INVESTIGATING WASTE MANAGEMENT PROGRAMS IN SCHOOL FOODSERVICE OPERATIONS

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BY

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ABSTRACT

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This study investigated demographic food waste management practices, recycling of packaging waste, and attitudes and barriers concerning waste management activities in school nutrition programs. Research methods included a pilot study and a national survey of a random sample of 599 child nutrition directors who were members of the School Nutrition Association. Survey invitations were mailed and/or emailed and 79 usable responses were received. Majority of respondents (75%) indicated that the school district paid for waste hauling without billing the child nutrition program; however 18% paid a standard percent allocation (indirect cost). Cardboard, paper and plastic bottles/ containers were the most frequently recycled materials. Most respondents had positive attitudes towards recycling, but limited space, non-availability of recycling facilities in local area, and lack of customer/student participation and support were revealed as the three top barriers to waste management programs.

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CHAPTER I

INTRODUCTION

Within the past few decades as natural resources have diminished, the concept of sustainability has emerged with ideas for the conservation, reduction, and responsible management of resources. This places additional responsibility on child nutrition directors to make sound ecological decisions regarding solid waste disposal. Plans for solid waste management are dependent on the cost-effectiveness of disposal strategies and the operational policies and practices that influence the generation of production and waste services (Wie, Shanklin, & Lee, 2003).

Packaging waste has a serious effect on the environment when not recycled. Most packaging materials from households and businesses are thoughtlessly thrown away in the trash to be disposed of either by incineration or landfills. "The decomposition of solid waste in landfills results in the release of methane, a greenhouse gas 21 times more potent than carbon dioxide", according to the EPA (2007a). According to the Environmental Protection Agency (EPA), the school system is a major waste-producing sector. Thus, the school system provides an excellent avenue of opportunity to divert waste into recycled materials. A case study by Wie et al., determined that if a central food processing center in a school district recycled tin/metal cans, 30.7% of the packaging waste could be diverted from landfills and the facility could save $75,000 in waste disposal cost over the next 10-year period (2003). The literature includes several food service organization success stories about managing waste through recycling packaging and composting food waste (Hahn, 1997; Parker-Burgard, 2009). Since the production of packaging waste is inevitable in food service operations, it is important to evaluate all waste disposal methods for both cost effectiveness and environmental impact.

With well educated administrators, students, and employees, schools have the potential to influence their communities. The possibility of effective packaging waste management in school foodservice operations has been demonstrated. Lousiana's East Baton Rouge Parish Schools were able to save $30,000 per year in waste disposal expenses by recycling 30 to 35 tons of cardboard and 5 tons of steel cans per month (Hahn, 1997). Bellingham Washington's school district was able to compost over 800,000 lbs of food and packaging waste, resulting in a savings of $53,000 in four years (Parker-Burgard, 2009).

Even though these schools participate in recycling and composting, only a few school nutrition programs have actively reported participating in alternative waste disposal programs. Therefore, this research is designed to investigate current trends in packaging waste management, child nutrition directors' perception of barriers when making decisions for packaging waste management program implementation, and the cost effectiveness of current packaging waste disposal methods used by child nutrition directors.

Purpose and Objectives

The purpose of this study was to investigate the present status of food waste management programs, recycling of packaging waste, and cost of waste hauling in school nutrition programs in the United States.

The objectives were:

1. To determine food and packaging waste management practices utilized in child nutrition programs.

2. To investigate differences in attitudes and perceptions of barriers regarding food and packaging waste management by child nutrition directors.

3. To determine if there is a relationship between the method of paying for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging.

4. To determine if there is a relationship between per student cost for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging.

Null Hypotheses

1. H_0: There is no significant difference or relationship in the amount of items recycled by child nutrition directors based on the following demographic characteristics of directors': gender, age, years worked in a foodservice operation, highest education, and school enrollment.

2. H_0: There is no significant difference in child nutrition directors' perceptions of barriers to recycling based on school enrollment.

3. H_0: There is no significant difference in child nutrition directors' waste disposal costs based on whether or not they participate in recycling packaging waste.

4. H_0: There is no relationship between the method of paying for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging.

5. H_0: There is no relationship between per student cost for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging.

6. H_0: There is no relationship or difference in child nutrition director's attitudes about recycling and the following variables: school enrollment, age, gender, education, years worked in a foodservice operation, and years worked at the current foodservice operation.

Assumptions

The survey method was used to collect data from respondents. Respondents were child nutrition directors who are members of the School Nutrition Association (SNA). The researcher assumed that the SNA directors were qualified to provide reliable and adequate information about waste management practices and costs. The researcher also assumed that the requested individuals were the respondents who completed the survey and those invited to participate only completed the survey once.

CHAPTER II

REVIEW OF LITERATURE

Sustainability

Sustainability has become a big concern within the past few decades. In the past, industries have used large amounts of natural resources without concern for environmental impact and the future, but diminishing resources have led to the rise of ideas for the conservation of natural resources and the reduction and responsible management of wastes. Many businesses and agencies have become interested in sustainability and have invested time and money into developing ways in which materials and resources can be conserved to help reduce their negative impacts upon the environment. According to *Merriam-Webster's Collegiate Dictionary*, 11th ed. (2008), "Sustainability is a method of harvesting or using a resource so that the resource is not depleted or permanently damaged; or relating to a lifestyle involving the use of sustainable methods." Sustainable development can create policies that integrate environmental, economic, and social values in decision making. The consciousness about human activities and their impacts on the global environment have fostered the development and implementation of various strategies to prevent environmental degradation (Glavic & Lukman, 2007).

Foodservice operations have become the target of environmental concern. According to the Environmental Protection Agency (EPA), school systems are a major waste-producing sector, contributing between 20 and 35% of the national total of waste disposed in 2007. The school system provides an excellent avenue of opportunity to divert waste into recycled materials. Waste from foodservice operations is composed of 60 to 70% of solid waste that includes food, paper, and plastic supplies, and the remaining 30 to 40% is from food preparation and production.

Waste management efforts in all areas should focus on three objectives: reducing the quantity of waste, reusing materials, and recycling used materials. Many food service opportunities exist to decrease waste and to implement recycling strategies. Factors that influence waste production in a foodservice operation include the type of operation, the menu mix, type of service ware, and service options. For effective waste management, the challenge for administrators, departments, and school personnel is to provide infrastructure that supports waste management programs and increase positive behaviors. Factors to be considered when making decisions regarding a disposal method are the availability of alternatives, state and local regulations, environmental issues, the mission of the facility, the position of the community, storage space, labor, cost for diversions, cost for utilities and supplies, and sanitation. Conservation practices, if implemented, are able to reduce cost and decrease the environmental impact that waste has on the community and the world (Shanklin & Hackes, 2001; Puckett, 2004).

The National Dairy Council, in conjunction with the School Nutrition Association and the Child Nutrition Foundation, conducted a study to investigate recycling and waste management practices within school nutrition programs (School Nutrition Association, 2007). The study investigated waste management and recycling practices in school nutrition. The study found that 81% of 675 respondents indicated that their school district pays for the district's trash pick-up. Of those that are charged, the most common method of being charged is by standard percent allocation. With reference to recycling, 58% of the respondents indicated that the school nutrition program recycles. Cardboard was recycled by 89% of the respondents, office paper and steel/tin cans were recycled by 50%, and newspaper, plastic, and aluminum were recycled by at least 33% of school nutrition programs. Respondents indicated that in about half of the districts recycling companies provided recycling bins/containers for inside the school. For recyclable hauling, 62% indicated that their waste haulers also pick up their recyclables, 26% use a separate company, and 12% were unaware of who picks up the recyclables. With reference to recyclable charges and revenue, 54% of school nutrition programs indicated that they were not typically charged for recycling and only 2% received revenue from recycling. Respondents for school nutrition programs that did not recycle indicated there was no hauler for recyclables or that the district did not recycle.

Municipal Solid Waste (MSW)

Solid waste disposal is currently one of the most costly environmental problems that affect foodservice operations. Municipal solid waste (MSW) is solid waste that is produced in residences and at commercial, institutional, and industrial sources; it excludes any construction or demolition wastes, automobile scraps, combustion waste, and municipal sludge. Thus, all waste generated in food service organizations, excluding chemicals, is MSW. Increased disposal fees, landfill shortages, government regulations, and consumer demands for a safer environment are cited as priorities that require immediate action on the part of food service facilities. Tipping fees, the cost of placing waste materials in a landfill, have been on the rise since 1990, and are expected to continue to escalate in cost as stricter government regulations are passed (Shanklin & Hackes, 2001).

As waste disposal costs rise each year, these trends place additional responsibility on foodservice professionals to make ecologically sound decisions regarding waste disposal. Because most facilities are charged on the basis of dumpster capacity and waste disposal pickup frequency, waste disposal costs would be reduced if waste volume were decreased. However, the cost of waste management equipment, such as compactors and balers, and labor costs must be analyzed and compared to waste-hauling expenses before a program is implemented (Puckett, 2004; Wie, Shanklin, & Lee, 2003).

Solid Waste Management

In 2008, Americans generated 250 million tons or 4.5 lb per person/day of MSW and they recycled or composted 83 million tons or 1.5 lb per person/day; equivalent to a 33.2% recycling rate. The top four MSW generated items included paper, 31.0%, yard trimmings, 13.2%, food scraps, 12.7%, and plastics, 12.0%. Of the recovered material, 61 million tons were recycled and 22.1 million tons were composted. Metals (aluminum, steel, and mixed metals) were recycled at a rate of 35%, which eliminated close to 25 million metric tons of carbon dioxide equivalents in green house gas (GHG) emissions. The following are the recycling rates of selected products in 2008: 70.9% of office-type papers, 62.8% of steel cans, 48.2% of aluminum cans, 28% of glass containers, and 27.3% of polyethylene terephthalate (PETE) bottles and jars. The recovery rate of food waste was only 2.5%. While MSW generation increased from 3.66 to 4.5lb per person/day between 1980 and 2008, the recycling rate increased from 10% in 1980 to over 33% in 2008. Landfill disposal declined from 89% in 1980 to 54% in 2008 (EPA, 2009d). Several researchers have described majors issues related to solid waste management in school foodservice. Some of the concerns identified included waste hauling costs, types of service ware, the type of service system, specification of the packaging of food and supply products, labor cost and availability, and the administration's philosophy regarding environmental issues (Wie & Shanklin, 2001).

Disposal of MSW into landfills poses a major challenge because it is expensive and the least desirable option. Other alternatives to landfills and incineration include source reduction, resource recovery such as recycling and composting, and donation. According to the US Environmental Protection Agency, the key ways to diverting organic materials from landfills and incinerators includes the four "R's", reducing, reusing, recycling, and re-buying (EPA, 2010e). These strategies help to prevent greenhouse gas (GHG) emissions, reduce pollution, save energy, conserve resources, and reduce the need for more landfills.

The first step to determining which alternative waste disposal methods are most cost-effective is to perform a waste audit to determine what types of wastes are produced at a facility. For school foodservice facilities, a one week cycle or 5 day average can be used to determine the average weight and volume of waste per day (Wie & Shanklin, 2001). The initial step is to separate different types of waste to identify its origin and classification; these items can then be separated for back-of-house and front-of-house comparisons. The weights of the separated waste can be recorded, both for initial data and for comparison to check future performance if a waste reduction program is set in place. Collecting this data will help determine what waste can be reduced by ordering less product or ordering product in another form, how much can be sent to charity such as food banks or shelters, and how much can be recycled or composted. Once all wastes have been tabulated, the percentage of the facility's waste that can be reduced or recycled can be determined. Recovery methods can depend on the quantity and type of food discards, the availability of space for on-site recovery, the existence of haulers and/or end users for off-site recovery, and program costs.

The second step includes planning for cost. Cost components for alternative disposal methods for food and packaging wastes include labor for sorting wastes and operating equipment, initial purchase prices for equipment and containers, utilities, maintenance, storage, waste hauling, and other related expenses such as surcharges and transportation costs. These costs are related to collecting, transporting, and/or composting waste. Collection costs can also include containers for separation and pick-up. Starting the program requires time for research and creating communication networks through local waste organizations, recycling coordinators and facilities, local shelters, food banks, and renderers for food recycling and waste pick-up. Detailed forecasting and buying products in bulk or with less packing can also help to reduce waste production. Monitoring preparation of food items and plate waste can help to trim waste, decrease mistakes, and monitor compliance with practices and customer acceptance, which can be adjusted accordingly. The most cost-effective disposal method cannot be truly effective until it is implemented successfully and evaluated later. Even though a desire exists to implement the least costly method, sometimes it may not be the best solution. In reality, other factors should be considered in the final selection of an appropriate disposal method for each foodservice operation, such as site availability for alternatives such as animal feeding, recycling, food recovery, and composting. Other factors also include availability of labor for sorting materials and operating equipment, environmentally friendly disposal, regulations, and administrative willingness and time.

The Environmental Protection Agency (EPA) has introduced a Waste Hierarchy Chart to give guidance toward the most efficient use of resources (See Figure 1). The EPA recommends an integrated, hierarchical approach to MSW management composed of four main components: source reduction and reuse, recycling/composting, energy recovery (incineration), and treatment and disposal (landfill). The hierarchy favors source reduction to reduce the volume and toxicity of waste and to increase the useful life of manufactured products. Recycling, which includes composting, is the second preferred waste management approach to divert waste from landfills and incinerators. The next two tiers of the hierarchy consist of incineration and landfilling. Incineration is used to reduce the volume of waste being disposed, which also recovers energy from this process. Landfilling is used for the final disposal of non-recyclable and non-combustible materials. The goal of this approach is to use a combination of all of these methods to safely and effectively handle the MSW stream with the least adverse impact on human health and the environment (Green Seal, 2009; EPA, 2010c).

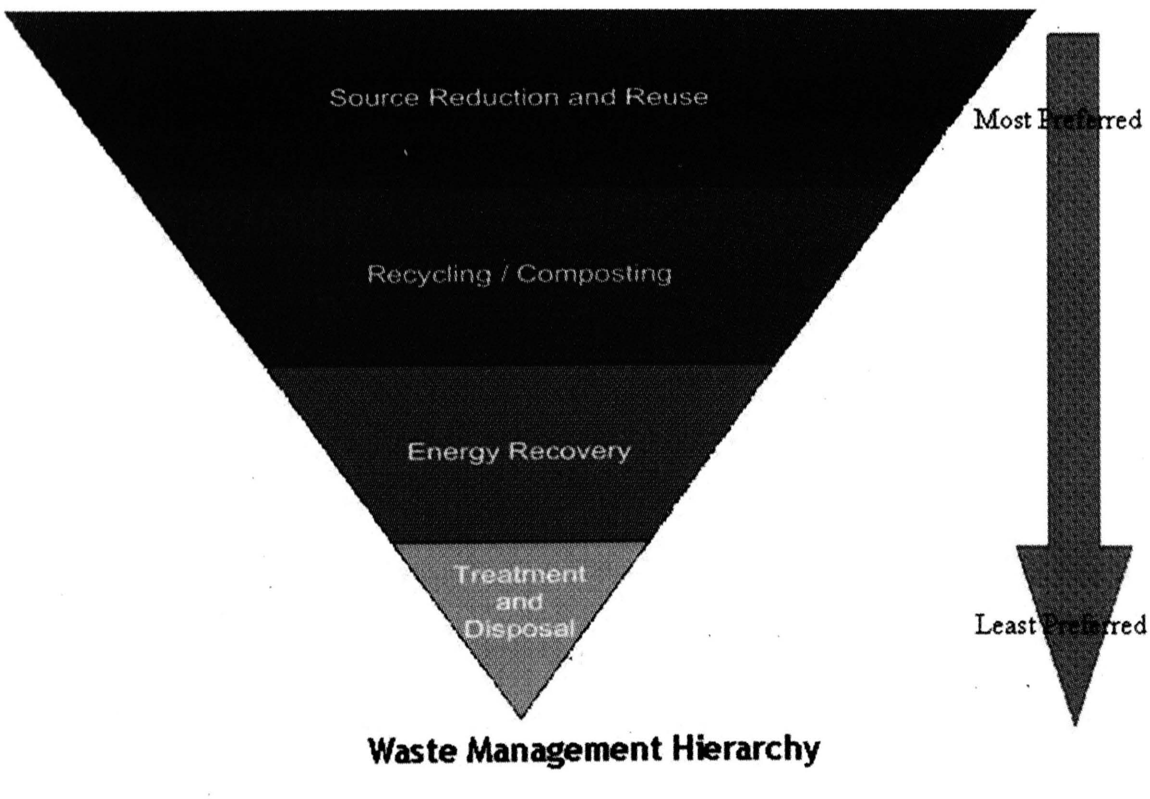

Figure 1. Waste management hierarchy.

Image: (EPA, 2010d) Figure 1 represents the Waste Management Hierarchy introduced by the EPA. It describes the most to the least preferred waste disposal methods. The most to the least preferred methods, in descending order, include source reduction and reuse, recycling/composting, energy recovery, and treatment and disposal to incineration facilities and landfills.

Payment for Waste Management

Costs that can be identified by the school district and are related to foodservice are treated as direct foodservice costs. These costs may be charged to the foodservice account and reported on the school districts expense report, or they may be absorbed by the school district, which would be unreported direct foodservice costs. Alternative costs can be treated as indirect costs; indirect costs represent over-head type expenses such as utilities, administrative support, equipment, housekeeping, and payroll. These are expenses incurred by the school district that are not practical to identify with specific functions or activities (such as foodservice), but are necessary for the general operation of the organization.

School districts can only recover indirect costs of foodservice if revenue from the school nutrition program exceeds the direct costs to be charged. Revenue from the National School Lunch Program, (NSLP) and the School Breakfast Program (SBP) is a fixed subsidy per meal based on a child's eligibility status and the percentage of meals served at a free or reduced price. School districts can decide that it is not feasible to recover these costs due to a policy, not charging indirect costs to any program, or that there are insufficient funds of the program to pay the indirect costs. If a district can prove that costs are greater than the amount of reimbursement being claimed, then the district can recover more revenue from a grant when its direct costs plus its indirect costs are charged. According to a study of 353 schools, the most common reason for not recovering all of the indirect costs was that the district expected the program funds to be insufficient (Bartlett, Glantz, & Logan, 2008).

Source Reduction

Source reduction is the preferred method of waste management since it prevents the generation of waste. Source reduction is the practice that reduces the quantity of materials entering a waste stream from a specific source by redesigning products and patterns of production and consumption. The EPA defines source reduction as the design, manufacture, purchase, or use of materials to reduce their quantity or toxicity before they reach the waste stream (O'Leary & Walsh, 1995). They also define waste minimization as measures or techniques that reduce the amount of waste generated during industrial production processes. This includes source reduction or recycling activities undertaken by the generator that results in either a reduction in the total volume of waste, a reduction in the toxicity of the waste, or both, so long as the reduction is consistent with the goal of minimizing and reducing future threats to human health and the environment (EPA, 2010b). Source reduction contributes to a lowering of disposal and handling costs because it avoids the costs of recycling, municipal composting, incineration, and landfilling. Source reduction can include purchasing products made from recycled content or with minimal packaging, monitoring food inventories to help purchase items only when needed, redesigning menu cycles to utilize opportunities for secondary use of food, ordering in bulk, and working with suppliers to return packaging waste (Glavic & Lukman, 2007; EPA, 2005).

Recycling

"Recycling is the act of removing materials from the solid waste stream for reprocessing into valuable new materials and useful products" (Puckett, 2004, pg. 348). Recycling turns materials that would be discarded as waste in landfills into valuable resources. Some of the many benefits of recycling include protecting and expanding U.S. manufacturing jobs and competitiveness, reducing the need for landfills and incineration, preventing pollution, saving energy, decreasing green house gas (GHG) emissions, conserving natural resources, and helping to sustain the environment for future generations. Recycling glass saves 25-32% of the energy used to make virgin glass. Recycling paper uses 60% less energy than manufacturing paper from virgin timber and reduces pollutants by 50%. Recycling steel and tin cans saves 74% of the energy used to produce them from raw materials and recycling aluminum uses 95% less energy than producing aluminum products from raw materials (Sharr & Pezza, 2000).

There are many materials that are used within a foodservice operation that can be easily and safely recycled. These items can include paper products, plastics, metals such as steel, tin, and aluminum, glass, wood items, fats, oils, and grease, and food waste. Depending on the market conditions, a disposal contractor may pay for recycled product, haul it away for no extra charge, or provide a reduced rate for containers and periodic pick-ups. Containers provided by disposal contractors are usually offered in sizes of two, four, six, eight, and ten cubic yards. Foodservice directors can expect to pack seven or eight filled trash bags per cubic yard. When recyclable materials are collected, they are sent to recovery facilities to be sorted and prepared into marketable commodities for manufacturing. These items are sold and bought as a commodity, and prices for the materials change and fluctuate with the market. Once cleaned and separated, these materials are used to manufacture products with recycled content. Common items that contain recycled materials include paper items, plastics, glass containers, and metal containers such as aluminum and steel. Purchasing economically feasible recycled products helps complete the loop of recycling, which makes the recycling process a success (EPA, 2010a).

External factors that influence the long-term success of a recycling program includes a continuous supply of recyclable materials, a significant volume of recyclables to recycle, and adequate markets for such materials. Recycling has environmental benefits by reducing air and water pollution associated with making new products from raw materials. The ultimate benefits from recycling are cleaner land, air, and water, for a more sustainable environment and economy. By sending the waste materials to facilities to reuse or recycle, society is getting the most benefits from its resources (Puckett, 2004; EPA, 2009d).

When Louisiana's East Baton Rouge Parish School System learned that the city would no longer provide free waste hauling service for schools, they conducted a waste audit to avoid the unanticipated $150,000 expense for a private waste contractor. The waste audit found that foodservice operations contributed to 26.5% of the school district garbage. The waste audit revealed that cardboard boxes and steel cans from food containers contributed the greatest volume of foodservice waste, which sparked an interest in a pilot recycling program. The program included training staff to rinse out steel cans and collapse cardboard boxes. By the end of the school year, 30 to 35 tons of cardboard and 5 tons of steel from 101 schools in the district were recycled every month, which amounted to a saving of $30,000 that year in garbage costs (Hahn, 1997).

Steel

Steel cans are found in every foodservice setting and the most common are one-gallon cans. Additionally, many glass and plastic containers used in kitchens have steel lids and closures. All steel products are recyclable, and more than 65% of the steel produced in the United States is recycled. Steel cans and other recyclable food containers must be rinsed for basic sanitation purposes because many recyclable items are stored for a period of time before they are picked up or delivered for recycling. Rinsing the steel cans only requires the removal of food particles, and they can be rinsed in leftover dishwater or run through the automatic dishwasher. Steel cans can be flattened manually or mechanically to reduce their volume for efficient storage and economical transportation. Mechanical flattening is done with a specially designed machine, which effectively flattens all sizes of metal cans with the bottom end intact. These machines also flatten plastic and aluminum containers (Recycle Steel, 2006-2007a).

According to an Institute of Scrap Recycling Industries report (2007), 81.4 million tons of iron and steel were recycled in 2007 (1 ton = 2,000 lbs). Scrap metal recycling saves 74% or more of the energy it takes to smelt metal from ore. There are two dominating processes in modern steel production. These include the production of steel from virgin iron ore or steel scrap. Ire ore is a naturally occurring element found in the earth's crust. In its natural state, iron ore is a metallic-looking rock that usually has other types of nonmetallic rock clinging to it. When ore is fired to its melting point in a blast furnace, a great deal of air pollution is created by the burning of coal. Refining ore into metal is called smelting. While iron ore is plentiful, the process of smelting iron, or refining ore into metal or steel, is energy-intensive. It takes significantly larger volumes of coal to smelt ore than it does to simply melt down recycled iron and steel. Thus, air pollution can be reduced by recycling metals. Recycling helps to reduce dependence on coal for electricity and helps to reduce the rate at which society is polluting the environment (Childress, 2008).

Scrap that requires processing before it can be made available for re-melting is collected by scrap processors or through the municipal waste disposal system. Steel is magnetic, so it can be separated or removed from the solid waste stream or other recyclables magnetically. The scrap is then processed into a physical form and chemical composition that steel producers can consume. There exist strong economic incentives to use scrap materials for steel production. Steel essentially does not suffer any downgrading when scrap is recycled, and it can thus almost be recycled indefinitely. The process chain from scrap to steel involves fewer steps and less costs compared to virgin ore-based production. Recycling of steel represents not only a means of acquiring raw materials, but the activities also save virgin natural resources, reduce pollution, and prevent accumulation of ferrous waste that would otherwise be disposed of in landfill sites (Fenton, 2004 & EUROFER, 2006). According to Emery et al. (2002) every ton of recycled steel saves approximately 1.1 tons of iron ore, 0.6 tons of coal and 54kg of limestone. Recycling also results in 86% less air pollution, 76% less water pollution, a 40% reduction in water use, and reduces the generation of solid waste by about 1.3 tons.

Aluminum

Aluminum is the second most-used metal in the world after steel. The aluminum industry obtains its raw materials from two sources: primary and secondary aluminum. Bauxite is the raw material from which primary aluminum is obtained. The mineral is obtained from areas where temperatures are high and rains are frequent, such as West Africa and Central-South America. Primary aluminum has the greatest energy requirement but has the possibility of being recycled nearly without limit. The secondary source of aluminum is recycled metal, derived from end of life cycle products. Firms are becoming more interested in pro-active strategies which consider environmental problems during the planning phase of the product rather than in 'end of pipe' strategies. With aluminum recycling, there is a 95% energy saving compared to primary aluminum production, and the use of natural and non-renewable raw materials is avoided. Recycled aluminum has the same quality as new aluminum; repeated recycling does not diminish the quality of the metal as it does materials such as cardboard and plastics (Olivieri, Fomani, Neri, 2006 & Gutierrez & Johnson, 2009).

Energy saved from recycling one ton of aluminum is equal to the amount of electricity the average homes uses over 10 years. Recycling one aluminum can saves enough energy to run a 100-watt bulb for 20 hours, a computer for 3 hours, or a TV for 2 hours. Aluminum recycling is so efficient that it can take as few as 60 days for a can to be collected, melted down, and made into a new can sitting on a grocery store shelf. Even so, only 63.5% of aluminum cans are recycled annually. Twenty recycled cans can be made with the energy needed to produce one can using freshly mined ore. Using recycled aluminum beverage cans to produce new cans allows the aluminum can industry to make up to 20 times more cans for the same amount of energy. Recycling aluminum creates 97% less water pollution than producing new metal from ore. Throwing away an aluminum can wastes as much energy as pouring out half of that can's volume of gasoline (Can Manufacturers Institute, 2006).

Plastic

In 1988 the Society of the Plastics Industry, Inc. (SPI) voluntarily created a coding system to help identify the resin content of bottles and containers commonly found in the residential waste stream. The SPI's resin identification code's stated mission is to facilitate the recovery of post-use plastics. Plastic is not any one material; rather, it is a family of related materials with varying properties that can be engineered to meet the requirements of a broad range of applications. Coding enables individuals to perform quality control (sorting) before recycling, ensuring that the recycled plastic is as homogenous as possible to meet the needs of the end markets (Association of Postconsumer Plastic Recyclers & American Chemistry Council, 2008 & SPI, 2009).

Figure 2 describes the different plastic resin codes. The majority of plastic packaging is made with one of six resins: polyethylene terephthalate (PETE), high density polyethylene (HDPE), polyvinyl chloride (PVC or V), low density polyethylene (LDPE), polypropylene (PP), or polystyrene (PS). The SPI resin identification code assigns each of these resins a number from 1 to 6. The SPI coding system includes a 7th code, with is identified as "other." The #7 code indicates that the product is made with a resin other than the previous six listed, or is made with more than one resin. Currently, 39 states have adopted legislation regarding the use of the resin identification codes on bottles of 16 ounces or more and rigid containers of 8 ounces or more consistent with the SPI code (SPI, 2009).

Plastic Identification Code	Type of plastic polymer	Properties	Common Packaging Applications
01 PET	Polyethylene Terephthalate (PET, PETE)	Clarity, strength, toughness, barrier to gas and moisture.	Soft drink, water and salad dressing bottles; peanut butter and jam jars
02 PE-HD	High Density Polyethylene (HDPE)	Stiffness, strength, toughness, resistance to moisture, permeability to gas	Milk, juice and water bottles; trash and retail bags.
03 PVC	Polyvinyl Chloride (V)	Versatility, clarity, ease of blending, strength, toughness	Juice bottles; cling films; PVC piping
04 PE-LD	Low Density Polyethylene (LDPE)	Ease of processing, strength, toughness, flexibility, ease of sealing, barrier to moisture.	Frozen food bags; squeezable bottles, e.g. honey, mustard; cling films; flexible container lids.
05 PP	Polypropylene (PP)	Strength, toughness, resistance to heat, chemicals, grease and oil, versatile, barrier to moisture	Reusable microwaveable ware; kitchenware; yogurt containers; margarine tubs; microwaveable disposable take-away containers; disposable cups and plates.
06 PS	Polystyrene (PS)	Versatility, clarity, easily formed	Egg cartons; packing peanuts; "Styrofoam"; disposable cups, plates, trays and cutlery; disposable take-away containers;
07 O	Other (often polycarbonate or ABS)	Dependent on polymers or combination or polymers	Beverage bottles; baby milk bottles; electronic casing.

Figure 2. Plastic resin codes. Image: (WIZTEM Group Company Limited, 2008)
Figure 2 describes the different plastic resin codes.

Continuing innovation in packaging design for household products and beverage bottles has resulted in lighter bottles and fewer pounds of recycling-available material for the same number of bottles. The applicable disposal methods for packaging wastes include recycling, processing them though a pulper, or transporting them to a landfill, where incineration may occur (Wie & Shanklin, 2001). PET and HDPE bottles continue to comprise over 96% of the US plastic bottle market and over 99% of the bottles recycled. Resins #3- #7 are recyclable to varying degrees and make up less than 4% of the plastic bottle market; the actual level of recycling is limited by the continuing challenge to reach a critical mass of readily recognizable bottles for economical collection and processing. Barriers to plastic bottle recycling include consumers being unaware of the value and demand of recycled plastic and the lack of sufficient access to recycling collection opportunities. (Association of Postconsumer Plastic Recyclers & American Chemistry Council, 2008)

Milk Packaging

Schools typically pay for trash disposal by the cubic yard. Plastic milk bottles can easily be recycled and can be the one item that makes enough "critical mass" to be worthwhile for a recycling company to work with a district for no or very low cost. According to National Dairy Council pilot tests, since milk bottles are bulky, recycling them can reduce trash volume between 9 and.20 %. As additional materials are recycled, even more trash/dumpster disposal costs are avoided. Having less garbage to pick up can translate into lower waste-hauling costs when contracts are renegotiated due to initiation of a recycling program. National Dairy Council pilot tests have also shown that up to 95 percent of milk bottles are recycled at the elementary level, about 65-75 percent at the middle school level and 10-15 percent at the high school level. With reference to weight, there are typically 32 8-oz plastic milk bottles with caps, or 40 bottles without caps per pound. Single serve beverages of 16-oz or more average 16 bottles per pound. There are approximately 1,600 8-oz milk bottles to a cubic yard. Pilot tests also revealed that with plastic bottle recycling, an average of 7.71 pounds of recyclable materials per student will be collected over a school year (National Dairy Council, 2005 & 2006).

Brenda Freshour, the school nutrition director for Green County School District, located in Greenville, Tennessee switched to plastic milk bottles to increase milk consumption. The Southeast United Dairy Industry Association (SUDIA) provided training to each of the school's managers to implement the recycling program. SUDIA provided recycling bins to collect the plastic milk bottles. The school conducted four week "trial runs" in two of their sixteen schools. Freshour stated that "while the cost of the plastic bottles was higher than cartons, the increased milk sales helped to absorb some of the additional cost." After implementation in all sixteen schools, milk sales increased 33% and an estimated 2,800 -2,900 lbs of plastic milk bottles was recycled per week (National Dairy Council, 2008b).

Beth Glitt, the foodservice director at South-Western City schools decided to invest in plastic milk bottles to also increase milk consumption, but knew that the switch from cartons to plastic bottles would require an investment. The Solid Waste Authority of

Central Ohio (SWACO) partnered with the school to help recycle the #2 plastic bottles by providing recycling bins for the students to use. After their programs implementation, milk sales increased 6% in the first year and an estimated 88 tons of plastic was recycled each school year (National Diary Council, 2007).

Polycoated layers in milk carton construction provide barrier properties to retain milk freshness; however, these coatings are deterrent to recycling and the pulping process used to make new paperboard products. Refrigerated paper milk cartons are lined with 2 layers of polyethylene (LDPE, or #4 plastic) inside and out for waterproofing. Shelf stable cartons contain an added aluminum layer for light, color, and oxygen protection. Residual milk left in paperboard cartons is also a contaminant to the recycling process. Only very small quantities of milk carton material can be handled during recycling at one time because it must be blended with other higher quality fiber sources to meet feedstock requirements in new paperboard production. Paperboard cartons can be recycled but few facilities are capable of handling the polyethylene layers in the cartons. A website has been set up by the Carton Council to provide users with the capability of finding a carton recycling facility nearest to their location. Therefore, most paper cartons end up in landfills. In contrast, plastic bottles are easy to recycle and the collected material is in high demand. (Killinger, 2007)

Most processors use natural (non-pigmented) high density polyethylene (HDPE) resin to manufacture 8-oz plastic milk bottles. HDPE milk bottles are largely made from petroleum and natural gas. Plastic packaging (bottles, film, foam) account for 1.4% of the nation's annual consumption of natural gas and petroleum. Recycled natural HDPE consistently has the highest market value of any post-consumer plastic and is typically second to post-/consumer aluminum cans in value on a per ton basis of all post consumer recyclables collected. Recycled natural HDPE from milk bottles is used to make a variety of recycled content materials. Two million plastic milk bottles can easily be recycled from a district with 30 schools, which is equivalent to recycling and diverting the same amount of space taken up by 1,182 refrigerators. Recycling a ton of plastic bottles saves the equivalent of 3.8 barrels of oil. The process of making new plastic products requires less than half the energy when recycled plastic resin is used in place of natural resin Plastic bottles are more readily recycled than paperboard milk cartons because few recycling facilities can handle paperboard cartons that are polycoated (Killinger, 2007). In 2008, over 9,200 schools served more than 5.5 million students and experienced increases in milk sales of 10% to 50% and increases in lunch participation of 10% to 15% (National Dairy Council, 2008a).

Plastic pouches are another type of milk packaging. A machine produces plastic pouches from rolls of polyethylene, creating pouches with a capacity from 8 to 74 fl oz. The 8 oz Mini-Sip pouch name refers to the straws, which are specifically designed to pierce the pouches. To drink the milk, the kids pick up the straws and punch one end though the plastic pouch and into the milk. The Mini-Sip pouch is a source reduction option; the pouches require 85% less dry storage space than cartons, take up 70% less space in non-compacted trash cans, and 90% less space in compacted landfills. The 8oz pouches from Producers Dairy require about 25% less refrigerated storage space in dairies, delivery trucks, and schools than cartons (Dairy Foods, 1999).

When Louisiana's East Baton Rouge Parish school system learned that the city would no longer provide free waste hauling service for schools, they conducted a waste audit to avoid the unanticipated $150,000 expense for a private waste contractor. Knowing the volume of the garbage was essential to knowing the number of dumpsters needed for the school. The waste audit was conducted at six schools in the district to identify the volume, weight, and composition of the garbage generated by the foodservice operation. The waste audit first found that foodservice operations contributed to 26.5% of the school district garbage. The district served 60,000 students, which resulted in throwing away 10 million milk cartons per year. Switching to milk pouches reduced the volume by 25% and saved $120,000 in dumpster leasing costs over 3 years (Hahn, 1997).

Food Waste

Food waste includes uneaten food and food preparation scraps from household residences or commercial establishments such as restaurants, grocery stores, and cafeterias. Foodservice operations commonly discard food due to trimming in preparation, overproduction, overstocking, improper stock rotation, expired self dates, expanded menu choices, and plate waste. The disposal methods applicable to food waste include the use of a pulper, where items can be composted, either on or off site, or sent to the landfill. Food wastes can also be recovered, used for animal feeding, or disposed of in a garbage disposal.

A joint publication of the EPA and USDA estimated that the nation spends about one billion dollars a year to dispose of food waste. The third largest waste stream generated in the US is food waste, closely following paper and yard waste. In 2008, about 12.7 % of the total MSW generated in the US was food scraps; less than 3% of 32 million tons were recovered and recycled, leaving 31 million tons to be thrown away into landfills or incinerators (EPA, 2009a).

Food recovery and waste reduction efforts can help decrease waste collection and disposal fees due to reducing the size of the needed dumpsters and lengthening the time between waste disposal pick-ups. According to "A Citizen Guide to Food Recovery" published by the USDA, the term food recovery refers to the collection of wholesome food from farmers' fields, retails stores, or foodservice establishments for distribution to the poor and hungry (1996). Improved sanitation is also a benefit of food waste reduction, donation, and composting. When food waste is disposed in standard trash cans and dumpsters, it can attract rodents, insects, and produce a foul odor. If this food is placed in nonabsorbent, leak proof, and durable containers to be picked up frequently for donation or composting, these problems can be significantly reduced or eliminated.

Separating and managing food waste can result in both economic and environmental benefits. Economic benefits include decreased disposal fees because food banks and renderers often provide free pick-ups for excess food. Composting fees can also be less than landfill and incineration fees. Foodservice operations can have decreased sewer treatments due to the elimination of sending excess food waste down the drain and increased tax deduction for food donations to charities. Environmental benefits include creating nutrient rich compost, eliminating the usual dumpster visitors and odors, conserving landfill space, decreasing GHG emissions, and decreasing the volume of waste sent to incineration (EPA, 2006).

Garbage disposals and pulpers are mechanical devices that are used in foodservice operations to dispose of solid waste. When disposals are used, solid waste can be reduced by 75 to 85 percent. Pulpers can typically reduce food, paper, plastic, and other waste by as much as 90%, which translates into 10 bags of garbage compressed into one. Food waste disposed of down drains and garbage disposals contributes to increased levels of biological oxygen demand (BOD) and chemical oxygen demand (COD) which deplete oxygen levels in water, thus oxygen levels become too low to support aquatic life (Sherman, 1998).

A pulper system is only an intermediary volume reduction strategy. The residue must be discarded either by composting or sending to a landfill. Therefore, costs for pulper use should be added to costs for composting or landfill. Pulpers are expensive investments, averaging from $8,000 for smaller units to $125,000 for larger units. Employees must be trained how to use, clean, and properly maintain the equipment. A pulper works like a garbage disposal except that it is designed specifically for the disposal of additional items with food waste. Pulpers can handle a variety of items which include paper trays, foam, foil, corrugated boxes, bones, food scraps, and some plastics. The pulper hydrates products into a slurry in a shredding device and then presses water out of it. The waste becomes a semi-dry, degradable pulp ready for disposal and the excess water is recycled in the pulping tank for reuse. A pulper can use from one to five gallons per minute and a garbage disposal can use seven to eight gallons per minute. The disadvantage to a pulper is that they require constant maintenance and must be cleaned daily to remove excess garbage that has collected during daily use. If not cleaned daily, the excess waste can harden into a rock-like consistency and ruin the machine. A waste pulping system is not designed to be a final disposal method. If the pulper only handles organic items, the semi-dry pulp can be transported to a composting site. If the pulper handles non-biodegradable items, this dry pulp must be disposed with other solid waste, either to incineration or a landfill. The underlying problem is that even though pulpers are effective at reducing the volume of trash, the end weight is the same, and may even be heavier due to added water. Even though trash is compressed, some garbage hauling companies charge extra fees due to denser waste. This ultimately disposes the same amount of waste into a landfill (Spears & Gregoire, 2003; Puckett, 2004).

Food Recovery

If a garbage disposal is normally used to discard food waste, food recovery can reduce waste disposal costs and reduce water and energy use. In 1995, the USDA estimated that if just 5% of food losses were recovered, it would provide one day's worth of food for 4 million people and save $50 million dollars a year in MSW disposal costs (Kantor, Lipton, Manchester, & Oliveria, 1997). Donation to local shelters, soup kitchens, and food banks can be considered when dealing with safe excess edible food waste. In addition to decreasing environmental impact and cost savings, a business can create a positive public image and feel good about helping others who might have gone hungry. Food recovery also has benefits that extend beyond providing food to the needy. The additional food supplied by recovery programs allows agencies that serve the disadvantaged to reallocate money to other services, money that they would have otherwise been spent on food. To protect food donors, "Good Samaritan" laws that address food donations have been enacted in all fifty states. The Bill Emerson Good Samaritan Food Donation Act, a federal law, strengthens the Good Samaritan laws by providing national liability protection to food donors and encouraging the donation of food and grocery items to nonprofit organizations. The language of the law varies with each state but they all provide some level of protection from civil and criminal liability unless injury is caused by gross negligence, recklessness, or intentional misconduct of the donor (U.S. Government Printing Office, 1996).

Donating Waste for Animal Food

If excess food is unable to be used for human consumption, a foodservice director can choose to donate food scraps to local livestock farmers for animal feed. Before setting up a food scrap collection with a local farmer for animal feed, a foodservice director should consider the volume generated either daily or weekly and the composition of the food scraps, because farmers may not accept certain foods that could be harmful to their animals. A pick-up schedule should also be planned to guarantee freshness and adequate storage space to house collected food until pick-up. The initial cost of transitioning to animal feeding includes the purchase of a refrigerator and additional collection containers. Utility costs to refrigerate the food waste must also be considered (Wie, Shanklin, & Lee, 2003).

In accordance with the Swine Health Protection Act (SHPA) and Federal regulations, food waste containing meat may only be fed to swine if it has been treated to kill disease organisms. Regulations require that food waste containing meat must be heated throughout at boiling (212 °F or 100 °C at sea level) for 30 minutes before being fed to swine. Requirements exist regarding the licensing of facilities that treat garbage for feeding to swine. Food waste that can be safely fed to swine without being heated include: rendered products, bakery waste, candy waste, eggs, domestic dairy products (including milk), fish from the Atlantic Ocean within 200 miles of the continental United States or Canada, and fish from inland waters of the United States or Canada that do not flow into the Pacific Ocean (USDA, 2011). However, individual states may adopt stricter versions of this act.

Composting

Composting, as it relates to food service waste management, is the process of separating organic waste such as food, napkins, paper, paperboard, cardboard, and biodegradable items from other waste so that the organic waste is stored and eventually used as fertilizer or land conditioner. Degradation, which occurs in composting, is a biological, chemical, or physical process, in which plant and animal residues render their elemental components available for future generations. Organic products that can be diverted from the waste stream for composting include the following: produce trim, spoiled fruits and vegetables, frozen food, day-old, spoiled, or excess batter from bakery products, coffee grinds, filters, tea bags, egg shells, floral waste and plant trimmings, and leftovers that cannot be served again. Paper and plastic items that can be composted include waxed or wet paper, corrugated cardboard, paper towels, paper cartons, plates, napkins, trays, cups, food wrappers, and biodegradable plastic ware (flatware, plates, cups, bags, trays). It must be noted that protein containing items such as dairy, seafood, and meat products can attract rodents and other animals when composted. The removal of organic waste from trash sent to landfills can significantly decrease waste-hauling expenses (Glavic & Lukman, 2007; Puckett, 2004).

In 2007, Scott Kingery, RD, SNS, Olathe Kansas Public Schools director of food services, decided to form an environmental issues study committee to examine how to reduce waste in the food service department. At the time, disposable polystyrene trays were being used in all 50 of the district's schools due to small kitchen size. Thus at the time, disposable trays were the best solution for service ware for the schools, which were convenient, sanitary, and inexpensive.

In 2008, Kingery decided to prepare projections for the cost of changing to reusable tableware. The start-up costs, which involved building additions were projected at $12 million and the additional annual cost to maintain such a system would have been $1.1 million. A project would have required a lunch price increase of approximately $.385 per meal. With this in mind, the environmental study committee launched a compostable tray pilot study program in one high school and all its feeder middle and elementary sites. For the program to work, students dumped leftover food scraps in the trash and put the trays into a designated recycling container, and now schools in the pilot study now yield less trash overall. The foodservice department then contracts with the city to have the trays picked up and sent to a compost facility. There, the trays are mixed with city grass and lawn clippings. The finished compost is then available to any resident for home and garden and is also used on parks and any other city-maintained areas (Mclaren, 2011).

Composting has been implemented successfully in many operations, especially those located in close proximity to a commercial compost facility. Small scale projects have been established at schools and institutions that compost kitchen food waste on-site using low-tech methods. Larger sized projects have been seen at prisons, universities, military bases, zoos, and some industries that use more complex methods of composting to process both pre- and postconsumer waste on-site. The largest projects are operations such as commercial sites, farms, and municipal facilities that accept food waste from other waste generators (Puckett, 2004).

Students in the Bellingham Washington's school district did what many other students do; they throw all their trash and food residuals into one trash can. But when a representative from the district's waste hauling company mentioned a composting program to the food service manager to help reduce the amount of waste and cost, a pilot program was set in place. The pilot composting program was approved by administrators and projected that the district would save money through composting because of a lower hauling rate: $12 per cubic yard for compost versus $15 for garbage. After the pilot program proved successful, it was expanded to other elementary schools, middle schools, and then high schools. From 2006 to 2009, the district was able to divert over 800,000 pounds from the waste stream, resulting in a net savings of $53,000 in only four years. With the composting program, students are able to learn about the science of composting, the community is able to devote less space to landfills, and the district is able to benefit from the compost made each year (Parker-Burgard, 2009).

Vermicomposting is a type of composting that uses worms to help transform food scraps into nutrient rich soil that can be used or sold as compost. This program is usually found on-site at schools, businesses, prisons, hospitals, universities, businesses, sports stadiums, zoos, farms, and municipal facilities. Compost is very versatile and beneficial for many applications because it has the unique ability to improve the properties of soils leading to healthier plants. The use of recycled food waste in the form of compost improves soil health and structure and increases drought resistance, as well as reducing, or even eliminating the need for fertilizer and pesticide use. Today, compost and mulch are gaining acceptance in both the development and construction fields for their ability to help control erosion (USCC, 2008; EPA, 2009a).

Waste-hauling costs to compost sites are less than those for transporting wastes to a landfill, but composting requires other cost components such as labor and time for sorting compostable wastes. A food service director must first assess financial feasibility of composting and the availability of storage space for holding waste before pickup. Also, these facilities must be monitored and maintained properly for the diversion of organic waste to be successful (Wie, Shanklin, & Lee, 2003).

Fats, Oils, and Grease (FOG)

Grease from restaurants, homes, and industrial sources are the most common cause (47%) of reported sewer blockages and overflows. This occurs when grease solidifies, reduces conveyance capacity, and ultimately blocks flow. FOG wastes are generated at food service establishments as byproducts from food preparation activities. This occurs with the use of cooking oil (yellow grease) for frying food items and grease collection from cooking food items (grease trap). A grease trap is designed to prevent grease, oil, solids, and other debris from entering the waste stream, where it can create a problem by clogging sewers and disrupting the water flow in the system. A grease trap is able to capture the FOG waste and hold it until it is collected by a rendering company who can properly dispose or process the waste.

Rendering companies accept oil, grease, and animal byproducts, which can either be re-sold or re-used for the manufacture of tallow, animal feed supplements, or bio-fuels. The cost of rendering FOG waste is considerably lower than the charge for pumping out a grease trap due to overflow. Renderer's service fees for collection are often low, and in some cases they are willing to pay for surrendered FOG waste. If uncollected, the annual production of 800-17,000 pounds/year per restaurant can enter sewage treatment plants. Establishments who adopt FOG waste management programs are likely to reduce the occurrence of sewer overflow and improve their operation.

Biodiesel is an alternative fuel source that is produced from renewable resources such as waste cooking oil or soy bean oil. The use of biodiesel helps to reduce the nation's dependency on non-renewable energy resources and foreign oil. The recovery process of waste cooking oil helps to reduce and eliminate these oils from either being dumped into landfills or discarded down drain, which can clog piping and cause sewer spills. Turning cooking oil waste into fuel helps to extend the life of landfills and prevents the waste from contaminating groundwater supplies. Biodiesel processing plants help to improve the local economy by adding jobs and they also provide a renewable energy source (EPA, 2009b, 2009c, 2007b).

While many foodservice operations are implementing waste reduction programs, the use of alternative waste disposal methods is not without its challenges. Several factors can influence the success of waste management programs. Sorting of waste for composting or recycling can mean increased labor and resistance from staff and employees. Management's motivation and support, along with the education and motivation of employees and guests are critical to success of a waste management program. Management should initiate recycling programs with education and incentives that stress that employees are at the heart of the program's success. Investments must be made to educate and train employees about the importance and mechanics of the program, and employees should be trained until they are comfortable with implementing the proposed changes. When these changes are made, it is important to remember that employee feedback is essential during program planning and implementation. All parts of the program must be considered to render it successful (Mc Caffree, 2009).

Incineration and Landfills

Incineration, or combustion, is a method that is used to decrease the volume of solid waste generated and produce energy from waste materials. Incineration is the most costly waste management option and is at least twice as expensive as landfills. Incinerators have numerous liabilities which include pollution generation, the waste of energy and materials, and the undermining of waste prevention and rational approaches to waste management. The incineration process often exceeds air pollution standards, and creates toxic ash. These facilities can release pollutants such as dioxins, heavy metals, nitrogen oxides, sulfur oxides, particulate matter, and numerous volatile compounds into the atmosphere. Dioxin in a cancer causing organic pollutant and is also known as one of the most toxic substances to humans. These pollutants can cause a wide variety of adverse health effects including cancer, respiratory disease, and the disruption of the endocrine system.

Not all material discarded is incinerated; about 5 to 10% is considered "by-pass" material, which includes nonburnable items and waste that is landfilled when the incinerator is not working properly. In addition, 25% by weight of what is burned ends up as ash that still requires landfill disposal. The small amount of energy incinerators do produce does not come near the amount of energy that could be saved by recycling and resource conservations. If the U.S. burned all of its MSW, it would contribute to less than 1% of the country's energy needs. The alternatives to incineration cost a fraction of what incineration costs and pollute far less. In industrializing countries, source separation recycling and composting programs have the potential to divert 90% of household waste from disposal, a level incineration cannot achieve. Incineration cost can range from $136,000 to $270,000 per tonne per day. A" tonne" refers to a metric ton (1,000kg). In the U.S., capital costs of recycling facilities average about $30,000 per tonne per day of capacity, and composting facilities cost even less than recycling operations. Materials burned in incinerators such as paper, garden discards, and some plastics have a much higher value when used as raw materials than when used as fuel. As a whole, three to five times more energy can be saved by recycling materials than by burning them. Reuse, recycling, and composting also creates more jobs than landfilling and incineration. In the U.S., on a per tonne basis, sorting and processing recyclables alone sustains 11 times more jobs than incineration (Platt, 2004).

The disposal of solid waste into landfills produces greenhouse gas emissions by producing methane, which is 21 times more potent than carbon dioxide. Waste reduction through prevention and recycling can reduce methane emissions from landfills and incinerators, save energy, and allow more natural resources to remain un-harvested. Methane and other harmful gaseous by-products of decomposition are produced when conditions become anaerobic, as when landfills are capped. It is important to note that organic wastes do not contain methane; it is only when the environment becomes anaerobic, that methane is released. When gas is collected in landfills, it can be burned to convert it to mainly carbon dioxide and water, or into an energy source (EPA, 2007a; Shanklin & Hackes, 2001).

Waste Management Programs Selected by Foodservice Operations

Mockville School District, Davie County, North Carolina

Daughn Baker, Child Nutrition Director for Mocksville School District and new president-elect for the North Carolina School Nutrition Association started a new waste management program in the spring of 2010. Now, all 12 districts recycle more material than they discard. Recycled items include school paper, plastic, aluminum, cardboard boxes, steel cans, and water and juice bottles. Recycling resulted in multiple dumpsters being eliminated, which increased their cost savings.

The Mockville school meals program has also experimented with other green initiatives, some with more success. While Baker still uses polystyrene trays, she states that her team is able to mix up disposable and permanent ware from day to day, using permanent ware on days with easier food prep, which is usually twice a week. Two middle school kitchens have installed new ENERGY-STAR-rated dish machines. The new machines are taller and allow three to four sheet pans in one load, increasing efficiency (Mclaren, 2011).

Grapevine-Colleyville Independent School District (GCISD), Texas

In 2009, the nutrition department at GCISD decided to launch a recycling campaign. Some highlights of their recycling campaign include the "Drink It or Sink It" program to promote beverage container recycling, as well as a successful transition from polystyrene trays to permanent plastic trays at all 11 elementary schools. The school nutrition team is still in the initial stages to creating an agreement with a company to recycle the disposable trays currently used in all secondary schools. Other green initiatives within GCISD include recycling bags, boxes, steel cans, milk containers and water bottles; recycling bins are located in each classroom. The nutrition department promotes Earth Day each year with different activities. Only ENERGY STAR-rated appliances are purchased by the department and menus are printed on recycled paper (Mclaren, 2011).

Prior Lake-Savage Area Schools, Minnesota

Jean Winters, Director of Food Services, revealed that her foodservice department still uses permanent trays and flatware. While they continue to use permanent ware in elementary schools, they have switched to compostable ware in high schools because they have continued to notice that high school students tend to throw away or leave flatware on the tables more than elementary and middle school students. Other initiatives taken by their food service department toward sustainability include piloting a green cleaning product at a high school. Sunburst Chemical, a family owned Minnesota company, used in the pilot program has shown good cleaning power and indicate that the products may cost 15% less than other brands. Elementary and middle school students also collect leftover food scraps in central bins; the collected scraps are then bagged up and sent to feed pigs at a nearby farm (Mclaren, 2011).

Doubletree Hotels, Part of Hilton Hotels Corporation

There are two ways to implement a reduction and recycling initiative in the hospitality industry, either subtly, where guests are unaware of the changes or by actively promoting sustainability and inviting guests to help conserve resources. The Doubletree Hotels, found in 200 or more cities, chose to incorporate guests into their program. Since 1996, they have reduced their waste disposal volume by 65%. During the first six months in 2006, they diverted over 126 tons of waste from the landfill, saving almost $10,000. Doubletree Hotel currently participates in a food residual diversion program, where they place anything that can be recycled into compost bins, which includes food waste, paper products, and wood. Containers for paper, glass, aluminum, and plastic are also setup in guest areas for collection. Their current program is cost neutral, because the reduced garbage disposal costs offset the increased costs for frequent pick-ups. They have also teamed up with a local firm that collects and sells the hotel's kitchen oil waste for producing biodiesel and other waste-oil products. To further reduce waste, the hotel tries to appropriately forecast meal production and then donates safe excess food to a local shelter. Their company estimated that the system they currently use diverts about 600lb/month of recyclable items from the landfill (McPhee, 2006).

Burgerville, Holland Inc.

Burgerville Restaurants of Holland Inc., currently participates in recycling, composting, and waste reduction. Their profit margin of 10% is not far behind McDonald's 15%. They first began their waste reduction idea as a pilot program in a

Vancouver, Washington restaurant. With the success of a pilot program, they decided to expand it across the entire chain. All food waste and soiled paper are separated into composting containers to be taken to a transfer station and then hauled to a composting site. A company waste audit identified that 85% of their total waste stream could be recycled and composted (1% containers, 80% food waste and soiled paper, 4% mixed paper, and 5% film plastic). Results of this audit convinced the company that waste diversion made sense for all Burgerville restaurants. If all 39 restaurants were to fully set in place the recycling and composting project, the company projected an annual savings of $100,000 due to waste diversion. The company found that the composting program could pay for itself if it only diverted organics from the back of the restaurant. The company noted that the cost to pick up two cubic yards of MSW was $146 compared to $85 to pick up the same amount of organic waste. Through this program, they recommend that the first step to implementing a waste diversion program is to start with container collection. Education for any individual coming in contact with the container must be provided to make the program a success. Two restaurants within the company have transitioned their back of the house recycling program to the front of the house to engage their guests. This transition is one more conversation their employees can have with their customers (Goldstein, 2007).

The University of New Hampshire in Durham (UNH)

The University of New Hampshire has created a closed loop to recycling food scraps. In 1999, UNH dietetic interns conducted a food waste study, which estimated that a total of four ounces of pre and post-consumer food residuals were generated with each meal. This totals almost 4 tons/week, when serving approximately 75,000 meals/week during an academic year at UNH. This investigation prompted UNH Dining to invest in a compost operation. The project began by initially adding food scraps from the UNH dining halls to the already composted items of poultry and dairy manure. Food waste is collected from UNH dining halls and local Durham businesses and composted at the UNH College of Life Sciences and Agriculture's Kingman Farm. At the dining halls, all waste is handled by foodservice employees. Students load trays on a conveyor which leads directly into the dish room. It is here that food waste items are separated and sent through a pulper, which when combined with water, reduces the food waste into very small pieces and extracts the liquid. The pulped food waste is ideal for composting due to its increased surface area, which allows for quicker decomposition and helps to eliminate odors at the compost site. This pulped material is then collected in plastic garbage cans, and then stored in a dedicated refrigerator until pick-up for delivery to the composting site. Composting allows the organic waste items to be beneficially used instead of burdening the wastewater stream.

The compost is sold locally and also used by the UNH Organic Garden Club to grow fruits and vegetables that are sold on campus, used in the dining halls, or used at community dinners for the public. The compost is sold for retail as "U Doo" to area farmers and gardeners. Since the program began, more than half a million pounds of food waste have been diverted from the waste stream. Besides composting, UNH also has a well developed recycling program. They have contracts with waste management operations that collect the waste and recyclable items weekly. Recycled items from academic buildings and residence halls include cardboard, paper, plastic and glass containers. In 2006, their collection amounted to about 596 tons of recycled materials from UNH (Jambeck, Farrell, Cleaves, 2006).

Surveys

A survey is a non-experimental, descriptive research method. Survey methods are data collection techniques which aim to obtain opinions, attitudes, and knowledge on a specific topic from a sample population or group of individuals. Conventional survey administration modes include mail, in person, telephone, and central site. Only recently, the use of email and web surveys has emerged as another option. The choice of survey mode requires the consideration of several issues and no single mode has been proven superior. Mail surveys have much in common with web-based surveys in areas of degree of personal contact with respondents and freedom of the respondent regarding the timing and method to answering the questionnaire. With traditional mailed surveys, time and money are spent printing questionnaires, placing them in envelopes, and paying for postage. With web surveys, the Internet makes distribution quick, easy, and less costly.

The advantage of the comparatively low cost of web-based surveys is that it allows for a large sample size, which provides an increased potential for sub-group analysis and decreased sampling variance. Web-based surveys are quicker, more efficient, and less expensive compared to traditional surveys. The response rate, quality, and speed are common problems faced by all types of surveys. A mixed mode survey is the use of several delivery modes to issue a survey, which is able to combine the strengths of several modes, to balance cost, errors, ethics, and to provide privacy. The effects of mixed mode surveys on response rates are unclear: some studies have seen improved response rates while others have not. Many researchers are concerned about the different results that can come from the same web-based and print surveys. But the main difference between the surveys is mode of delivery, and web surveys allow for a new mode of data collection (Fleming & Bowden, 2007; Huang, 2004).

Among web survey challenges, low response rates have become a major concern. According to the *American Association for Public Opinion Research* (2009), the response rate is generally defined as the number of completed units divided by the number of eligible units in the sample. The response rate is the most widely used statistic to indicate the quality of a survey (*American Association for Public Opinion Research*, 6th ed., 2009). It has been estimated that the response rate of a web survey is 11% lower than other survey types. Respondents' level of computer skills might affect their motivation to respond to web surveys and different modes of surveys tend to attract distinctively different respondents. The process of survey execution usually involves three key elements: researchers, participants, and tools or modes. The process of a web survey includes these four basic steps: development, delivery, completion, and return. (Fan & Yan, 2009; Huang, 2004)

Development

Within development, factors that affect the response rate include the sponsors of the survey, the topic, and the length. Surveys sponsored by academic or governmental agencies have higher response rates than commercial surveys. Topics of high interest receive higher response rates, and the length of a survey is found to have a negative linear relation in both mail and web surveys. Thirteen minutes or less for the completion time for a survey is considered ideal length to obtain a good response rate. (Fan & Yan, 2009)

Presentation

The presentation of a survey including question writing or wording, question ordering, and visual display has been found to alter response rate. Questions should have simple, easy-to-understand wording, and avoid bias. Each question can either be presented in open or closed form. An open form allows respondents to insert answers in their own words into an entry box. A closed form question only permits the selection of provided responses, such as multiple choice, true/false, or forced choice. Ordering can affect how potential respondents consider and evaluate later questions. Now, many software programs are able to randomize both questions and response options to help improve the validity of data. Display can be presented as a screen-by-screen or scrolling questionnaire. Scrolling allows the display of all questions on one single web page, which requires less computer time. In contrast, screen-by screen can put one or several questions on one web page and require the participant to press "next" to proceed. Adaptive questionnaires allow respondents to skip questions that are irrelevant or not applicable, based on previous answers. This can tailor the survey to the respondent, reduce complexity, and prevent or reduce missing data. Visual and audio stimuli can also be incorporated to alert participants if they skip or incorrectly answer questions (Huang, 2004; Fan & Yan, 2009).

Delivery

Contact messages to participants can include pre-notification and reminders, which can be accomplished though many delivery modes such as mail, telephone, and/or email. Email contact has low delivery cost and quick delivery time. The use of pre-notification and reminders affects response rate from modest increases to almost doubling it. The first reminder has a more positive effect when it is sent 2 days after the initial invitation than when it is sent in 5 days. Personalization of survey invitations has been shown to positively influence response rates in web surveys. Survey literature suggests that the computer administration of surveys on highly sensitive topics reduces or eliminates the tendency of individuals to answer in an effort to make a positive impression. When compared to print surveys, web surveys have reported comparable or higher quality of responses. For Web surveys, online identity is usually anonymous, but unidentified visitors and multiple responses can lead to corrupted and unreliable data (Huang, 2004; Fan & Yan, 2009).

Return

Web surveys use software that allows for quick delivery of completed surveys, so none are lost in the mail, and data is ready for analysis. Another advantage of software use is the accuracy of data collection. Responses from online surveys are automatically inserted into a form of data collection, which reduces human error in data entry. Because of web-based technology, data can be collected any time of day and without geographical limitation. On the downside, a computer can experience technical failure which can destroy data. Privacy and/or confidentiality can be a key factor affecting web surveys, which is why data should be safely guarded against disclosure for privacy reasons (Fleming & Bowden, 2007).

Incentives

Incentives are often used to increase response rates in both mail and web surveys. Many studies have shown that incentives raise response rate and quality. Incentives can be classified into two types based on the instrument and time when the incentive is given. Incentives include material, nonmaterial, prepaid, or promised incentives. Material incentives include cash, gifts, bonuses, loyalty points, and lottery tickets. Studies have shown that material incentives have a significant effect on raising the response, speed, and retention rate. Monetary incentives have been shown to affect traditional surveys; however, the delivery of small amounts of cash to every participant is difficult.

Unconditional incentives are given before a survey to everyone without conditions and conditional incentives are given after participants complete surveys and return them. Some studies have shown that the response rate with conditional incentives is strongly affected by the amount of money given as an incentive, while other research indicates that the amount of incentives do not improve response rate in a linear way.

Also, post-paid incentives do not substantively improve response rates. Every type of survey is different and the type and use of incentives should be evaluated by the researcher to determine if it could help increase the response rate (Jie, Peiji, & Jiaming, 2008; Fan & Yan, 2009).

CHAPTER III

METHODOLOGY

The researcher completed the National Institutes of Health web-based training course "Protecting Human Research Participants". 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.

Survey Instrument

Based on a review of literature, the researcher developed a questionnaire that focused on (a) demographic information about school foodservice directors and operations, (b) food waste management practices, (c) recycling of various types of packaging waste, (d) cost of waste hauling and (e) attitudes and barriers concerning waste management activities.

A Likert-type scale ranging from strongly agree to strongly disagree was used to measure attitudes concerning packaging waste management. A Likert-type scale ranging from never to always was used to measure barriers concerning the operation of waste management programs. The questionnaire was validated by five professionals that included foodservice management educators and school foodservice administrators for content validity and clarity of questions. The questionnaire was converted into an online survey using PsychData (State College, PA, PsychData ™ LLC) provided by Texas Woman's University.

The online pilot study was emailed to 30 randomly selected child nutrition directors who were members of the School Nutrition Association (SNA). There was minimal response from these individuals, so an additional 50 foodservice directors were emailed the survey invitation. Forty directors were selected by the researcher using a Google search and 10 individuals were known to the researcher's advisor. All individuals who participated in the pilot survey used the survey code: 700. These individuals were emailed an invitation letter, which included a web page link to the survey. The cover letter explained the purpose and importance of the survey, assured the respondents that their privacy and anonymity would be maintained, and specified a return date of December 17, 2010. Fourteen individuals participated in the pilot study. A review of the pilot survey results showed that the content and length appropriately suited the participants and research questions of interest. All Likert-type scale questions were tested using alpha-cronbach to measure inter-rater reliability. Results showed that the results for questions 1-15 were reliable (Cronbach's α=.996). For question 17 on barriers relating to operation of a waste management program Cronbach's α was .668 and for question 18 concerning attitudes about recycling Cronbach's α was .849. Cronbach's alpha reliability coefficient normally ranges between zero and one. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. A Cronbach's alpha coefficient $\geq$ .60 was considered acceptable for this study.

Sample Selection

Power analysis determined that 159 usable surveys would be needed to complete statistical analyses for the study. Child nutrition directors who are members of the School Nutrition Association (SNA) were included in the on-line and mailed surveys. The researcher first became a student member of the SNA and signed a list agreement with the SNA organization; the survey was reviewed and approved by the SNA staff before it was conducted. In return for the list, the researchers agreed to make the study results available to the SNA and participants who wished to receive a copy of the study results. The mailing list supplied by the SNA, was a random sample of 599 child nutrition directors who were members of the School Nutrition Association (SNA). The researcher selected 30 individuals from the list to conduct the online pilot study. The remainder of the names on the list were included in the final study.

Data Collection

A cover letter inviting participation in the survey via a web page link was mailed to 569 randomly selected SNA child nutrition directors on November 29, 2010. The specified return of date for the survey invitation was December 10, 2010. Email addresses for the foodservice directors were not provided by SNA. The researcher attempted to find email addresses for all invited participants using the Internet, but only 331 email addresses were found. Follow-up e-mail reminders for the survey were sent to those participants one week later. Three weeks later cover letters, printed questionnaires, and self-addressed postage paid envelopes were mailed to SNA child nutrition directors with a specified return date of January 21, 2011. A final email was sent one week later. Follow-up postcards were sent on January 24, 2011 with a specified return date of January 31, 2011.

Each survey invitation or printed survey included a code, which was specific to that assigned participant. When completing the on-line survey, the respondent was asked to enter the code. This code was not included on the printed mailed surveys. This code was used to track individuals who had participated in the online surveys. This tracking code was used to determine which participants were mailed the printed survey and follow-up postcards. This code was also used to maintain the privacy and anonymity of respondents. An incentive was offered for the completion of the survey. All respondents who completed the online or mailed survey were entered into a drawing to win a gift card; four $25 cards were awarded in the drawing.

Data Analyses

The survey was reviewed by a Texas Woman's University statistician to determine the statistical analyses needed to test hypotheses for this study. The Statistical Package for the Social Sciences for Windows (SPSS Inc, Chicago, IL, v 15.0) was used to summarize and analyze data.

Descriptive statistics were used to summarize the data related to demographics, packaging waste disposal methods, and equipment use. Frequencies were calculated for Likert-type questions to summarize the data. Likert-type questions included waste management strategies ranging from daily to never, barriers to the operation of waste management programs ranging from never to always, and child nutrition director's attitudes about recycling ranging from strongly disagree to strongly agree. Pearson's correlation coefficient was used to determine correlations for age, years worked in a foodservice operation and school enrollment while Analysis of Variance (ANOVA) was used to determine significant relationships for categorical variables (gender and highest education). Pearson's correlation coefficient was used to investigate relationships between waste disposal cost and the following variables: food waste management practices and packaging recycling practices. This statistical analysis method was also used to determine relationships between child nutrition directors' perceptions of barriers based on school enrollment. ANOVA was used to determine relationships between the method for paying for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging. Cross tabulations were computed to test associations between the following categorical variables: school district enrollment, and type of milk packaging vs. child nutrition department's method for waste hauling.

During data analysis, enrollment was skewed so the data was formatted into 3 categories to more equally distribute enrollment. Enrollment categories included < 3500, 3500 – 9999, and 10,000 or greater. The data, once formatted resulted in the following groupings; < 3500 (n= 23), 3500 – 9999 (n=30), and 10,000 or greater (n= 23). The method of paying for waste hauling was grouped into two categories for cross tabulations: 1) "the school district pays for waste hauling costs" and 2) "the child nutrition program pays some percentage of the bill", which included all other responses. Food waste management practices were also collapsed into two categories, "never" and "sometimes". "Sometimes" included: daily, 2-3 x per week, once a week, and monthly. For data analysis, plastic pouch packaging was removed from the data set due to low respondent use (n=1).

CHAPTER IV

INVESTIGATION OF WASTE MANAGEMENT IN SCHOOL NUTRITION PROGRAMS

A Paper to be Submitted for Publication in the Journal of Child Nutrition and Management.

Abstract

Purpose/ Objectives

This study was designed to investigate food waste management practices, recycling of various types of packaging waste, and attitudes and barriers regarding waste management activities in school nutrition programs.

Methods

Research methods included a pilot study and a national survey conducted both online and by mail. The School Nutrition Association, (SNA), provided a random sample of 599 child nutrition directors who were members of the SNA. Survey invitations were mailed and/or emailed to participants and 79 usable responses were received. The Statistical Package for the Social Sciences for Windows (SPSS Inc, Chicago, IL, v 15.0) was used to summarize and analyze data.

Results

The majority of survey respondents were female (85%) and between the ages 42 to 58. The mean work experience was 12.6 years in their current foodservice operation

and 26.2 years in any type of foodservice operation. The majority of respondents (77%) indicated that the school district pays for waste hauling expenses without billing the hild nutrition program. However 18% paid a standard percent allocation (indirect cost) Cardboard was the most recycled item; glass and plastic packaging were least recycled. Most frequently encountered waste management program barriers included limited storage (2.16 $\pm$ .75) and the non-availability of recycling facilities in local area (1.93 $\pm$ .77). Garbage disposals and grease traps were the most commonly purchased equipment for waste management.

Applications to Child Nutrition Professionals

Results of this study should encourage child nutrition directors who are considering waste management programs other than landfilling. School nutrition programs need the support of administration, students/customers, teachers and faculty, foodservice employees, community and other school nutrition programs to encourage the initiation and continuation of waste management programs promoting resource conservation and sustainability.

Introduction

Within the past few decades as natural resources have diminished, the concept of sustainability has emerged with a focus on conservation, reduction, and responsible management of resources. This places additional responsibility on foodservice directors to make sound ecological decisions regarding solid waste disposal. Municipal solid waste (MSW) is solid waste that is produced in residences and at commercial, institutional, and industrial sources; it excludes any construction or demolition wastes, automobile scraps, combustion waste, and municipal sludge. Thus, all waste generated in food service organizations, excluding chemicals, is MSW.

In 2008, Americans generated 250 million tons or 4.5 lbs per person/day of MSW and they recycled or composted 83 million tons or 1.5 lb per person/day, equivalent to a 33.2% recycling rate. While MSW generation increased from 3.66 to 4.5 lbs per person/day between 1980 and 2008, the recycling rate increased from 10% in 1980 to over 33% in 2008. Landfill disposal declined from 89% in 1980 to 54% in 2008. The top four MSW generated items included paper, 31.0%; yard trimmings, 13.2%; food scraps, 12.7%; and plastics, 12.0%. Of the recovered material, 61 million tons were recycled and 22.1 million tons were composted. Metals (aluminum, steel, and mixed metals) were recycled at a rate of 35%. The following are the recycling rates of selected products in 2008: 70.9% of office-type papers, 62.8% of steel cans, 48.2% of aluminum cans, 28% of glass containers, and 27.3% of polyethylene terephthalate (PETE) bottles and jars. The recovery rate of food waste was only 2.5% (EPA, 2009).

Packaging waste has a serious effect on the environment when not recycled. Most packaging materials from households and businesses are thoughtlessly thrown away in the trash to be disposed of either in landfills or by incineration. According to the Environmental Protection Agency (EPA), the school system is a major waste-producing sector. Since the production of packaging waste is inevitable in food service operations, it is important to evaluate all waste disposal methods for both cost effectiveness and environmental impact. Thus, the school system provides an excellent avenue of opportunity to divert waste into recycled materials.

In 2007, the School Nutrition Association (SNA) conducted a study that investigated recycling and waste management practices in school nutrition programs (SNA, 2007). Eighty-one percent of 675 respondents indicated that their school district pays for the child nutrition program's trash pick-up. Of those charged, the most common method was by standard percent allocation. Fifty-eight percent of the respondents indicated that the school nutrition program recycled. Cardboard was recycled by 91% of respondents, office paper and steel/tin cans by 50%; and newspaper, plastic, and aluminum were recycled by at least one-third of school nutrition programs. At about half of the districts, recycling companies provided recycling bins/containers for inside the school. Sixty-two percent indicated their waste haulers also picked up their recyclables while 26% used a separate company, and 12% were unaware of who picked up the recyclables. Fifty-four percent indicated they were not typically charged for recycling, and only 2% received revenue from recycling. Respondents for school nutrition programs that did not recycle indicated that there was no hauler for recyclables or that the district did not recycle (SNA, 2007).

The possibility of effective packaging waste management in school foodservice operations has been demonstrated. Bellingham Washington's school district was able to compost over 800,000 lbs of food and packaging waste, resulting in a savings of $53,000 in four years (Parker-Burgard, 2009). Green County School District located in Greenville, Tennessee was able to increase their milk sales by 33% and recycle an estimated 2,800 – 2,900 lbs of plastic milk bottles per week by switching milk packaging from paperboard cartons to plastic milk bottles (National Dairy Council, 2008). South-Western City schools located in Grove City, Ohio were also able to increase their milk sales by 6% and recycle an estimated 88 tons of plastic by switching from cartons to plastic milk bottles (National Dairy Council, 2007). Even though schools participate in recycling and composting, only a few school foodservice operations have actively reported their success. Therefore, this study was designed to investigate food waste management practices, recycling of various types of packaging waste, and attitudes and barriers regarding waste management activities in school nutrition programs.

METHODOLOGY

Pilot Survey

Based on a review of literature, the researchers developed a questionnaire that focused on food waste management practices, recycling of packaging waste, cost of waste hauling, perceived barriers to waste management programs, and attitudes concerning recycling. Demographic information about child nutrition directors and operations was also collected. The questionnaire was validated by three foodservice management educators and two child nutrition directors for content validity and clarity of questions. The questionnaire was converted into an online survey using PsychData (State College, PA, PsychData ™ LLC). The mailing list supplied by the School Nutrition Association (SNA), was a random sample of 599 child nutrition directors who were SNA members. Pilot study participants were recruited from 30 of the random sample SNA child nutrition directors, 40 directors were located using Google search, and 10 directors suggested by the researcher's advisor.

Response rate for the online pilot survey was 17.5% (14/80). Review of the pilot results showed the content and length were appropriate for the research topic. Alpha-cronbach analysis of the Likert-type survey questions for inter-item reliability showed the following results: food waste management strategy questions, Cronbach's α =.996; barriers relating to operation of a waste management program, Cronbach's α = .668; attitudes about recycling, Cronbach's α = .849. Cronbach's alpha reliability coefficient normally ranges between zero and one. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. A Cronbach's alpha coefficient $\geq$ .60 was considered acceptable for this study.

National Survey

This study used both online and mailed surveys. A cover letter inviting participation in the survey via a web page link was mailed to 569 randomly selected SNA child nutrition directors. Mailing addresses but not email addresses were provided by the SNA. The researcher looked for email addresses using the Internet, but only 331 were found. Follow-up e-mail reminders for the survey were sent to those participants one week later. Three weeks later cover letters, printed questionnaires, and self-addressed postage paid envelopes were mailed to SNA directors who had not yet completed the online survey. A final email was sent one week later. Nine weeks after the initial invitation, follow-up postcards were sent to individuals who had not yet responded. Fifty-six surveys were completed online (including the 14 completed pilot surveys) and 28 surveys were returned by mail. The incentive offered for completion of the survey was a chance to win one of four $25 gift cards.

The Statistical Package for the Social Sciences for Windows (SPSS Inc, Chicago, IL, v 15.0) was used to summarize and analyze data. Descriptive statistics were used to summarize the data related to demographics, packaging waste disposal methods, and equipment use. Frequencies were calculated for Likert-type questions on waste management strategies, barriers to the operation of waste management programs, and child nutrition director's attitudes about recycling. Pearson's Correlation coefficient and Analysis of Variance (ANOVA) were used to compare and test differences among groups. During data analyses, enrollment was divided into 3 categories according to size to equally distribute enrollment due to skewed results; < 3,500, 3,500 – 9,999, and 10,000 or greater. The method of paying for waste hauling was grouped into two categories for cross tabulations: "the school district pays for waste hauling costs" and "the child nutrition program pays some percentage of the bill". Food waste management practices were also collapsed into two categories, "never" and "sometimes" due to low respondents. "Sometimes" included: daily, 2-3 x per week, once a week, and monthly. For data analyses, plastic pouch packaging was removed from the data set due to low respondent use (n=1).

RESULTS AND DISCUSSION

Since no changes were made in the survey questions after completion of the pilot study, the pilot study results and national study results were combined. Therefore, a total of 84 surveys were collected (return rate = 13.1 % (84/640), but only 79 had complete data (usable data return rate = 12.3 % (79/640)). Five surveys were removed due to incomplete data; but three partially completed surveys were included in the results. There were 4 returned envelopes due to inaccurate addresses.

Likely due to a small number of survey participants, Pearson's correlation coefficient analysis did not show any significant correlations between age, years worked, and school enrollment to food waste management practices, child nutrition director attitudes, and perceptions of barriers. Likewise ANOVA did not detect any significant relationships between gender and education and waste management practices, child nutrition director attitudes, and perceptions of barriers.

Demographic Characteristics of Respondents

The majority of survey respondents were female (85%) and between the ages 42 to 58 (See Table 1). Mean work experience was 12.6 years in their current foodservice operation and 26.2 years in any type of foodservice operation. Approximately 35% had obtained a Bachelor's degree and approximately 41% had obtained a Master's or Doctoral degree. Mean enrollment for all schools was 12,342 students. Respondents indicated the average daily participation rate ranged from 57% to 84%. The majority of survey respondents (77%) indicated they were purchasing milk in cardboard cartons, while 22% stated they were purchasing milk in plastic bottles. In a 2009 study conducted by the School Nutrition Association (SNA) with 1,207 school districts from 49 states (all except for Hawaii) indicated that average school district enrollment was 7,949 students. Respondents also indicated that 34.5% of districts offered plastic milk bottles but this study did not indicate the use of cardboard cartons. Meal participation ranged from 1% to as high as 100% (SNA, 2009).

Payment for Waste Disposal in School Child Nutrition Foodservice Operations

The majority of respondents (75%) indicated that the school district pays waste hauling without billing the child nutrition program while 18% said they paid a standard percentage allocation (indirect cost) for waste hauling (See Table 2). Of 62 respondents answering a question about change in waste hauling costs over the past 2 years, the majority of respondents (73%) indicated waste hauling costs had remained the same while (22%) indicated an increase. Respondents who had an increase were asked why they believed an increase had occurred. Of 15 respondents answering this question; 6 indicated that the increase was due to fuel costs, 3 attributed it to an increase in meal participation and 2 attributed it to labor. In a previous 2007 survey of 675 school districts, 64% of respondents indicated that the child nutrition department did not pay for trash pick-up. Of those who paid waste hauling fees, 19% were charged by the school district and 5% were charged by the waste hauler (SNA, 2007).

Food Waste Management Practices used by Child Nutrition Directors

Respondents were asked to indicate how often they used eight specific food waste management strategies (See Table 3). Forty-seven directors indicated they used a garbage disposal daily, while 24 never use a garbage disposal. Twelve respondents participated in the donation of prepared food or non-perishable food to nonprofit organizations at least monthly. Six respondents indicated that they had used a food pulper at least monthly to reduce food waste or sent food scraps to an on-site composting site at least once a week. Three respondents donated food scraps to farmers for animal feed daily and three respondents sent food scraps to an off-site composting site at least once a week. School directors indicated that they had purchased various types of equipment to assist in waste management. Types of equipment most commonly purchased and the number of respondents purchasing each were: garbage disposal (62), grease trap (61), recycling containers/ bins (39) and a shredder (22). Only six respondents had purchased a compactor and one had purchased a baler.

Amounts of Packaging Waste Recycled by Child Nutrition Programs

Respondents estimated the approximate weight or volume per month of food/beverage packaging materials their operation recycled. Both volume and weight of materials were reported by respondents. After data collection, the researcher converted all volume amounts into pounds of weight by using a conversion chart. Conversions used were mixed paper, corrugated cardboard (flattened loose boxes), whole glass bottles (0-10% broken), aluminum cans (whole, unflattened), steel cans (whole, unflattened), and plastic bottles (whole, unflattened) (See Table 3). A conversion rate for plastic packaging was not available so the researcher used the same conversion rate as used for plastic bottles. Respondents who stated they recycled 5 or less pounds of an item were removed from the data set. Fifty-nine percent of respondents (n=47) recycled some material. Cardboard, paper, and plastic bottles/containers were the most frequently recycled materials. Thirty-five schools recycled cardboard (mean of 2,984 lbs), and 23 schools recycled plastic bottles and containers (mean of 9,012 lbs). The least recycled materials were glass, plastic packaging, and steel recycled by 5, 9 and 11 schools respectively. However glass and steel accounted for the highest mean amounts per month, 60,136 lbs and 19,303 lbs respectively. The majority of plastic bottles, steel, aluminum, and glass was recycled by one respondent. This respondent recycled 180,000 lbs of plastic bottles, 150,000 lbs of steel, 94,500 lbs of aluminum, and 300,000 lbs of glass. This respondent indicated they had a daily participation rate of 50% and an enrollment of 14,000 students. In a previous 2007 study, cardboard was the most recycled material, recycled by 89% of respondents, and aluminum and newspaper were the least recycled items, 37% and 39% respectively (SNA, 2007).

Child Nutrition Directors' Perceptions of Barriers to Waste Management Programs

Respondents rated how frequently they encountered barriers to waste management program at their school on a 3-point scale ranging from 1 (never), 2 (sometimes), to 3 (always). The four barriers receiving the highest ratings were: limited storage (2.16±.75), non-availability of recycling facilities in local area (1.93±.77), lack of customer/student participation and support ($1.89 \pm .68$), and investment/start up costs ($1.86 \pm .78$). Not enough waste to implement a reduction plan and school policies received the lowest barrier ratings ($1.38 \pm .61$) and ($1.42 \pm .57$) respectively (See Table 4).

In a 2007 survey, school representatives stated the most common reasons that school nutrition programs did not recycle was because there was not a hauler for recyclables (47%), the district did not recycle (37%), or they did not produce enough material (9%). For the same survey, school nutrition programs that did not recycle indicated that the biggest obstacles to recycling included no hauler for recyclables (46%), no coordinator to oversee (37%), refuse must be separated (37%), and limited space (36%). Programs that currently recycled, indicated that their biggest obstacles were limited space (41%), refuse must be separated (31%), and no coordinator to oversee (26%) (SNA, 2007).

Child Nutrition Directors' Attitudes about Recycling Activities

Respondents rated attitude statements concerning recycling activities on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) (See Table 4). The four statements receiving the highest agreement ratings were: "If my school recycles, it has a positive effect on the environment" ($4.37 \pm .85$); "Students are interested in recycling" ($3.91 \pm .77$); "My community supports recycling" (3.72 ± 1.00); and "My school administrators' support recycling" ($3.66 \pm .81$). Participants disagreed with the statement, "Protecting the environment is less urgent than often implied by the media," ($2.08 \pm .95$), thus indicating that they and their employees support environment-friendly activities that conserve resources.

CONCLUSIONS AND APPLICATIONS

Conclusions

Overall study results show that child nutrition directors have a positive attitude towards recycling and perceive that their employees, administrators, students and community do also. This positive perspective should give child nutrition directors the support they need to establish and maintain waste management programs. Results from this study prove that while some school nutrition programs are participating in alternative waste management programs such as recycling, food donation and composting, the majority are not.

This leads one to question why recycling has not been implemented by more school nutrition programs. Since most respondents had their waste hauling costs paid by the school district, this could potentially have a large impact on whether child nutrition directors choose to spend time and efforts on alternative programs that will not save their program any money since they are not required to pay for their own waste hauling costs. If more child nutrition programs were required to pay for their waste hauling costs, child nutrition directors might have greater interest in ways to decrease the amount of waste they produce in their programs. Decreasing the volume of waste through recycling and composting would help to decrease dumpster costs though waste reduction.

Limitations

One limitation of the present study was the response rate. Results from this study could have differed if more child nutrition directors had participated in the study. Another limitation involves the composition of the study respondents. Participants were recruited from child nutrition directors who were members of the School Nutrition Association, so results cannot be generalized beyond these school nutrition programs. Study participants were also limited to child nutrition directors who were located in the United States so results from this study cannot be generalized to other counties. This study was conducted when new proposed menu regulations were being considered for school lunch programs which may had resulted in less participation. Results would have also differed with the accurate collection of data for the average amount of money the child nutrition program pays per month in waste hauling fees. Also, results would have differed if respondents had been allowed to select multiple milk container packaging and if more respondents would have reported the amount of their recycled packaging waste. The amount of packaging waste was also estimated so results may have differed if accurate weights of each item were taken.

Applications

More research needs to done to determine what initiatives would help to transition more programs from land-filling to recycling and composting. One suggestion is to recommend that child nutrition directors research their communities to determine what items are being recycled. Also, if no recycling facilities exist in their community, they could search for a recycling facility within a reasonable distance. School district administrators could hold a meeting with waste management providers and child nutrition directors to explore what materials can feasibly be recycled in their area, and follow up to negotiate programs with waste management providers. Many recycling facilities provide dumpsters for collection, and these could also be centrally located between several school districts for multiple use. Also, when schools and kitchens are designed and built, some storage space for recycling programs could be planned. This would allow space to store materials for recycling.

School nutrition programs today are facing many challenges. This study was conducted during a period when new proposed menu regulations were being considered for school lunch programs. The urgency and importance of these new proposed menu regulations may have detracted from interest in recycling and composting programs.

For composting, smaller school districts may be able combine their compostable materials and invest in a cooperative composting program. This could be maintained in a central location to the school districts and be used for other programs such as science classes, growing local fruits and vegetables and for landscaping mulch. Also many school districts have an agricultural department and those students who raise livestock might be able to take home leftover food scraps daily. Recycling clubs at schools consisting of students and faculty could help to promote and organize a recycling or composting program.

Further pilot testing and case studies should be conducted in different size school districts that have waste management programs. Analyses of their budgets related to recycling and their cost savings could help to strengthen the evidence that recycling can decrease waste costs. Studies should compare the waste hauling costs and dumpster yardage usage of school nutrition programs who recycle and those who do not.

Waste management programs are time consuming during planning and first implementation, but after continual use, both monetary and "green" rewards accrue to the school nutrition program and the school district involved. Other studies that research the availability of recycling facilities and what items they accept, cost per month vs. payment for materials, and dumpster rental would help to increase child nutrition director's awareness of recycling facilities. Publicizing the monetary benefits of recycling and composting could help to promote the use and importance of these waste management programs.

Results of this study may encourage child nutrition directors who are considering waste management programs other than landfill. Child nutrition directors need the support of administrators, students/customers, teachers, foodservice employees, and community members to initiate and continue waste management programs that promote sustainability and wise use of resources.

Table 1
Demographic Characteristics of Child Nutrition Directors and School Nutrition Programs

Characteristic	n	%
Gender		
Male	12	15
Female	67	85
Age		
20 – 29	4	5
30 – 39	4	5
40 – 49	20	26
50 – 59	41	53.5
≥ 60	8	10.5
Education		
High school and some college	13	16
Associate's degree	6	8
Bachelor's degree	28	35
Master's degree or Doctoral degree	32	41
School district enrollment		
≤ 3,499	23	29
3,500 – 9,999	30	38
≥ 10,000	26	33
Pint milk container packaging		
Paperboard cartons	61	77
Plastic bottles	17	22
Plastic pouches	1	1

(N=79)

Table 2

Payment for Waste Disposal in School Nutrition Programs

Payment Variable	n	%
Payment methods (n = 79)		
School district pays without billing Child Nutrition Program	59	75
Child nutrition program pays a standard % allocation (indirect cost)	14	18
Child nutrition program pays waste hauling fees directly	4	5
Each building is billed individually	1	1
Child nutrition program pays a flat fee per month (or other time period)	1	1
Change in waste hauling costs during past 2 years (n= 62)		
Remained the same	45	73
Increased	14	22
Decreased	3	5
Reasons for increase in waste hauling costs* (n=15)		
Fuel costs	6	
Increase in meal participation	3	
Labor	2	
Increased waste amount	2	
Increased emphasis on composting/ recycling	2	
Increase in landfill charges	1	
Change in waste management company	1	
To decrease district costs, (passing the bill on)	1	

(N=79)

*Some respondents gave more than one answer for an increase in waste hauling cost.

Table 3

Waste Management Strategies (N=79) and Amounts of Packaging Materials Recycled by Child Nutrition Directors (N=47)

	Frequency of Use				
Strategies^	Daily	2-3 x per week	Once a week	Monthly	Never
Waste management strategies used at the facility within 5 years	n	n	n	n	n
Use a garbage disposal to dispose food waste into water stream	47	4	1	3	24
Donation of prepared food (hot or cold) to nonprofit organizations	1	0	0	11	67
Donation of non-perishable food to nonprofit organizations	1	0	0	11	67
Use a food pulper to reduce food waste	4	0	1	1	73
Send food scraps to an on-site composting site	4	1	1	0	73
Send food scraps to an off-site composting site	1	1	1	0	76
Donation of food scraps to farmers for animal feed	3	0	0	0	76

Packaging Material*	Number of Schools	Total (lbs per month)	Mean (lbs per month)	Range (lbs per month)
Cardboard [a]	35	104,429	2,984	5 – 32,914
Paper [b]	26	27,080	1,042	5 – 20,000
Plastic bottles and containers [c]	23	207,270	9,012	5 – 180,000
Aluminum [d]	19	129,630	6,823	10 – 94,500
Steel [e]	11	212,330	19,303	20 – 150,000
Plastic packaging [f]	9	13,475	1,497	20 – 10,800
Glass [g]	5	300,680	60,136	20 – 300,000

^Scale used to measure strategies was: 1, Daily; 2, 2-3 x per wk; 3, Once per week; 4, Monthly; 5 Never.

*Some participants stated materials in volumes, and these were converted to pounds using the following formulas:

[a] Cardboard (flattened boxes, loose): 100 pounds/cubic yard

[b] Paper (mixed): 484 pounds/cubic yard

[c f] Plastic bottles (whole, unflattened): 36 pounds/cubic yard

[d] Aluminum cans (whole, unflattened) 63 pounds/cubic yard

[e] Steel cans (whole, unflattened): 150 pounds/cubic yard

[g] Glass (whole bottles, 0-10% broken): 600 pounds/cubic yard (EPA, 1997)

Table 4

Child Nutrition Directors' Perceptions of Barriers to Waste Management Programs and Attitudes about Recycling Activities in School Nutrition Programs

Barriers[a]	Mean + SD
Limited storage	2.16 ± .75
Non-availability of recycling facilities in local area	1.93 ± .77
Lack of customer/student participation and support	1.89 ± .68
Investment/start up costs	1.86 ± .78
Lack of employee participation and support	1.83 ± .77
Waste collection costs	1.74 ± .77
Lack of support from administration	1.68 ± .57
School Policies	1.42 ± .57
Not enough waste to implement a reduction plan	1.38 ± .61

Attitude Statements[b]	Mean + SD
If my school recycles, it has a positive effect on the environment.	4.37 ± .85
Students are interested in recycling.	3.91 ± .77
My community supports recycling.	3.72 ± 1.00
My school administrators' support recycling.	3.66 ± .81
Sending waste to a landfill is harmful to the environment.	3.43 ± 1.01
Recycling increases labor costs.	3.14 ± 1.09
It is costly and time consuming to recycle.	3.07 ± 1.10
Employees feel that recycling is a waste of time.	2.66 ± .84
Protecting the environment is less urgent than often implied by the media.	2.08 ± .95

(N = 76)

[a]Scale used to measure barriers was: 1, Never; 2, Sometimes; 3, Always.

[b]Scale used to measure attitude: 1, Strongly disagree; 2, Disagree; 3, Neither agree or disagree; 4, Agree; 5, Strongly agree

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CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This study was designed to investigate food waste management practices, recycling of packaging waste, cost of waste hauling and attitudes and barriers concerning waste management activities in school nutrition programs. Data was analyzed to determine differences based on the following variables: school enrollment, age, gender, education, years worked in a foodservice operation, and years worked at the current foodservice operation. Statistical significance was set at $p \leq 0.05$ for all tests. Results of statistical analyses were as follows:

1. H_0: There will be no significant difference or relationship in the amount of items recycled by child nutrition directors based on the following demographic characteristics of directors': gender, age, years worked in a foodservice operation, highest education, and school enrollment.

Due to an insufficient number of respondents reporting recycling, inferential statistical analysis was unable to be calculated and the hypothesis could not be tested.

2. H_0: There will be no significant difference in child nutrition directors' perceptions of barriers to recycling based on school enrollment.

PARTIALLY REJECTED: There was a significant difference in child nutrition directors' perceptions of limited storage space as a barrier to recycling based on school enrollment.

For non-availability of recycling facilities in local area, lack of customer/student participation and support, investment/start-up costs, lack of employee participation and support, waste collection costs, lack of support from administration, school policy statements, and not enough waste to implement a reduction plan, there was no significant difference based on school enrollment.

3. H_0: There will be no significant difference in child nutrition directors' waste disposal costs based on whether or not they participate in recycling packaging waste. The entry box for waste disposal costs on the online survey was set to a 2 digit response so incomplete and/or incorrect data was collected and the hypothesis could not be tested.

4. H_0: There will be no relationship between the method of paying for waste hauling and the following variables: food waste management practices, packaging recycling practices, and type of milk packaging.

FAILED TO REJECT: Chi-square analysis was not appropriate because there was only 1 child nutrition program paying for waste disposal that purchased milk in plastic bottles. There was also no relationship between the method of paying for waste hauling based on food waste management practices and packaging recycling practices. Therefore, researchers failed to reject this null hypothesis.

5. H_0: There will be no relationship between per student cost for waste hauling and the following variables: food waste management practices, packaging recycling practices and type of milk packaging.

Data for this hypothesis was unable to be tabulated and calculated. The entry box for waste hauling costs on the online survey was set to a 2 digit response so incomplete and/or incorrect data was collected.

6. H_0: There will be no relationship or difference in child nutrition director's attitudes about recycling and the following variables: school enrollment, age, gender, education, years worked in a foodservice operation, and years worked at the current foodservice operation.

PARTIALLY REJECTED: There was a relationship or difference in child nutrition director's attitudes about recycling based on school enrollment, age, and education. There was no relationship or difference in child nutrition director's attitudes about recycling based on gender, education, years worked in a foodservice operation, and years worked at the current foodservice operation.

Payment for Waste Disposal

The majority of child nutrition programs indicated that waste hauling costs paid by the school district. The fact that only 79 child nutrition directors responded to this survey indicated a lack of interest in waste management and recycling. This lack of interest may be due to the fact that most programs are not charged for waste disposal cost. Also, with recent legislation focusing on nutrition standards and wellness, child nutrition directors may place a lower priority on waste management practices. This may lead child nutrition directors to not focus on the option of recycling to decrease waste volume or costs because there is no urgency to decrease waste hauling costs. Recycling can also require more storage and dumpster space, which was indicated as a significant barrier to recycling by respondents.

Milk Packaging

The majority of respondents indicated that they purchased milk in paperboard cartons. This could possibly be related to price, as plastic bottles are more expensive than cartons. Concerning milk packaging and waste hauling cost payment, paperboard cartons were purchased by the majority of respondents regardless of whether the school district or the school nutrition program paid for waste hauling. Thus the choice of milk packaging did not seem to be influenced by waste hauling costs.

Garbage Disposal

The majority of respondents indicated that they used a garbage disposal, compared to other waste disposal methods. Child nutrition directors may face obstacles when attempting to use some of the alternative methods of waste disposal. For example, there could be possible liability issues accompanying the donation of foods to nonprofit organizations. Schools also might not have a large enough amount of food to donate to these organizations. Donation may also require a trip to deliver the food and if the food is perishable, it may require daily delivery. This would involve considerable travel expense. Sending food scraps to a farmer requires finding a farmer to pick up the waste. Also if the farmer is unable to come daily, the food scraps must be stored properly to prevent spoilage and pest attraction. The collection of food scraps can also require the investment of additional waste containers and employee training on how to sort food.

Composting is a program that requires additional resources such as an area to compost the materials, employee training for sorting and composting, student/customer training for sorting, waste collection bins, and maintenance. Many schools located in smaller communities many not have access to composting facilities and would need to manage their own composting program to be able to compost materials. Composting is also a program that requires extra expenses related to labor and resources such as water and materials such as soil, fertilizer, bins, rakes and shovels.

Many types of equipment can be used to assist with waste management. The majority of respondents purchased a garbage disposal, grease trap, recycling containers/ bins, and a shredder. Only six respondents had purchased a compactor and one had purchased a baler. This may be related to cost factors; compactors and balers are very expensive equipment that also requires extra space. Smaller school districts may not be able to afford the cost of equipment that is not essential for basic foodservice operation.

Methods of Recycling

Over half (n=47) of respondents were recycling some type of material. Cardboard, paper, and plastic bottles/containers were the most frequently recycled items. The majority of plastic bottles, steel, aluminum, and glass was recycled by one respondent's facility. This respondent recycled 180,000 lbs of plastic bottles, 150,000 lbs of steel, 94,500 lbs of aluminum, and 300,000 lbs of glass. This respondent indicated they had a daily participation rate of 50% and an enrollment of 14,000 students. It seems likely that cardboard would be the most recycled material because it is the main type of packaging in food service departments that is thrown away daily. Almost all foods including fresh, frozen, and shelf stable come in cardboard cartons. If schools are purchasing milk in plastic bottles, this would also make up a large amount of their waste stream. Other plastic bottles might come from vending machine drinks such as sodas, juice, and water and condiment items such as dressings. While paper is not a major packaging material for the foodservice department, if the school district has decided to recycle, they might also recycle all the paper they use in classrooms and administration buildings.

The least recycled materials were glass, plastic packaging, and steel. Only five schools recycled glass, and 11 schools recycled steel cans; however these materials accounted for the highest mean amounts per month, 60,136 lbs and 19,303 lbs respectively. The main source for steel/tin for school foodservice departments would be #10 cans. But #10 cans need to be rinsed and flattened for recycling and this involves labor, time, and storage space. This may translate to the reason why they are least recycled. Glass is also a container type not frequently used in child nutrition programs. Glass and steel have the highest weight conversion rate for materials, glass (whole bottles, 0-10% broken): 600 pounds/cubic yard and steel cans (whole, unflattened): 150 pounds/cubic yard. Plastic packaging, like cardboard is a main packaging material for food products. While plastic packaging may be abundant, smaller school districts may not have recycling facilities in their local area that accept plastic packaging or glass; this in turn can also hinder their recycling. Steel is a packaging material that is easily recyclable in most cities: almost all small towns have a metal recycling facility that accepts all types of scrap metals such as copper, brass, stainless steel, and aluminum.

Barriers

There was a significant difference in child nutrition directors' perceptions of limited storage space barriers to recycling based on school enrollment. Enrollment of <3,500 and 3,500 – 9,999 stated that limited storage space was "always" a barrier to recycling, 48% (n=11) and 47% (n=14) respectively. Enrollment of 10,000 or greater 74% stated that limited storage space was "sometimes" a barrier to recycling (n=17). Pearson Chi-Square = .004, significant. Chi-square analysis was not significant for lack of support from administration because there were only 4 child nutrition programs who responded "always" based on enrollment. It appears that limited storage space is an issue for school foodservice child nutrition programs no matter the size of enrollment. Kitchens are not typically built with an initial design to house storage containers for recycling or for collecting food scraps.

Other main barriers to waste management programs perceived by child nutrition directors included non-availability to recycling facilities in local area, lack of customer/student participation and support, investment/start up costs, and lack of employee participation and support. While all cities do not contain facilities that accept all packaging waste materials, even small cities usually have access to at least a scrap metal recycling facility. While all materials from a school nutrition program may not be recycled, child nutrition directors should at least make an effort to recycle the materials that are accepted in their area. While recycling may require some investment/start-up costs, such as the purchasing of extra trash cans for material collection, these are items that can still be used and do not become obsolete if the program is discontinued. Many facilities provide recycling containers for use in classrooms and cafeterias such as recycling trash cans. While lack of employee participation and support may be a barrier before beginning a recycling program, taking time to discuss the recycling program with employees will allow them to voice their concerns. Employee training can also be used to decrease negative perceptions concerning recycling.

Attitudes

Age was found to have a relationship to child nutrition director's attitudes about recycling. As respondent's age increased, they agreed less with the statement "Students are interested in recycling", $p = .041$. This could deter child nutrition director's encouragement and support for recycling. Recycling requires both employee and student/customer training and support for the program to be a success. If directors feel that the people who will be most involved with the function of the program are not interested, it would lead directors to focus on other issues or programs to help with their child nutrition programs.

Level of education was also found to be related to child nutrition director's attitudes about recycling. Respondents with higher levels of education agreed less with the statement, "It is costly and time consuming to recycle" ($p = .005$) and "Employees feel that recycling is a waste of time" ($p = .006$). Over half of the respondents had earned a bachelor's degree or higher in their education. This leads one to assume that recycling is not seen as an expensive program in which to invest. Also, respondents with more education may also feel that their employees support recycling.

When comparing school enrollment and child nutrition director's attitudes about recycling, small and mid-size enrollment (<3500, small; 3500 – 9999, medium) agreed with the statement "Sending waste to the landfill is harmful to the environment" and schools with larger enrollment (10000 or greater) disagreed/neutral to the statement ($p =$ .001 and .003).

The four attitude statements that had the highest level of agreement included "If my school recycles, it has a positive effect on the environment", "Students are interested in recycling", "My community supports recycling", and "My school administrators' support recycling". With the four statements, it appears that child nutrition directors feel recycling is a positive program and that they have support from the administrators, students, and community. However, many are still not implementing recycling programs. Thus, it appears that other barriers to recycling might need to be addressed before a child nutrition director feels confident in initiating a recycling program.

Limitation

One limitation of the present study was the response rate. Results from this study could have differed if more child nutrition directors would have participated in the study. Another limitation involves the composition of the study respondents. Participants were recruited from child nutrition directors who were members of the School Nutrition

Association, so results cannot be generalized beyond these school nutrition programs. Study participants were also limited to child nutrition directors who were located in the United States so results from this study cannot be generalized to other countries. Results would have also differed with the accurate collection of data for the average amount of money the child nutrition program pays per month is waste hauling fees. Also, results would have differed if respondents had been allowed to select multiple milk container packaging and if more respondents would have reported the amount of their recycled packaging waste. The amount of packaging waste was also estimated so results may have differed if accurate weights of each item were taken.

Conclusion

Overall study results show that recycling is perceived by child nutrition directors to be a positive program in which to participate. Results also show that child nutrition directors have a positive attitude towards recycling and perceive their employees, administration, students and community do also. This positive perspective gives child nutrition director's the support they need to establish and maintain waste management programs. Results from this study prove that some school nutrition programs are participating in alternative waste management programs such as recycling, food donation and composting.

Recommendation

Responses to recycling by child nutrition directors appear to be positive and supported by beliefs of their community, administration, employees, and customers/ students. This leads one to question why recycling has not been implemented by more school nutrition programs. More research needs to done to determine what initiatives would help to transition more programs from land filling to recycling and composting. One suggestion is to recommend that child nutrition directors research their cities to determine what items their city recycles. Also, if no recycling facilities exist in their city, they could search for a recycling facility within a reasonable distance. School district administrators could also hold a meeting with waste management providers, school district administration, and child nutrition directors to figure out what materials can be recycled in their area, what their school district is able to recycle, and to negotiate programs with the waste management providers. Many recycling facilities offer pickups or dumpsters for collection, and these could also be centrally located between several school districts for multiple use. Also, when schools and kitchens are designed and built, recycling programs should be taken into consideration; this would alleviate the "limited space" limitation to recycling.

For composting, smaller school districts may be able combine their compostable materials and invest in a cooperative composting program. This could be maintained in a central location to the school districts and be used for other programs such as science classes, growing local fruits and vegetables and for landscaping mulch. For viable food scraps, many school districts have an agricultural department where students who raise livestock would be able to take home the leftover food scraps daily.

Further pilot testing and case studies should be conducted in different size school districts that have waste management programs. Analyses of their budgets related to recycling and their cost savings could help to strengthen the evidence that recycling can decrease waste costs. Studies should compare the waste hauling costs and dumpster yardage usage of school nutrition programs who recycle and those who do not. Waste management programs are time consuming when planning and first implementing, but the rewards after continual use give both a monetary and "green" reward gain both to the school nutrition program and the school district involved. Other studies that research the availability of recycling facilities and their items accepted, cost per month vs. payment for materials, and dumpster rental would help to increase child nutrition director's awareness of recycling facilities. Publicizing the monetary benefits of recycling and composting could help to promote the use of these waste management programs.

Results of this study may encourage child nutrition directors who are considering waste management programs other than the use of landfills. Child nutrition directors need the support of administration, students/customers, teachers, foodservice employees, community members to initiate and continue waste management programs that promote sustainability and wise use of resources.

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APPENDIX A

Approval of the Study from the Institutional Review Board

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

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

October 19, 2010

Ms. Janet Baca
12348 Salt Creek Rd.
Temple, TX 76501

Dear Ms. Baca:

Re: *Investigating Waste Management Programs in School Foodservice Organizations (Protocol #: 16261)*

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 annual/final report is enclosed. A final report must be filed with the Institutional Review Board at the completion of the study. Because you do not utilize a signed consent form for your study, the filing of signatures of subjects with the IRB is not required.

This approval is valid one year from October 19, 2010. Any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any unanticipated incidents. If you have any questions, please contact the TWU IRB.

Sincerely,

Kathy DeOrnellas, PhD.

Dr. Kathy DeOrnellas, Chair
Institutional Review Board - Denton

enc.

cc. Dr. Chandan Prasad, Department of Nutrition & Food Sciences
√ Dr. Carolyn Bednar, Department of Nutrition & Food Sciences
Graduate School

APPENDIX B

Approval of Study from Texas Woman's University Graduate School

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

The Graduate School
P.O. Box 425649, Denton, TX 76204-5649
940-898-3415 FAX 940-898-3412

0905487

October 22, 2010

Janet Baca
12348 Salt Creek Road
Temple, TX 76501

Dear Ms Baca:

I have received and approved the prospectus entitled ***Investigating Waste Management Programs in School Foodservice Organizations*** for your Thesis research project.

Best wishes to you in the research and writing of your project.

Sincerely yours,

Ruth A. Johnson, Ph.D.
Associate Dean of the Graduate School

kb

cc: Dr. Carolyn Bednar, Nutrition and Food Sciences
Dr. Chandan Prasad, Chair, Nutrition and Food Sciences

APPENDIX C

Approval of Study from School Nutrition Association

SCHOOL NUTRITION ASSOCIATION

Making the right food choices, together.

To: Janet Baca
From: Susan Coppess, SNA Research Manager
Date: November 5, 2010
Re: Complimentary List Rental

As a student member of the School Nutrition Association, you have access to SNA's online membership directory. To help you with your research, SNA has complied information from this list for the research study you shared with SNA on the topic of "Investigating Waste Management Programs in School Foodservice Organizations."

Names of 600 school nutrition director/supervisor-level members were randomly pulled from SNA's membership database, per your requested sampling plan. This list is intended for a one time use for the research survey "Investigating Waste Management Programs in School Foodservice Organizations" which you shared with the School Nutrition on September 10, 2010. The names and addresses of SNA members on the provided list are not to be used for purposes other than what has been stated above. The information provided in the list is the same as what you will find in the membership directory which is accessible to SNA members.

The School Nutrition Association would like to receive a copy of the final research report upon completion.

120 Waterfront St. | Suite 300 | National Harbor, MD 20745 | phone: 301.686.3100 • 800.877.8822 | fax: 301.686.3115 |
www.schoolnutrition.org

APPENDIX D

List Agreement from School Nutrition Association

SCHOOL
NUTRITION
ASSOCIATION

School Nutrition Association
Membership List Usage Agreement

Requesting Organization:

Janet Baca
Student
Texas Woman's University
Dept of Nutrition & Food Sciences
P. O. Box 425888
Denton, TX 76204

Janet Baca understands and agrees that this list usage order is for a one-time use only and is to be used only to send materials herewith submitted for review on the date of the mailing specified herein – on or before **December 31, 2010.**

If unauthorized use is detected, **Janet Baca** understands that they are liable for 10 times the value of this list order and may be subject to other legal action.

A separate order form must be submitted and approved before each list use. Neither the list nor excerpts thereof are to be duplicated, reproduced, reused or transferred without written authorization.

Signature: Janet Baca

Name (Printed in full): Janet Nicole Baca

Date: Nov 5, 2010

School Nutrition Association | 120 Waterfront St. | Suite 300 | National Harbor, MD 20745
phone: 301.686.3100 • 800.877.8822 | fax: 301.686.3115 | www.schoolnutrition.org

APPENDIX E

Cover Letter

TWU TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

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

Investigating Waste Management Programs in School Foodservice Organizations
Department of Nutrition and Food Sciences, Texas Woman's University January 2010

Dear Child Nutrition Director:

Today, disposal of food and packaging waste can be a significant cost in operating child nutrition programs. Therefore, we are inviting you to participate in a national survey focusing on waste management in schools. The purpose of this study is to investigate current food and packaging waste practices, recycling of packaging waste, and cost of waste hauling in school foodservice operations.

Your name, mailing address, and operation were obtained from the members' directory of the School Nutrition Association. If you would like to participate in this thesis study, please go the the Web site https://www.psychdata.com/s.asp?SID=138479 and enter the survey code which was provided on your origional invitation or fill out the paper survey included, and return through the mail. There is a potential risk of loss of confidentiality in all email, downloading, and internet transactions. Completion of the study should take approximately 15-20 minutes. Direct benefits of participating in the study will include a chance to win one of four $25 gift cards in a drawing at the completion of the study. Also, a summary of the study will be provided to participants who request a copy. This will be provided within 6 months of completion of the research project.

Survey forms were pre-coded to protect confidentality. Confidentiality will be protected to the extent that is allowed by law. The code number on the questionnaire will only be used for follow-up and prize drawing purposes. After follow-up postcards are mailed, and the names for the prizes are drawn, the record of code numbers and confidental information will be destroyed. Only summarized data will be published in reports and a scientific journal, and the name and facility of participants will not be revealed.

The researchers will try to prevent any problem that could happen because of this research. You should let the researchers know at once if there is a problem and they will help you. However, TWU does not provide medical services or financial assistance for injuries that might happen because you are taking part in this research.

Participation in this survey is completely voluntary, and you may withdraw your participation from the study at any time without penalty. If you have any questions about this research study, you can contact the researchers; their contact information is provided at the bottom of this form. If you have any 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 email at IRB@twu.edu.

Please complete and return the survey by January 25th, 2010.

Sincerely,

Janet Baca

Janet Baca, BS., R.D., L.D.
Graduate Student
Texas Woman's University
Phone: 254-721-7530
Email: JBaca@twu.edu

Carolyn M. Bednar

Carolyn M. Bednar, Ph.D., R.D., L.D.
Professor
Texas Woman's University
Phone: 940-898-2658
Email: CBednar@twu.edu

APPENDIX F

Mailed Survey Questionnaire

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

Please complete and return the survey by January 25th, 2010.

Investigating Waste Management Programs in School Foodservice Organizations

1. Gender: CODE NO:______________

   Male ☐ Female ☐

2. Age: __________ Years

3. How long have you worked in any type of foodservice operation? ________ Years

4. How long have you worked at your current foodservice operation? ________ Years

5. Please select your highest level of education:

   ☐ High school

   ☐ Some College

   ☐ Associate's Degree

   ☐ Bachelor's Degree

   ☐ Master's Degree

   ☐ Doctoral Degree

   ☐ Other, please specify: ____________________________

7. Current student enrollment in school district: ______________

8. Average daily participation rate: ____________________

9. How are waste hauling fees to a landfill paid at your school?

___ School district pays without billing the Child Nutrition program

___ Child Nutrition program pays waste hauling fees directly

___ School district pays, but bills the Child Nutrition Program a standard % allocation (indirect cost)

___ School district pays but bills the Child Nutrition Program a flat fee per month (or other time period)

___ Other method. (Please describe)_______________________________________

10. If your child nutrition program pays indirect costs for waste hauling to a landfill, what is the percentage? ________%

11. The average amount that my child nutrition program pays **per month** for waste hauling to a landfill is:

$____________

12. During the past 2 years, waste hauling costs for my child nutrition program have:

_____ Decreased _____Remained the same _____Increased

13. If there has been an increase in waste hauling costs, why do you think this has occurred?

____

____

14. I purchase individual pint containers of milk for school meals in:

- ☐ Wax paperboard cartons
- ☐ Plastic pouches
- ☐ Plastic bottles

Food Waste

15. Please indicate (by checking the box) how often you have used any of the following food waste management strategies at your facility within the past 5 years.

	Daily	2-3 x per week	Once a week	Monthly	Never
Donation of prepared food (hot or cold foods) to nonprofit organizations					
Donation of non-perishable food (canned products) to nonprofit organizations					
Donate food scraps to farmers for animal feed					
Send food scraps to on site composting site					
Send food scraps to off site composting site					
Use a food pulper to reduce food waste					
Use garbage disposal to dispose food waste into wastewater system					
Other, please specify:					

Packaging Waste

16. Please estimate either the approximate weight or volume per month of food/beverage packaging materials that you recycle. If you do not recycle that material, please mark "N/A" in the column.

	Weight (lbs per month)	Volume (cubic feet per month)
Paper		
Cardboard		
Plastic bottles and containers		
Plastic packaging		
Steel		
Aluminum		
Glass		
Other, please specify: ________		

17. Please indicate (by checking the box) how frequently you have encountered the following barriers with the operation of a waste management program at your school.

	Never	**Sometimes**	**Always**
Investment/start-up costs			
Waste collection costs			
Lack of employee participation and support			
Lack of customer/student participation and support			
Lack of support from administration			
Non-availability of recycling facilities in local area			
Not enough waste to implement a reduction plan			
Limited storage space			
School policies			
Other, please specify: ____________________			

18. To assess your attitudes about recycling, please indicate (by checking the box) how strongly you agree or disagree with the following statements.

	Strongly disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly agree**
If my school recycles, it has a positive effect on the environment.					
It is costly and time consuming to recycle.					
Protecting the environment is less urgent than often implied by the media.					
Sending waste to a landfill is harmful to the environment.					
Employees feel that recycling is a waste of time.					
Recycling increases labor costs.					
Students are interested in recycling.					
My community supports recycling.					
My school administrators' support recycling.					

19. Please indicate if you have purchased any of the following equipment to assist in waste management.

	Yes	**No**
Pulper		
Recycling containers/ bins		

Compactor		
Baler		
Shredder		
Garbage disposal		
Grease trap		
Other, please specify: ______		

20. Please check below if you would like to receive a summary of the results.
☐ Yes ☐ No

21. Please check below if you would like to be entered into a drawing for one of four $25 gift cards.
☐ Yes ☐ No

22. Please provide a valid email address so that we may send you study results and/or contact you if you are a prize winner. ______________________

Thank you for your assistance!

For the return of your completed survey, please fold across the dotted lines found on the back of the survey, making sure the business reply is facing outward, tape or staple the bottom, and place in the mail. Postage will be paid.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 13 DENTON, TEXAS

POSTAGE WILL BE PAID BY ADDRESSEE

TEXAS WOMAN'S UNIVERSITY
DEPARTMENT OF NUTRITION AND FOOD SCIENCES
P.O. BOX 425619
DENTON TX 76204-9982

APPENDIX G
Postcard

Dear Child Nutrition Director:

Reminder! We need your help!

You have been invited to participate in a 15-20 minute survey concerning waste management programs used in school foodservice organizations. Direct benefits of participating in the study will include a **chance to win one of four $25 gift cards** in a drawing at the completion of the study. If you would like to participate, please go the the Web site https://www.psychdata.com/s.asp?SID=138479 and enter the survey code which was provided on your initial invitation letter. After completing survey, you will be asked to give us an email address for the drawing of gift cards and summary of results. Participation in the survey is completely voluntary, and you may withdraw at any time without penalty.

Thank you in advance for your help! **Please reply by January 30th.**

Sincerely,

Janet Baca

Carolyn M. Bednar

Janet Baca, BS., R.D., L.D.
Graduate Student
Texas Woman's University
Phone: 254-721-7530
Email: JBaca@twu.edu

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