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THE FOOD WASTE MANAGEMENT SYSTEM IN A SOUTHEASTERN HOSPITAL

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THE FOOD WASTE MANAGEMENT SYSTEM IN A SOUTHEASTERN HOSPITAL

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ABSTRACT

Effective waste management has always posed a challenge to those in food service operations. This study investigated the amount of food waste from Bon Secours St. Francis Health System foodservice operations using the Trim Trax® program. Trim Trax® is a food waste management program in which employees measure the volume of waste produced in pre-production and post-production areas. The objectives of this study were to collect the amount of waste produced during meal preparations and compare it with three weeks of retrospective data kept by employees in the salad/baking pre-production area, the cooking/grilling pre-production area and post-production area. Results showed a significant difference between the collected (26.38, 49.10 and 32.71 quarts for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) and employee reported data (19.14, 30.38 and 9.88 quarts, for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) over the three week period. It was also found that lettuce (6.33 quarts), onion (10.24 quarts) and tomatoes, zucchini and onion (~3.80 quarts each) accounted for the most waste in the salad/baking area, cooking/grilling pre-production area and post-production area. Overall, the results indicated that even though the data obtained in both cases (reported and collected) were similar by produce type, there was a marked difference in the total waste obtained over three weeks in all three areas (salad/baking pre-production, cooking/grilling pre-production and post-production). This could be due to a lack of proper training or the lack of understanding of proper waste

disposal practices. Thus, developing an educational intervention that effectively utilizes the Trim Trax ® program could help in managing inventory and reducing food waste within the food service operation.

DEDICATION

This thesis is dedicated to my father, Bakr M. Habadi, who taught me that the best kind of knowledge to have is that which is learned for its own sake and, who helped me in any way he could whether I needed him or not. It is also dedicated to my mother, Fatmah I. Habadi, who taught me that even the largest task can be accomplished if it is done one step at a time, and who gave so willingly of her time to help me at the most critical stages of my graduate studies.

In addition, this work is dedicated to my husband, Abdurrahman A. Alsaggaf, without whose caring support my work would not have been possible. He has been a great source of motivation and inspiration. I also dedicate this thesis to my dear daughter, Nadiah, whom I want to be proud of her mother.

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CHAPTER ONE

INTRODUCTION

In 2010, there were an estimated 1,000,000 dining facilities in the US (National Restaurant Association, 2010). One challenge facing many of these foodservice operations is consumer demand for sustainable foods (Avermaete, 2008).

Conventional food production relies on extensive chemical and energy input and produces considerable waste output. To address this, the Environmental Defense Fund and National Restaurant Association partnered to develop the Green Dining Practices, a comprehensive set of cost-effective, science-based recommendations for the food service industry. The 12 Green Dining Practices fall into 2 key categories:

1. **Sustainable Food Purchasing**
    - Meat, Dairy, and Eggs - Increase low carbon menu options and choose products that are grown without the use of antibiotics designed for humans.
    - Produce - Design menus with a focus on seasonal freshness and choose produce grown organically.
    - Seafood - Select seafood that comes from eco-friendly fisheries and is safe for human consumption.
    - Food Transport - Reduce greenhouse gas emissions from food transport by purchasing from local farms and using efficient modes of transport.

- Coffee and Tea -- Purchase products through rigorous certification programs that promote habitat protection and organic growing methods.
- Bottled Beverages -- Reduce climate and waste impacts of bottled water and other beverages by promoting “bottle less” beverage options.

2. **Sustainable Dining Facility Operation**

- Cleaning Chemicals -- Use cleaning solutions approved by credible third parties and implement practices that limit the use of toxic cleaning chemicals.
- Cooking and Refrigeration Equipment -- Use energy efficient appliances and deploy an appliance scheduling program to turn off equipment when not in use.
- Dishwashing and Water Use -- Use low flow valves to control water use and purchase efficient dishwashers.
- Facility Construction and Design -- Choose efficient lighting and HVAC technology and upgrade new and existing facilities to green building standards
- Service ware -- Use washable, reusable service ware and increase recycled content and recyclability of “to-go” containers.
- Waste and Recycling -- Prevent waste from being generated in the first place and recycle or compost the rest.

Bon Secours St. Francis Health System, Greenville, SC, has adopted many of these green practices and is engaged in assessing their impact. A typical foodservice operation generates tons of waste each year and its disposal is a major expense (Rhodes, 2009). A considerable amount of money could be saved by reducing food waste and by composting food scraps, for instance. Wine et al. (2003) found that the annual cost of garbage disposal from food service operations, excluding labor costs, was $3,582 compared to hauling waste to landfills ($1,804) or using it for animal feed ($241).

Nearly half of foodservice waste comes from leftover food scraps (www.epa.gov, 2010). One suggested way to cut down on this waste has been through the use of a program called Trim Trax®. Trim Trax® is designed to increase operational efficiencies and to create awareness about reducing food waste and its environmental impact by having employees place food waste into plastic containers and measuring its volume prior to composting.

CHAPTER TWO

REVIEW OF LITERATURE

The definition of sustainability may not sound critical, but it becomes an important term for human life when combined with ecological or environmental factors. For humans, sustainability is the potential for long-term maintenance of well being, which has environmental, economic, and social dimensions.

American consumers have raised many concerns about economic and environmental sustainability. Two major areas for environmental sustainability in foodservice operations are energy conservation and waste reduction.

Kantor et al. (1997) identified and measured food waste in the United States and found that more than 96 billion pounds of edible food was lost by retailers, foodservice, and consumers in 1995. This waste was categorized as

- Fresh fruits and vegetables, 19.6% (18.9 billion pounds).
- Fluid milk, 18.1% (17.4 billion pounds).
- Grain products, 15.2% (14.6 billion pounds)
- Caloric sweeteners, 12.4% (11.9 billion pounds)
- Processed fruits and vegetables, 8.6% (8.3 billion pounds)
- Meat, poultry, and fish, 8.5% (8.2 billion pounds)
- Fats and oils, 7.1% (6.8 billion pounds)
- Other , 10.5% (10.1 billion pounds)

Much has been published on how to assess and reduce food waste. Most of the research can be assigned to one of four categories: recycling, recovery, disposal, and digestion. Jambeck et al. (2006) used organic waste to create compost in a closed loop system at the University of New Hampshire dining services, which serves more than 75,000 meals per week. They were able to achieve a final compost product with a 15:1 carbon to nitrogen ratio.

Reducing the amount of waste is also important. Hyde et al. (2001) brought attention to the fact that minimizing food waste will assist in improving environmental performance. They reported that optimized purchasing policies contributed to food waste reduction. Others have tried to prove that minimizing food waste will enhance sustainability. For instance, compactors can reduce the size of pre-consumer food scraps. In addition, using tray-less dining, canceling free lunch services, and improving menus could help to reduce food waste. (Caity Monroe, 2010).

Kim et al. (1997) explored the composition of food waste generated in a long term care unit where family style meals were served for 70 residents. The food waste stream was tracked at service, production, and packaging. Food waste resulting from production and service contributed between 63% and 70% of the total solid waste. They also reported that the volume of food waste could be reduced between 37% and 47% when a collapsible material was used for food packaging. Likewise, Hackes et al. (1979) reported that tray service generated a greater volume of food waste compared to waited table and family style services. Engstrom and Kanyama (2004) reported that about 20% of total food is wasted, with 11-13% of the total waste coming from plate waste. They also reported that the economic and environmental consequences of current levels of food waste can be substantial.

Much has been published on composting food waste. For example, Adhikari et al. (2008) monitored and quantified the variations of characteristics in food wastes. They reported that a food waste composter required a flexible design in order to accommodate the volume of food waste and seasonal fluctuations.

Several studies were conducted to determine the cost of disposal strategies for the waste generated in food services operations. Wine et al. (2003) developed a decision tree strategy in order to determine the most cost effective disposal strategy for four food service operations. No single disposal method provided the optimal results in all cases analyzed. The composition of food and packaging wastes, quantity of recyclable materials, waste hauling charges, facility location, labor cost, start-up costs, inflation rates, current disposal methods, and ease of conversion of methods are all factors that influence the total cost.

Robert (2008) implemented the use of in-vessel composting, which uses rotary drums. They found that the compost was able to produce 30 gallons of leachate per week. At that rate of saving, it would take about six months to recover the investment of $90,000.

Landfill food wastes are responsible for most of human made methane. Ike et al (2010) analyzed a full scale digester treatment of industrial food waste to produce methane. It was found that *Methanosarcina* and *Methanobrevibacte/Methanobacterium* were the main contributors to methane production. Moreover, another study indicated that energy intensive food waste is responsible for 19% of the fossil fuel consumption in the United States (Macdonald, 2009). Alternatively, Bloom (2007) suggested methods of diverting food from landfills as a way to decrease methane emissions, and demonstrated on a NC university campus that tons of food waste could be diverted by connecting food recyclers with sources of waste.

Kevin et al. (2004) engaged 21 airport vendors in a food waste diversion study of the amount of pre-consumer scraps and food contaminated paper. Thus as noted, more than 60 tons of "contaminant free, pre-consumer food residuals were diverted from the landfill, hence the food waste diversion program could lead to about 3% reductions by weight in the waste stream."

Anaerobic digestion has been used for the economical recovery of methane gas from food waste for several years. Organic waste collected from food processing plants can be treated in an anaerobic digestion tank and the methane gas produced can then be used for power generation (Ike et al., 2010, Gray et al., 2008).

Frankel (2010) reported Vermicomposting or worm composting is the process of having worms process the food waste and turn it into a natural fertilizer (called vermicompost). Vermicompost contains, worm castings (vermicastings), aerobic compost from other worm bin organisms, and some material which is food waste that is on its way to the worms. Vermicomposting is considered a simple process that requires very few supplies. A simple box or container creates a worm bin and keeps worms and decomposing food waste in one area. This set-up can maintain the worms indoors or outdoors. Vermicomposting is considered to be the fastest way to transform food waste into nutrient-rich castings.

Nair et al.(2005) tested combinations of the thermocomposting and vermicomposting to improve the treatment efficiency and to assess the optimum period required in each method to produce quality compost. The results showed that pre-thermocomposting improved vermicomposting of kitchen waste. A 9-day thermocomposting prior to vermicomposting helped in mass reduction, moisture management and pathogen reduction. Vermicomposting or worm composting is considered the quickest way to transform food waste into nutrient-rich castings. Worm castings are an excellent soil amendment for gardens. In the process of breaking down food waste, worms feed on microorganisms, which grow on the surface of the waste, and excrete particles of a smaller size, which are called worm castings. Certain C: N ratios are important for a successful vermicomposting operation. Worms however, prefer a vegetarian diet, and will consume leafy greens, fruits, vegetables, and coffee grounds quickly. They also require a source of calcium to reproduce. Calcium can be provided in the mix through eggshells or a calcium-rich antacid tablet. The foods to include in the vermicomposting operation are bread, cereal, pasta in addition to those mentioned above. Types of food that are not recommended for this process include dairy products, fats, meat and oils. (Gannett Fleming 2003)

CHAPTER THREE

MATERIALS AND METHODS

The Department of Food and Nutrition Services at Bon Secours St. Francis Health System in Greenville SC serves 155,000 meals per year with a cook-serve food service system utilizing a 7- day cycle menu. The department has an annual budget of $5 million. They have three main areas for food handling: salad/baking pre-production, cooking/grilling pre-production, and post-production. They have an active recycling and waste management system which includes use of a system called Trim Trax® which reduces kitchen waste and recycles at the point of production.

As part of the Trim Trax® system, food waste is separated from non-food waste, measured, and then composted. The Trim Trax® system is designed to increase operational efficiencies and to create awareness among food service employees about the environmental impact of food waste as well as the importance of reducing it. Food waste generated is then prepared for use in a vermicomposting system. The "worm tea" is collected in plastic gallons and sold as fertilizer.

The overall objective of this study was to study the reported utilization of Trim Trax® by employees and compare that with the actual utilization of Trim Trax® at Bon Secours St. Francis Health System, Greenville, SC. The specific objectives to accomplish this goal were to:

1. Collect data related to the amount of food waste in the salad/baking pre-production, cooking/grilling pre-production and post-production areas
2. Compare volume of waste collected in this study with volume reported by employees over three weeks.

3.1 Data Collection

The food waste collected from salad/baking pre-production, cooking/grilling pre-production and post-production areas was placed in a Trim Trax ® bin as shown in figure Figure 3.1. All compostable food waste from these areas was collected and placed in the Trim Trax ® bin for that area. The volume of waste is measured at the end of each production day and that volume is recorded in a data log.

Figure 3.1 Trim Trax® bins used for food waste collection

Figure 3.2 illustrates Trim Trax ® bins for food waste collected from the three areas with the separation of food items prior to the composting process. The amount of food waste was monitored and recorded carefully in order to be compared to the volume of food waste reported by employees.

Figure 3.2 Trim Trax® bins used for food waste separated as compostable and non-compostable prior to vermicomposting process

This study was implemented to compare the amount of food waste collected over two periods. The first period used three weeks of retrospective data for the amount of food waste as recorded by employees for three weeks using the Trim Trax ® program. The second period included actual monitoring of the amount of food waste from each area using the Trim Trax ® program. Data were collected for all food waste throughout the typical work day and were combined from breakfast, lunch and dinner.

The total quarts of food waste was recorded for individual areas over three week by the employees was compared with the total number of quarts of waste measured and separated into ingredients over three weeks by the investigator. Statistical analyses were performed using SPSS (version 12.0.2; SPSS Inc.). An ANOVA was performed to determine significant differences between the food waste reported by employees and the data collected by the investigator. ANOVA descriptive statistics including T-test were used to analyze the data.

CHAPTER FOUR

DATA ANALYSIS

Table 4.1 shows the daily food waste (in quarts) for three areas as reported by employees over three weeks. During the first week of the study, the average amount of waste obtained in the salad/baking pre-production, cooking/grilling pre-production and post-productions areas were 16.85, 28.42 and 9.21 quarts respectively. From Table 4.2 we can see that, on an average, the cooking/grilling pre-production area produced the largest amount of waste (30.38±8.58 quarts), followed by the salad/baking pre-production (19.14±6.38 quarts) and the post production area (9.88±2.41 quarts) at the end of the three week period. Correspondingly, the maximum waste was generated in the cooking/grilling pre-production area (44 quarts) and the minimum was generated in the post production area (6 quarts).

When compared on a day by day basis, the average amount of waste produced on Mondays was highest (24.7 quarts) and the lowest waste was produced on Wednesdays (10.7 quarts) in the salad/baking pre-production area (Table 4.3). Similarly, the cooking/grilling pre-production area produced the most volume of waste on Mondays (36 quarts) and the least amount on Wednesdays (20.7 quarts). For the post-production area, maximum waste was recorded on Sundays (11.5 quarts) and the minimum on Fridays (8.2 quarts).

Table 4.1

Daily food waste as reported by employees over three weeks

Week	Day	Salad/Baking Pre-production (quarts)	Cooking/Grilling Pre-production (quarts)	Post-production (quarts)
Week 1	Monday	20	33	10
	Tuesday	20	20	8.5
	Wednesday	10	26	9.5
	Thursday	15	24	11
	Friday	12	25	6
	Saturday	11	29	9
	Sunday	30	42	10.5
Week 2	Monday	33	43	8
	Tuesday	29	36	10.5
	Wednesday	13	18	8
	Thursday	20	24	6
	Friday	25	33	11
	Saturday	23	31	10
	Sunday	16	14	7
Week 3	Monday	21	32	9
	Tuesday	21	35	13
	Wednesday	9	18	15
	Thursday	16	32	14
	Friday	18	37	7.5
	Saturdays	18	42	11
	Sunday	22	44	13

Table 4.2

Descriptive statistics for daily food waste as reported by employees over three weeks

Measurements	Salad / Baking Pre-production(quarts)	Cooking / Grilling Pre-production(quarts)	Post-production(quarts)
Average	19.14	30.38	9.88
Standard Deviation	6.38	8.58	2.41
Min	9	14	6
Max	33	44	15
Range	24	30	9

Table 4.3

Average food waste as reported by employees over three weeks

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Salad / Baking Pre-production(quarts)	24.7	23.3	10.7	17	18.3	17.3	22.7
Cooking / Grilling Pre-production(quarts)	36	30.3	20.7	26.7	31.7	34	33.3
Post-production(quarts)	9	10.7	10.8	10.3	8.2	10	11.5

Table 4.4 shows the daily food waste (in quarts) as collected for three areas over three weeks. During the first week of the study, the average amount of waste obtained in the salad/baking pre-production, cooking grilling pre-production and post-productions areas were 26.28, 47.85 and 38.14 quarts respectively. As evident on Table 4.5 the cooking/grilling pre-production area produced the largest amount of waste on average (49.10±12.82 quarts), followed by the post production area (32.71±10.18 quarts) and the salad/bake pre-production (26.38±9.79 quarts) at the end of the three week period. Correspondingly, the maximum waste was generated in the cooking/grilling pre-

production area (76 quarts) and the minimum was obtained in the post-production area (11 quarts).

When compared by the day, the average amount of waste produced on Fridays was highest (24.7 quarts) and lowest waste was produced on Thursdays (19 quarts) in the salad/baking pre-production area over the three week period (Table 4.6). The cooking/grilling pre-production area produced the greatest amount of waste on Fridays (65.7 quarts) and the least on Wednesdays (36.3 quarts). For the post-production area, maximum waste was collected on Mondays (42.3 quarts) and the minimum on Sundays (25.3 quarts).

The volume of waste collected was compared with employee-reported waste. Though the cooking/grilling pre-production area but had the greatest volume of waste in both cases, the volume of waste reported by employees (30.38 quarts) was almost 60% lower that measured (49.10 quarts). The study showed that the post-production area generated the second highest volume of waste but the employees reported that to be the area where the least waste was generated. Overall, the results showed a vast difference in the amount of waste produced in all three areas when compared to those reported by the employees with significant difference ($p<0.05$) between the reported and the collected data in all areas of food production. The greatest difference was noted in the cooking/grilling pre-production area and the least in the salad/baking pre-production area.

The discrepancies in the results obtained could be due to a lack of proper training or a lack of understanding of proper waste disposal practices. The protocols for discarding waste such as overproduction, trim waste, expired goods, spoilage, overcooked items, contaminated items, and dropped items, should be reiterated and recorded.

Table 4.4

Daily food waste collected over three weeks

Week	Day	Salad / Bake Pre-production (quarts)	Cooking / Grilling Pre-production(quarts)	Post-production(quarts)
Week1	Monday	29	29	40
	Tuesday	34	40	56
	Wednesday	16	31	31
	Thursday	11	56	37
	Friday	51	57	40
	Saturday	19	64	38
	Sunday	24	58	25
Week2	Monday	30	61	43
	Tuesday	24	50	29
	Wednesday	33	44	43
	Thursday	26	49	37
	Friday	46	76	21
	Saturday	24	54	32
	Sunday	32	49	12
Week3	Monday	35	63	44
	Tuesday	17	42	22
	Wednesday	22	34	29
	Thursday	20	44	19
	Friday	14	64	23
	Saturday	29	27	27
	Sunday	18	39	39

Table 4.5
Descriptive statistics for daily food waste collected over three weeks

Measurements	Salad / Bake Pre-production(quarts)	Cooking / Grilling Pre-production(quarts)	Post-production(quarts)
Average	26.38	49.10	32.71
Standard Deviation	9.79	12.82	10.18
Min	11	27	12
Max	51	76	56
Range	40	49	44

Table 4.6
Average food waste collected over three weeks

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Salad / Bake Pre-production (quarts)	31.3	25	23.7	19	37	24	24.7
Cooking / Grilling Pre-production (quarts)	51	44.3	36.3	49.7	65.7	48.3	48.7
Post-production (quarts)	42.3	30.3	34.3	31	27.3	32.3	25.3

Table 4.7 shows the ANOVA results for employee-reported daily food waste for the Salad/Baking pre-production, Cooking/Grilling pre-production and post-production areas and those collected by the investigator over three weeks. There was a significant difference ($p<0.05$) between the reported and the collected data in all areas of production with the greatest difference in post-production and the least in the salad/baking area.

Table 4.7
ANOVA for daily food waste for Salad / Baking pre-production, Cooking / Grilling Pre-production and post-production reported by employees and collected by the investigator.

		Sum of Squares	df	Mean Square	F	Sig.
Salad/Baking	Between Groups	550.095	1	550.095	7.673	.008
	Within Groups	2867.524	40	71.688		
	Total	3417.619	41			
Cooking/Grilling	Between Groups	3677.357	1	3677.357	29.438	.000
	Within Groups	4996.762	40	124.919		
	Total	8674.119	41			
Postproduction	Between Groups	5474.292	1	5474.292	95.195	.000
	Within Groups	2300.238	40	57.506		
	Total	7774.530	41			

Employees collected the total food waste for each area for three weeks after which time that they indicated to the investigator that they were comfortable in the collection procedures. The largest volume of waste observed was from lettuce, followed by bananas, and tomatoes.

Cabbage on the other hand accounted for the least amount of waste observed. This could be a function of the lower incidence of cabbage on the menu in general as well as the purchase form. The purchase specification regarding produce items varies with individual food item (ingredient) as related to the intended use of the food on the menu. For example, institutional food establishments such as this hospital usually purchase head lettuce by the case. Outer leaves and cores are usually discarded during salad preparation therefore, it is anticipated that lettuce would generate a high waste volume as compared with baby carrots which may be used as purchased. Other produce items such as bananas and onions demonstrate considerable loss from the AP (as purchased) to the EP (edible purchased) forms since they are usually peeled before service. Mary (2006) A basic understanding of those terms impacts success with food service purchasing and production operations. Foodservice operation success may be influenced by application and practices with food various food items relative to AP (as purchased) and EP (edible portion) yields. For example, bananas have a .65 approximate yield as expressed by weight; potatoes .81 yield; and tomatoes a .80 yield. Thus within the food service areas one can expect that the purchase weight and the edible portion of items will vary depending on market form and intended use on the menu Amy (2011).

Vegetables such as lettuce, parsley, onions, zucchini and cabbage as purchased require cleaning and paring within the foodservice areas. Fruits such as bananas, lemons and strawberries are routinely manipulated during pre-preparation for service leading to varying amounts of food waste generated in specific food preparation areas. These specific food item yields are generally anticipated throughout the planning and purchasing functions within food service operations. Thus this study provides further demonstration and measurement of food service waste within a framework of three weeks of actual food production.

Table 4.8 shows the daily collected amount of food waste over a three week period. The results indicated that the average amount of waste collected in the salad/baking pre-production area for all types of produce was 25.19 quarts over a period of three weeks. On average, the produce that ranked for the highest amount of waste in this area was lettuce (6.38±3.92 quarts), followed by banana (3.71±2.17 quarts) and tomatoes (3.33±1.52 quarts). Cabbage accounted for the least amount of waste over the three week period (0.19±0.87 quarts).

In the cooking/grill pre-production area, the average amount of waste collected over the three week period was around 46.7 quarts (Table 4.9). The produce that created the highest amount of waste in this area was onion (10.24±3.01 quarts), followed by potato (7.9±3.88 quarts) and tomatoes (5.19±2.69 quarts). Spinach accounted for the least amount of waste over the three week period (0.48±1.08 quarts).

Table 4.10 illustrates the daily amount of food waste (in quarts) collected from the post-production area. The average amount of waste collected in this area for all types of produce was 29.71 quarts over a period of three weeks. On average, the produce that accounted for the highest amount of waste in this area was onion (3.9±1.45 quarts), followed by tomatoes (3.86±2.24 quarts) and zucchini (3.81±1.4 quarts). Spinach accounted for the least amount of waste over the three week period (0.19±0.47 quarts). As the results indicate the collected data represents a greater value for waste than does the reported data. The data was collected during specified time intervals within the foodservice operation production schedule. For the breakfast meal the food items were collected from 6:00 AM, to 10AM, for the lunch meal the food items were collected from 11: AM to 12:00 PM and for the dinner meal items were collected from 3:00 to 5:00 PM. The meal food waste was collected during these specified time intervals to ensure uniform collections per meal. It is important to note that some of the produce items reviewed in this study period were evident on the daily menu and other food items were utilized one or two times per week. Thus the incidence of an item on a particular menu cycle contributes to varying food waste measures. For example, the usage of lettuce, onion, tomato and potato is greater overall than that of other produce items such as turnip and spinach which demonstrate the lowest food waste values.

Table 4.8

Daily average food waste collected from salad\baking pre-production area over three weeks

Date	Tomatoes	Cucumber	Lettuce	Onion	Strawberries	Banana	Parsley	Carrot	Cabbage	Red Cabbage	Lemon	Potato	Total Quarts
Monday	4	4	14	1	3	3	0	0	0	0	0	0	29
Tuesday	5	4	10	2	6	4	3	1	0	0	5	0	40
Wednesday	3	3	8	2	0	0	0	0	0	0	0	0	16
Thursday	4	2	4	0	0	0	0	0	0	0	1	0	11
Friday	8	2	2	2	10	8	3	2	4	0	2	4	47
Saturday	2	1	4	2	3	5	0	0	0	0	2	0	19
Sunday	2	1	5	2	2	4	0	0	0	1	1	0	18
Monday	3	3	3	3	3	6	3	3	0	0	3	0	30
Tuesday	5	6	1	4	0	0	0	0	0	0	0	2	18
Wednesday	5	4	10	2	3	4	0	0	0	0	2	3	33
Thursday	2	0	10	0	3	4	3	0	0	2	0	0	24
Friday	5	3	12	0	2	5	4	1	0	0	4	0	36
Saturday	3	2	6	2	3	4	0	0	0	0	1	3	24
Sunday	3	5	10	0	3	4	3	0	0	4	0	0	32
Monday	2	5	10	0	2	6	4	1	0	0	5	0	35
Tuesday	2	3	5	1	2	4	0	0	0	0	0	0	17
Wednesday	3	4	9	1	3	0	0	0	0	0	1	0	21
Thursday	2	3	2	2	6	4	0	0	0	0	0	0	19
Friday	2	0	0	0	3	6	3	0	0	0	0	0	14
Saturday	3	4	4	1	2	3	2	1	0	2	0	6	28
Sunday	2	1	5	2	2	4	0	0	0	0	2	0	18
Total	70	60	134	29	61	78	28	9	4	9	29	18	529
Average	3.33	2.86	6.38	1.38	2.9	3.71	1.33	0.43	0.19	0.43	1.38	0.86	25.19
Standard deviation	1.52	1.65	3.92	1.12	2.23	2.17	1.62	0.81	0.87	1.03	1.66	1.71	9.46
Min	2	0	0	0	0	0	0	0	0	0	0	0	11
Max	8	6	14	4	10	8	4	3	4	4	5	6	47
Range	6	6	14	4	10	8	4	3	4	4	5	6	36

Table 4.9

Daily average food waste collected from cooking pre-production area over three weeks

Date	Tomatoes	Potatoes	zucchini	Onion	Yellow Squash	Green Pepper	Red Pepper	Celery	Spinach	Mushroom	Parsley	Turnip	Total Quarter
Tuesday	4	6	11	8	3	3	2	4	0	0	1	0	42
Wednesday	4	3	12	5	3	2	1	3	0	0	1	0	34
Thursday	2	5	4	11	6	5	4	5	0	0	2	0	44
Friday	10	6	7	12	2	5	3	5	0	0	2	15	67
Saturday	4	7	4	8	1	3	0	0	0	0	0	0	27
Sunday	2	6	6	10	2	4	4	3	0	0	2	0	39
Monday	3	4	4	7	1	3	3	4	0	0	0	0	29
Tuesday	5	5	3	9	0	5	4	5	0	1	2	0	39
Wednesday	3	9	5	4	0	3	1	2	0	0	0	0	27
Thursday	4	16	7	8	2	6	1	5	0	0	2	0	51
Friday	3	6	2	11	6	6	4	4	0	0	2	13	57
Saturday	4	5	6	10	5	7	4	3	2	4	2	0	52
Sunday	5	4	7	13	5	5	3	0	2	0	0	0	44
Monday	12	10	7	15	6	4	5	0	0	2	0	0	61
Tuesday	6	14	0	13	0	5	4	4	0	2	2	0	50
Wednesday	6	4	5	9	3	5	4	6	0	0	2	0	44
Thursday	5	10	7	12	2	6	2	2	0	0	3	0	49
Friday	10	14	4	13	0	7	0	12	0	0	2	14	76
Saturday	4	8	3	11	2	0	0	6	2	4	0	0	40
Sunday	5	10	6	10	1	3	0	3	4	4	0	0	46
Monday	8	14	5	16	6	5	4	4	0	0	1	0	63
Total	109	166	115	215	56	92	53	80	10	17	26	42	981
Average	5.19	7.9	5.48	10.24	2.67	4.38	2.52	3.81	0.48	0.81	1.24	2	46.7
Standard deviation	2.69	3.88	3.91	3.01	2.18	1.72	1.7	2.6	1.08	1.48	1	5.03	13
Min	2	3	0	4	0	0	0	0	0	0	0	0	27
Max	12	16	12	16	6	7	5	12	4	4	3	15	76
Range	10	13	12	12	6	7	5	12	4	4	3	15	49

Table 4.10

Daily average food waste (in quarts) COLLECTED from post-production area over three weeks

Date	Tomatoes	Potatoes	zucchini	Onion	Yellow Squash	Green Pepper	Red Pepper	Celery	Spinach	Mushroom	Parsley	Turnip	Total Quarts
Tuesday	2	2	3	3	3	3	2	2	0	0	2	0	22
Wednesday	2	2	7	5	3	3	1	3	1	0	2	0	29
Thursday	1	3	2	5	2	0	2	3	0	0	1	0	19
Friday	3	2	6	2	1	2	3	4	0	0	0	0	23
Saturday	4	1	4	3	1	3	0	0	0	0	0	0	16
Sunday	2	2	5	4	2	4	4	3	0	0	2	0	28
Monday	3	1	4	3	1	3	3	4	0	0	0	0	22
Tuesday	5	0	5	5	0	5	4	5	0	2	2	0	33
Wednesday	3	0	3	3	0	3	1	2	0	0	0	0	15
Thursday	4	2	8	6	2	6	1	5	0	0	2	0	36
Friday	3	6	6	6	6	6	4	4	0	0	2	13	56
Saturday	4	3	6	2	5	3	4	3	2	3	2	0	37
Sunday	2	3	7	5	5	2	3	0	2	0	0	0	29
Monday	3	5	11	4	5	3	5	0	0	3	0	0	39
Tuesday	6	0	5	5	0	5	4	4	0	2	2	0	33
Wednesday	6	3	6	2	3	5	2	6	0	0	2	0	35
Thursday	5	2	8	6	2	6	2	2	0	0	3	0	36
Friday	10	0	3	4	0	3	0	7	0	0	2	6	35
Saturday	4	2	3	2	2	0	0	6	2	4	0	0	25
Sunday	1	1	2	2	1	1	0	2	0	2	0	0	12
Monday	8	6	5	5	6	5	4	4	0	0	1	0	44
Total	81	46	109	82	50	71	49	69	7	16	25	19	624
Average	3.86	2.19	5.19	3.9	2.38	3.38	2.33	3.29	0.33	0.76	1.19	0.904762	29.71429
Standard deviation	2.24	1.78	3.12	1.45	1.99	1.8	1.62	1.95	0.73	1.3	1.03	3.06	10.52
Min	1	0	1	2	0	0	0	0	0	0	0	0	12
Max	10	6	11	6	6	6	5	7	2	4	3	13	56
Range	9	6	10	4	6	6	5	7	2	4	3	13	44

Based on study observation there are significant differences in data reported by employees and the data collected by the investigator. As noted there were significant differences between the collected (26.38, 49.10 and 32.71 quarts for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) and employee reported data (19.14, 30.38 and 9.88 quarts, for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) over the three week period. Lettuce (6.33 quarts), onion (10.24 quarts) and tomatoes, zucchini and onion (~3.80 quarts each) accounted for the maximum waste in the salad/baking area, cooking/grilling pre-production area and post-production area.

Results indicate that even though the data obtained in both cases (reported and collected) were similar for produce, there was a marked difference in the total waste obtained by employees and the reported data in all three areas. This could be due to a lack of proper training or a lack of understanding of proper waste disposal practices. The study also sheds light on some features such as developing a useful waste disposal training manual for food service employees, design and application of visual aids (such as area posters etc.) as a training enhancement. Also, a process of maintaining the necessary logs could further promote consistency of the waste management protocols within food service institutions.

CHAPTER FIVE

CONCLUSION

5.1 Conclusion

This study investigated the amount of food waste from Bon Secours St. Francis Health System foodservice operations using the Trim Trax® program. The amount of waste produced during meal preparation was collected and compared to three weeks of retrospective data kept by employees in the salad/baking pre-production area, cooking/grilling pre-production area, and post-production area. The total waste, along with the amount of waste by produce type, was also measured over the three week period in all three areas. Results showed a significant difference between the collected (26.38, 49.10 and 32.71 quarts for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) and employee reported data (19.14, 30.38 and 9.88 quarts, for the salad/baking pre-production cooking/grilling pre-production area and post-production areas respectively) over the three week period. Lettuce (6.33 quarts), onion (10.24 quarts) and tomatoes, zucchini and onion (~3.80 quarts each) accounted for the maximum waste in the salad/baking area, cooking/grilling pre-production area and post-production area, respectively. Although the data obtained in both cases (reported and collected) were similar by produce type, there was a marked difference in the total waste obtained over three weeks in all three areas. This difference could be attributed to the lack of proper training of foodservice operations employees, or to the lack of employees' understanding of proper waste disposal practices. Employee education and awareness of proper waste management are critical to ensure effective waste management practices.

Further work and limitations :

Due to cost and sample size constraints, the collected data might not be sufficient to allow for extrapolation to the larger population of food service establishments however, due to the in-depth nature of data collection, the data set still allows for making recommendations. Further studies could be conducted to assess specific training needs and to develop an educational intervention using the Trim Trax ® program effectively. Such an intervention could assist in managing inventory, reducing food waste, and optimizing waste reduction within the food service operation. In addition design and production of an employee training program complete with training manual, visual aids and continuous operational improvement measures could serve to train employees in order to further support the above goals.

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