarding effectiveness of food waste disposal methods (Cronbach's $\alpha=0.860$) were reliable.

Data Collection

A mailing list of 624 voting delegates of the National Association of College and University Food Services (NACUFS) was purchased as the study sample. A cover letter that included a web page link to the survey was e-mailed to 591 (i.e., 624 minus 33 from TX and OK) voting delegates of NACUFS who had provided e-mail addresses. Two weeks later follow-up e-mails were sent. At the same time, a cover letter and printed questionnaire were also sent to voting delegates of NACUFS who had not yet responded. Three weeks after the postal mailing, a follow-up reminder post card was sent to non-respondents to increase the participation rate.

Data Analysis

The Statistical Package for the Social Sciences for Windows (SPSS, v 15.0, 2008, Chicago, IL) was used for data analyses. Descriptive statistics were calculated to summarize data related to demographics, foodservice operation characteristics, food waste reduction activities,

and waste disposal methods. The number of meals served per week was divided into four groups ($\leq 5,999$, $n=14$; 6000-14,999, $n=16$; 15,000-39,999, $n=17$; and $\geq 40,000$, $n=15$) to determine the effect of number of meals served per week on college and university foodservice administrators' perceptions toward food waste reduction activities and food waste disposal methods. To evaluate the correlations between cost and frequency for collecting food and package waste, Spearman Rho correlation coefficients were calculated. Repeated measures multivariate analysis of variance (MANOVA) was conducted to test for differences in variables within each category including food waste reduction activities and food waste disposal methods as well as between group differences on those items.

RESULTS AND DISCUSSION

Characteristics of Survey Respondents

Online and/or mailing forms of questionnaires were sent to a total of 591 voting delegates of NACUFS. A total of 93 surveys were submitted (15.7%), but only 63 of them were complete (10.6%). Thirty-six surveys were collected online and 27 from mailed surveys. The majority of survey respondents were male ($n=46$) and between ages 40 to 59 ($n=49$) (Table 1). Their mean work experience was 13.8 years in college and university foodservice operations. Approximately half of the respondents had a bachelor's degree or higher. Respondents indicated that they obtained information about food waste management mostly from college and university web pages ($n=41$), professional journals ($n=39$), and trade journals ($n=37$); only a few used government web pages ($n=8$) as a source of information.

Table 1. Demographic Characteristics of College & University Foodservice Administrators (N=63)

Gender	n	%
Male	46	73.0
Female	17	27.0
Age	n	%
20-29	2	3.2
30-39	7	11.1
40-49	24	38.1
50-59	25	39.7
≥ 60	5	7.9
Education	n	%
Associate degree	7	11.1
Bachelor's degree	32	50.8
Master's degree	17	27.0
Doctoral degree	1	1.6
Other	6	9.5
Years of experience	Mean	\pm SD
College and university foodservice	13.8	\pm 10.3
All foodservices	26.6	\pm 9.80
Source of information about food waste management ^a	n	%
College and university web pages	41	26.5
Professional journals	39	25.2
Trade journals	37	23.9
Waste management company	24	15.5
Governmental web pages	8	5.2
I do not obtain any information about food waste management	6	3.9

SD=Standard Deviation

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

Characteristics of Foodservice Operations

Foodservice operations where respondents were employed varied in size from 14 serving fewer than 5,999 meals per week to three that served more than 100,000 meals per week (Table 2). If those three are excluded, the average for other respondents was 22,870 meals per week. The average number of catering events per week was 48.5 which represented an average of 1,345 catered meals weekly. The 47 foodservice administrators who stated that they had residential dining halls estimated that approximately 70% of total revenue came from this source. Twenty foodservice operations were contract managed, and 41 were self-operated. Two respondents specified "Other" type of management, but did not further describe. Meal plans were approximately evenly distributed between traditional, cash-based, and a combination of traditional and cash based meal plans. Responses for 15 colleges and universities that had other meal plans included a mandatory unlimited meal plan, no meal plan, or all meals included in tuition. Nearly all respondents used cook-to-serve (n=59) and cook-to-order (n=56) production systems while approximately one-fifth of respondents used cook-chill (n=12). One respondent listed in-store fast food restaurant under "other" methods of production.

Table 2. Characteristics of College and University Foodservice Operations (N=63)

Number of meals or meal equivalents served/week	n	%
Less than 5,999	14	22.2
6,000-14,999	16	25.4
15,000-39,999	17	27.0
More than 40,000	15	23.8
No answer	1	1.6
Number of catering events/week	n	%
Less than 10	14	22.2
11-25	15	23.8
26-50	19	30.2
More than 51	7	11.1
No answer	8	12.7
Number of facilities serving residential dining halls	n	%
	47	74.6
Type of management	n	%
Contract managed	20	30.7
Self-managed	41	65.1
Others	2	3.2
Type of foodservice production ^a	n	%
Cook-to-serve (cook and hold food at serving line)	59	35.1
Cook-to-order (order from customers and cook food right at serving line)	56	33.3
Assembly-serve (reheat and serve already prepared Foods)	40	23.8
Cook-chill (cook, cool, refrigerate, reheat and serve Foods)	12	7.1
Other	1	0.6
Type of meal plans ^a	n	%
Traditional meal plan (set number of meals per week or per semester)	26	32.1
Combination of traditional and cash based meal plans	21	25.9
Cash-based meal plan (cash deposit or credit card)	19	23.5
Other	15	18.5

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

Characteristics of Food Waste from Operations

The frequency and cost for collecting food waste was almost the same as frequency and cost for collecting package waste (Table 3). Although 31 respondents did not reported the weight or volume of waste from their operations, the other respondents (n=32) reported that the weight of food waste collected per month was about four times heavier than package waste (19,600 vs. 4,600 lb, respectively). On the other hand, the volume of food waste collected per month was only about one-twentieth of the volume of package waste (620 vs. 12,800 cu ft, respectively). Results of this study were very similar to the characteristics of waste from a continuing care retirement community in a previous study (Hackes, Shanklin, Kim, & Su, 1997) and waste from a university dining facility in Virginia (Sarjahani, Serrano, & Johnson, 2009).

Table 3. Characteristics of Waste Produced in College and University Foodservice Operations (N=63)

Frequency (times/month)	Package Waste	Food Waste
	n	n
Less than 5	13	16
6-10	11	5
11-20	21	23
More than 21	11	12
No answer	7	7
Cost (\$/month)	Package Waste	Food Waste
	n	n
Less than \$500	17	13
\$501-1000	5	7
\$1001-2000	6	6
More than \$2001	4	6
No answer	31	31

Based on the limited data regarding food and package waste from 32 operations, the frequency of collecting package waste was not correlated to the cost for package waste collection ($r=0.168$, $P=0.320$). The frequency of collecting food waste was also not correlated to the cost for food waste collection ($r=0.241$, $P=0.151$). The inconsistency of correlation between frequency and cost for each type of waste may be due to employees not separating food waste from package waste produced from foodservice operations.

Food Waste Reduction Activities to Reduce Food Waste

Respondents rated how likely eight food waste reduction activities would be to reduce food waste on a 5-point scale ranging from 1 (very unlikely) to 5 (very likely). There were significant differences among the activities listed in our survey (Degrees of freedom=7, $F=5.05$, $P<0.001$, a repeated measure MANOVA item analysis). The mean scores of all eight food waste reduction activities asked in the questionnaire were greater than 3.50 indicating that in general the respondents considered these activities positively (Table 4). Educating customers was perceived as most likely to reduce food waste from the foodservice operations. Educating customers was perceived to be significantly more likely to reduce food waste than adjusting portion sizes, putting a trash bin to collect food scraps for food waste program, and changing menu planning. This was consistent with the focus group results as well. All focus group participants agreed that consumer education should be the primary foodservice activity to reduce food waste from the operations. College and university foodservice administrators' perceptions of food waste reduction activities were not significantly different for other independent variables used in this study such as type of management and type of production.

Table 4. College and University Foodservice Administrators' Average Perceptions of Likelihood of Food Waste Reduction Activities to Reduce Food Waste (N=63)

Food waste reduction activities	Mean ± SD
Educate customers to reduce food waste	4.51 ± 0.69 ^a
Modify food production practices to reduce food waste (ex. change to small batch size, improve use of leftovers)	4.33 ± 0.98 ^{ab}
Use a computer program to have accurate forecasting and managing food production	4.26 ± 1.05 ^{abc}
Train employees to separate food waste and packaging (ex. animal feeds, composting)	4.17 ± 1.08 ^{abc}
Change service methods to reduce food waste (ex. trayless, charge by item style cafeteria)	4.06 ± 1.23 ^{abc}
Adjust portion sizes to reduce food waste	4.00 ± 1.06 ^{bc}
Put a trash bin to collect food scraps for food waste program (ex. animal feeds, composting)	3.72 ± 1.27 ^c
Change menu planning to reduce food waste (ex. reduce number of menu items produced, reduce portion size)	3.69 ± 1.42 ^c

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

SD: Standard Deviation

Statistical significance was analyzed by a repeated measures MANOVA (Degrees of Freedom=7, F=5.05, p<0.001).

Values with different superscripts are significantly different (P<0.05) from each other analyzed by pairwise comparisons

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. However, the repeated measures of MANOVA results showed that the mean differences were only significant when these variables were compared to putting a trash bin to collect food scraps for food waste program or changing menu planning. The other food waste management activities did not show the significant differences between mean scores despite the differences in numerical values (Table 4).

The results were somewhat consistent with the responses of foodservice administrators in focus groups who stated that batch cooking and accurate forecasting were helpful in reducing food waste from the operations. Modifying food production practices and using computer programs for accurate forecasting were considered more likely to reduce food waste by college and university foodservice administrators working at operations serving more than 15,000 meals per week compared to those serving less than 5,999 meals per week (One-way ANOVA, F=5.995, P<0.01 for modifying food production practices; F=4.771, P<0.01 for using computer programs for accurate forecasting).

Food waste reduction activities receiving the next highest likelihood ratings were to train employees to separate food waste and packaging, change service methods to reduce food waste (i.e. trayless dining; charge by item style cafeteria), and adjust portion sizes. No significant difference was shown in college and university foodservice administrators' perceptions of using employee training and changing service method to reduce food waste according to any of the independent variables used in this study such as type of production and type of management. Recent research has shown that trayless dining environments result in a significant reduction in food waste from foodservice operations (Aramark Risk Management, 2008; Meltzer & Stumpf, 2008). Participants in focus group discussions rated trayless dining as a very effective method in reducing food waste from the operations. However, in this survey changing service methods (i.e. trayless dining or charging by item) was not perceived as one of the top three food waste reduction activities likely to reduce food waste. Changing service methods was also not significantly different from any of other food waste reduction activities. This may be because trayless service is a relatively new concept to the college and university foodservice administrators who responded to this survey. Adjusting portion sizes was perceived as a foodservice activity significantly likely to reduce food waste by foodservice administrators who offered cash-based inclining/declining balance meal plans compared to those who did not (4.44±0.71 vs. 3.82±1.13, P<0.05). The two food waste reduction activities that rated lowest in likelihood

to reduce food waste were trash bin placement to collect food scraps for food waste programs such as animal feeds and composting and change in menu planning to reduce food waste. No significant difference existed in college and university foodservice administrators' perceptions of menu adjustment to reduce food waste according to any of the independent variables used in this study. Although the previous studies did not address placing a trash bin to collect food waste as a food waste management activity, our focus group participants suggested this method as a way to encourage college students to separate food and package waste for better handling wastes. Trash bin placement was perceived as a significant foodservice activity to reduce food waste only by foodservice administrators who obtained information about a food waste management from a waste contract management company (4.13±1.01 vs. 3.47±1.35, P<0.05). Therefore, further research may need to address the effectiveness of this activity as a viable option for improving food waste management.

Perceptions of the Effectiveness of Food Waste Disposal Methods

College and university foodservice administrators' perceptions of the effectiveness of food waste disposal methods ranged from 3.00 to 4.06 (unsure to likely) (See Table 5), whereas their perceptions of likelihood of food waste reduction activities to reduce food waste ranged from 3.61 to 4.51 (likely to very likely) (See Table 4). Thus it appears that foodservice administrators were more knowledgeable and confident about the effectiveness of food waste reduction activities than specific food waste disposal methods.

Respondents were asked to rate on a 5-point likert type scale the effectiveness of seven food waste disposal methods. A repeated measure MANOVA item analysis showed that there was significant differences in the perceptions of foodservice administrators regarding waste disposal methods (Degree of freedom=6, F=8.07, P<0.001). Among waste disposal methods suggested in our survey, sending food scraps to composting sites was thought most likely to be effective for food waste disposal. Composting was perceived as significantly less likely to be effective than donating non perishable food and food scraps to farmers for animal feed (Table 5). Composting is one of the food waste disposal methods that has dramatically increased in the United States since 1985 (Miller, 2007) although there are disadvantages to composting such as possible contamination of water and air (Department of Hotel, Restaurant, Institution Management, and Dietetics, 2002). Focus group participants considered composting to be a viable food waste disposal method. However, limited space to hold food scraps in foodservice operations was mentioned as a major barrier. Interestingly, foodservice administrators who obtained information from a waste contract management company perceived sending food scraps to composting sites more likely to be effective

Table 5. College and University Foodservice Administrators' Average Perceptions of Effectiveness of Food Waste Disposal Methods (N=63)

Food Waste Disposal Methods	Mean ± SD
Send food scraps to composting site (s)	4.06 ± 1.17 ^a
Use a food pulper to reduce the volume of the food waste	3.93 ± 1.20 ^{ab}
Use garbage disposals to dispose food to sewage system	3.63 ± 1.41 ^{abc}
Donate prepared food (ex. hot or cold foods) for the needy such as local food banks	3.41 ± 1.51 ^{abc}
Send food waste to landfill along with other solid waste	3.33 ± 1.40 ^{abc}
Donate food scraps to farmers for animal feed	3.11 ± 1.27 ^c
Donate non-perishable food (ex. canned products) for the needy	3.00 ± 1.47 ^c

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

SD: Standard Deviation

Statistical significance was analyzed by a repeated measures MANOVA (Degrees of Freedom=6, F=8.07, P<0.001).

Values with different superscripts are significantly different (P<0.05) from each other analyzed by pairwise comparisons.

for food waste disposal than those who did not obtain information from a waste contract management company (4.43±0.68 vs. 3.81±1.36, P<0.05). 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 recommends a hierarchy of food waste management methods that included source reduction, feed hungry people, feed animals, industrial uses, and composting to landfill/incineration in that order (EPA, 2009c). Using a pulper or a garbage disposal for source reduction is suggested as a primary method for source reduction. In focus group discussions, however, using a pulper was not the first choice for foodservice operations. Some foodservice administrators commented that because pulper equipment requires high maintenance, they did not plan to use one again. In contrast to those comments, foodservice administrators who completed the survey thought that using a pulper and garbage disposal would likely be an effective method of food waste disposal (3.93±1.20 and 3.63±1.41, respectively). The perception of effectiveness of using a food pulper for waste disposal was significantly higher than that of donating nonperishable food for needy people and food scraps to farmers for animal feed. The perception of effectiveness of using garbage disposals was not significantly different from other disposal methods (Table 5). Foodservice administrators serving residential dining halls perceived using a food pulper more likely to be an effective method of waste disposal (4.13±1.09 vs. 3.40±1.35, P<0.05).

Survey respondents perceived donating prepared food for the needy as the next most effective food waste disposal method (3.41±1.51). This method was not significantly different from any other food waste disposal methods. The liability issues related to donating foods have been a concern for foodservice administrators, including those working at contract managed operations (Aramark Risk Management, 2008; Kwon, 2009). Although not statistically significant, contract managed foodservice administrators perceived food donation as less likely to be effective than self operated foodservice administrators (2.89±1.49 vs. 3.70±1.43, P=0.053).

According to the EPA, landfill/incineration is the least recommended waste disposal method (EPA, 2009c). However in this study, sending food waste to landfills was not rated significantly different from any other food waste disposal method. Sending food waste to landfills was perceived less likely to be effective in foodservice operations with residential dining halls than at operations without them (3.11±1.43 vs. 3.94±1.12, P<0.05). This method was also perceived less likely to be effective in foodservice operations with cook chill than those without it (2.30±1.34 vs. 3.58±1.32, P<0.01) and by foodservice administrators using college and university web pages as an information source compared to those using other sources of information (2.95±1.41 vs. 4.05±1.07, P<0.01).

CONCLUSIONS AND APPLICATIONS

Food waste management in foodservice operations is possibly one of the least researched areas related to improving environmental sustainability even though food waste is closely related to 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. Even though data from only a small number of respondents were available, this study was also able to determine significant differences in foodservice administrators' perceptions of likelihood of foodservice activities and food disposal methods according to other factors such as type of management, meal plan and food production, existence of a residential dining area, number of meals served, and source of information about food waste management.

The low response rate for this study with only 63 respondents was a limitation because the number was too small to use statistical analyses for several variables such as type of food production and source of information about food waste management. However, this study provides a glimpse of food waste management practices and waste disposal methods in college and university foodservice operations. Most foodservice administrators indicated they were interested in solid waste management 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 and alert the 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. Each administrator also should select effective methods of food waste management to suit their operation based upon available resources. 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 will depend upon size of operation and location. Therefore, foodservice administrators should be well informed prior to implementing any food waste management programs.

Further study with a larger number of colleges and universities should be conducted to verify the accuracy and reliability of the results in this study. Food waste management research could also be expanded to school and healthcare foodservice operations in order to compare their preferred food waste reduction activities and food waste disposal methods with that of college/university foodservice facilities.

REFERENCES

- Aramark Higher Education. (2008). *The business and cultural acceptance case for trayless dining*. Retrieved March 25, 2009, from <http://www.aramarkhighered.com/ThoughtLeadership/Articles.asp>
- Aramark Risk Management. (2008). *Donation of food items*. Retrieved May 20, 2009, from <http://www.aramarkslp.com/files/Risk%20Recommendation%20-%20Food%20Donation.doc>
- Association for the Advancement of Sustainability in Higher Education (AASHE). (2009). *Campus Sustainability Profiles*. Retrieved Dec. 29, 2009, from <http://www.aashe.org/resources/profiles/profiles.php>
- Buchthal, K. (2006). Slow burn: frustrated by heating-cost increases, operators weigh responses. *Restaurants and Institutions*, 116, 55-56.
- Center for Ecological Technology. (1999). *Strategies to Increase Food Waste Recycling in the Greater Boston Area*. Retrieved Dec. 29, 2009, from <http://www.cetonline.org/Publications/Strategies%20to%20Increase%20Food%20Waste%20Recycling%20in%20the%20Greater%20Boston%20Area.pdf>
- Department of Hotel, Restaurant, Institution Management and Dietetics, Kansas State University. (2002). *Module 3: management of waste/residues in interdisciplinary modules to teach waste or residue management in the food chain*. Retrieved Dec. 29, 2009, from <http://www.ksre.ksu.edu/swr/Module3/Introduction.htm>
- Edmunds, H. (1999). *The focus group research handbook*. Lincolnwood, IL: NTC Contemporary.
- Environmental Protection Agency (EPA). (2009a). *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008*. Retrieved Dec. 29, 2009, from <http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw2008rpt.pdf>
- Environmental Protection Agency (EPA). (2009b). *Solid waste management and greenhouse gases: A life-cycle assessment of emissions and sinks*. Retrieved Dec. 29, 2009, from <http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html>
- Environmental Protection Agency (EPA). (2009c). *Food scraps: Basic information, food waste recovery hierarchy, generators, success stories, frequent questions, and resources*. Retrieved Dec. 29, 2009, from <http://www.epa.gov/epaoswer/non-hw/organics/foodwste.htm>
- Gregoire, M. B. (2010). *Foodservice organizations: A managerial and systems approach (7th ed.)*. Upper Saddle River, NJ: Prentice Hall.
- Hackes, B., Shanklin, C. W., Kim, T., & Su, A. (1997). Tray service generates more food waste in dining areas of a continuing-care retirement community. *Journal of the American Dietetic Association*, 97(8), 879-882.
- Harmon, A. H., Gerald, B. L. (2007). Position of the American Dietetic Association: Food and nutrition professionals can implement practices to conserve natural resources and support ecological sustainability. (2007). *Journal of the American Dietetic Association*, 107(6), 1033-1043.
- Kwon, S. (2009). *Investigating food waste management in college and university foodservice operations* (Master's thesis). Texas Woman's University, Denton, TX.
- Meltzer, J., & Stumpf, S. (2008). *Illinois Wesleyan University Bertholf Commons Tray-Less Trial Final Report*. Retrieved Dec. 29, 2009, from http://digitalcommons.iwu.edu/green_docs/18/
- Miller, C. (2007). Food waste: increased composting could reduce the third largest part of the waste stream. *Waste Age*. May, 92.
- National Recycling Coalition (2009). *RecycleMania Final Results—RecycleMania 2009*. Retrieved Dec. 29, 2009, from <http://www.recyclemania.org/>
- Sarjahani, A., Serrano, E.L., & Johnson, R. (2009). Food and on-edible, compostable waste in a university dining facility. *Journal of Hunger & Environmental Nutrition*, 4(1), 95-102.