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Food Waste In Schools

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Abstract

This literature review examined the history of the National School Lunch Program from its inception to now. Ongoing questions and concerns related to food waste from school lunches have been explored by many researchers to understand its effect on the health of students, the environment, and the economy. Updates to the National School Lunch Program, specifically the authorization of the Healthy, Hunger-Free Kids Act of 2010, were implemented to align school lunches with the current United States Department of Agriculture's (USDA) nutrition guidelines and standards. Causes of food waste include the Offer Versus Serve model, order of recess and lunch, length of the lunch period, portion sizes and education, and the appeal or appearance of the food. Factors that reduce food waste include education, promotional campaigns, hands-on food waste-related activities, and school gardens. Targeting education to the environment, agriculture, nutrition, and health are effective ways to appeal to the needs of the world they live in and the people they love. Many nonprofit organizations have been established to bring awareness to the damaging effects of food waste. Many schools are also trying to establish programs, policies, and procedures to reduce food waste. Obstacles to educational endeavors are the time, energy, staffing, and funding needed to establish and continue food waste reduction initiatives.

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CHAPTER I: INTRODUCTION

Environmental sustainability is a common topic in the news, both locally and nationally. Food waste has been of increasing concern due to the economic and ecological impacts on the world. The Environmental Protection Agency estimated that the United States experienced approximately 63 million tons of food waste in 2018 in commercial, institutional, and residential sectors (Wasted Food Programs and Resources Across the United States, n. d.). Additionally, only eight states have state-led organic recycling policies (Byker Shanks et al., 2021). Given the number of meals consumed by school children in the United States, the issue of food waste at schools is relevant to the more significant issue of environmental sustainability. According to the World Wildlife Fund (2019), school food waste in the United States is over 5 million tons per year and costs close to ten million dollars per day, or 1.7 billion dollars per year. A heightened awareness of the amount of food thrown out daily during school hours in the United States has caused researchers to question whether the National School Lunch Program Act contributes to food waste in schools.

The National School Lunch Program (NSLP) was first implemented in 1946 by President Harry S. Truman (National School Lunch Program (NSLP) Fact Sheet, 2019). The NSLP "...is a federally assisted meal program operating in public and nonprofit private schools and residential childcare institutions. It provides nutritionally balanced, low-cost or no-cost lunches to children each school day…" (National School Lunch Program (NSLP) Fact Sheet, 2019, para. 1). Written by the United States Department of Agriculture (USDA) Food and Nutrition Service (FNS), the NSLP fact sheet (2019) determined that approximately 30 million children used the NSLP in 2016. In 2010, President Barack Obama signed a bill amending the NSLP by signing the Healthy, Hunger-Free Kids Act of 2010 (HHFKA) (Wengrovius, n.d.). The HHFKA, spurred by

Michelle Obama's Let's Move initiative, mandated the inclusion of updated nutritional standards and the implementation of specific food requirements (Eschmeyer, 2017). The updates are as follows:

> The Healthy Hunger-Free Kids Act of 2010 required updated nutrition standards for schools based on the most recent Dietary Guidelines for Americans and Institute of Medicine recommendations. The requirements consist of five meal components: fruits, vegetables, whole grains, low-fat dairy, protein, and sodium content in a specified range. The serving size and caloric limits for each meal for children enrolled in grades kindergarten through 12 are based on age group. (Byker Shanks et al., 2017, p. 2)

While the NSLP and HHFKA are essential guidelines ensuring that all students have access to nutritious meals to succeed in school, these guidelines also increase the opportunity for food waste. The Healthy Hunger-Free Kids Act of 2010 requires students to receive one fruit or vegetable serving per meal in order for schools to be reimbursed for the cost (Cullen et al., 2015). Research by Devaney et al. (1995) determined that food waste in schools based on the NSLP was "...about 12% of the calories in the food that they served" (as cited in Buzby & Guthrie, 2002, p. 2). Other studies estimate food waste to be between 10 and 37% (Reger et al., 1996, as cited in Buzby & Guthrie, 2002). Given the discrepancy in these figures and the environmental and economic crisis faced by the United States and the world, the amount of food waste in schools is a subject that needs closer scrutiny.

Research Rationale

Due to the scope of the problems of food waste in schools, the United States House of Representatives Committee on Appropriations (H. R. 106-619) requested a report to determine the scope of food waste in schools, as well as the methods implemented to decrease waste (Buzby & Guthrie, 2002). Given the time constraints, this report was based on existing research on the topic. The first initiative was to define food waste, also called plate waste. For this report, "... plate waste is defined as the number of edible portions of food served through USDA school nutrition programs, such as the National School Lunch Program (NSLP), that students discard each year" (Buzby & Guthrie, 2002, p. 1). A nationwide study published in 1993 shows that food waste by students is estimated to be 12% of the calories in the food served (Buzby & Guthrie, 2002). In 2002, a Congressional report estimated the cost of plate waste in schools NSLP at 600 million dollars. In 2019, the World Wildlife Fund (WWF) Food Waste Warriors education program concluded that food waste in schools was estimated to be "...530,000 tons per year, costing as much as $9.7M per day or $1.7B every school year" (World Wildlife Fund, 2019, para. 1). Overall, food waste in schools has economic and environmental consequences that must be addressed. Due to the inconsistent methodologies for determining the monetary and environmental cost of food waste in the NSLP, further research needs to be conducted to determine a total cost estimate per student/school and the overall economic, nutritional, and environmental effects it has on the country.

My first experience with food waste was during a volunteer opportunity at my son's middle school. As I was observing students and keeping them on schedule at the end of the lunch period, I noticed that many students were throwing away whole pieces of fruit, unopened milk cartons, and portions of unwanted entrees. My second experience was helping out in a high

school cafeteria while working as a school tutor. During this experience, I was asked to stand by a waste bin solely intended for uneaten foods that would eventually be used to feed pigs at a local farm. The frustrating part is that students also threw non-food items, like napkins, milk cartons, and plastic utensils. Given the rush of students emptying their trays before heading to their next class, I could not single-handedly pull out the materials contaminating the food waste bin.

Currently, I observe uneaten foods thrown in the compost bin at the charter school where I work. Two years ago, the school received a grant from a county recycling and composting program called Biz Recycling. This program provides education, bins, and signage to encourage waste reduction by recycling and composting. The program provides an economic and environmental solution to food waste while educating students and adults at the school. This program has allowed students to learn how to separate material on a lunch tray into separately labeled bins (trash, recycling, compost) and two students to gain work experience through a paid internship. The interns had to apply to oversee the recycling/trash/compost bins and clean the tables between lunch periods. While this program is helpful and exciting to have at the school, I believe that more can be done to reduce the amount of unwanted food thrown into the composting bin.

Furthermore, I have collected uneaten food items from students participating in the School Breakfast Program (SBP) in my classroom. Over four weeks, I collected 15 packaged fruit cups, 17 applesauce containers, ten red delicious apples, five bananas, four cheese sticks, seven containers of orange juice, three packages of a grain item (i.e., bagel) item, seven cereal bars, and three cartons of one percent milk. Also, this food waste was derived from only four students who participated in the SBP. These experiences have caused me great angst and concern

about the environmental, economic, and nutritional consequences of food waste during the school day.

Definitions of Terms

Important terminology used throughout this paper is defined as follows:

Cochran–Mantel–Haenszel Chi-Square Tests-The Cochran–Mantel–Haenszel test (CMH) is a test used in the analysis of stratified or matched categorical data. It allows an investigator to test the association between a binary predictor or treatment and a binary outcome such as case or control status while taking into account the stratification (*Cochran–Mantel–Haenszel statistics,* 2022)

Effective Public Healthy Policy Project (EPHPP) Quality Assessment Tool- An assessment tool created to address articles on a wide range of health-related topics. The Quality Assessment Tool for Quantitative Studies allows experts to apply this tool to articles on any public health topic (*Quality Assessment Tool for Quantitative Studies,* 2019, para. 2).

Food-Based Meal Planning Approach- One of two approaches used to implement the Nutrition Standards. It focuses on types and amounts of foods. Food-based menu planning, as established by the U.S. Department of Agriculture, includes so-called traditional and enhanced approaches (National Academies Press, 2008, para. 14).

Food Component-One of four food groups that comprise reimbursable meals planned under a food-based menu planning approach. The four food components are meat/meat alternate, grains/breads, fruits/vegetables, and fluid milk (Institute of Medicine (US) Committee on Nutrition Standards for National School Lunch and Breakfast Programs, 2008).

Food Waste/Plate Waste-The number of edible portions of food served through USDA school nutrition programs, such as the National School Lunch Program (NSLP), that students discard each year.

Free and Reduced-Price Meals (FRP)-The free or reduced price-lunch program, sometimes referred to as FRPL, refers to the lunches served as part of the National School Lunch Program, a federally assisted meal program that operates in over 100,000 public and nonprofit private schools and other residential child care institutions. *Free or reduced-price lunch*, (n.d.).

Healthy, Hunger-Free Kids Act of 2010- A federal statute signed into law by President Barack Obama on December 13, 2010. The law is part of the reauthorization of funding for federal school meal and child nutrition programs and increases access to healthy food for low-income children (*Child nutrition reauthorization healthy, hunger-free kids act of 2010, n.d.*)

National School Lunch Program-A federally assisted meal program operating in public and nonprofit private schools and residential childcare institutions. It provides nutritionally balanced, low-cost or no-cost lunches to children each school day (*National School Lunch Program (NSLP) Fact Sheet*, 2019)

Nutrient-Based Meal Planning Approach-One of two approaches used to implement the Nutrition Standards. It makes use of computer software to plan menus consistent with the Nutrition Standards. As established by the U.S. Department of Agriculture, the approach includes the so-called nutrient standard approach and the assisted approach (National Academies Press, 2008, para. 15).

Offer Versus Serve Model- Offer versus serve (OVS) is a concept that applies to menu planning and the determination of reimbursable school meals for grades K-12 in the U.S. Department of Agriculture (USDA) National School Lunch Program (NSLP). OVS allows

students to decline a certain number of food components in the meal and select the foods they prefer to eat. Under OVS, a student must be offered at least four food items and must select at least three food items, one of which must be ½ cup of fruit or vegetables for OVS (Connecticut's Official State Website, 2012, para. 1).

Serve Model- The serve model requires students to be served all five meal components to qualify for federal reimbursement. The components that must be included in school lunches under the NSLP are meat/meat alternates, grains, fruits, vegetables, and milks.

Quarter Waste Method-The method involves a visual estimation of food remaining on a student's plate or tray. When students bring their trays to the waste basket, the researcher or data collector simply records whether ¼, half, ¾, or all of each food they can identify has been eaten.

Research Question

The guiding research question for this thesis is as follows: How are schools in the United States addressing food waste generated in the lunchroom? In order to adequately address this question, it is first essential to understand the genesis and history of the National School Lunch Program (NSLP). Second, exploring the ramifications of the NSLP and its association with food waste among school-aged children in the United States is vital. Lastly, the focus will be on how schools are addressing food waste. Overall, given the economic, environmental, and nutritional effects of food waste generated by the required foods that are uneaten and thrown, it is vital to explore the scope of the problem and determine solutions.

CHAPTER II: LITERATURE REVIEW

In this chapter, the association between the National School Lunch Program (NSLP) and the tons of food wasted in schools each year will be discussed to determine the scope of the problem and possible solutions. First, the history of the school food service programs in the United States will be explored, including the early stages of the program, the reasoning behind the establishment of the NSLP, and the amendments that followed. Next, food waste will be defined, and the methodologies used to measure food waste will be explored. Methods range from simple observation and notetaking to using technology applications to generate more nuanced statistical data. This data, in turn, allows researchers to determine the nutritional, environmental, and economic effects of food waste in schools. Factors that affect food waste will also be discussed, such as education, promotion campaigns, and the time of lunch. The last portion of this literature review will look at the efforts being made by organizations, nonprofits, and schools to reduce food waste and create healthier, more sustainable schools.

History of Food Service Programs in the United States

While many people are aware of the services available to people who are food insecure, such as local food shelves, the Supplemental Nutrition Assistance Program (SNAP), and Free and Reduced-Price Lunches, not many people know the impetus behind these programs and how they have changed over the past century. Initial concerns about children's physical health stemmed from the fact that many military draftees were deemed physically unfit to enter the military during World War I and II (Martin, 1996). The National School Lunch Program (NSLP), enacted in 1946 by President Harry S. Truman, was spurred by vocalized concerns that many American men did not meet the criteria to provide military service to the United States during World War II (History of School Lunch, n. d.). According to Gay (1996), the concerns

were legitimate, as studies conducted by the Selective Service determined that the long-term effects of children with poor nutritional status resulted in adults being unfit to serve in the military.

Works Program Administration

The Works Program Administration (WPA), implemented in 1935 by President Franklin D. Roosevelt, was established to provide financial support to men following the Great Depression (FDR Creates the Works Progress Administration (WPA), 2009). In exchange for money, Americans were put to work rebuilding and improving the infrastructure of the United States (Martin, 1996). In addition to the economic priority of the WPA, supporting the health of school children was deemed a necessity. The WPA provided school lunches to all children to help their education for the duration of the program, which ended in 1943 (Gunderson, Early Programs in the United States section, 2008). Fortunately, the government provided funding for school lunches up until the passing of the National School Lunch Act in 1946.

The National School Lunch Program (The Richard B. Russell National School Lunch Act)

The National School Lunch Program (NSLP) was signed into law in 1946 by President Harry S. Truman due to the extraordinary efforts of United States Congressman Richard B. Russell (National School Lunch Program (NSLP) (Gay, 1996). The Richard B. Russell National School Lunch Act stemmed not only from the need for school children to continue to receive a nutritious lunch but also from his concerns about the plight of local farmers' financial losses and agricultural surpluses. Despite pushback from some fellow congressmen, Russell continued to pursue his belief that the economy and health of children were too essential to let go. Russell’s legislation was backed by the surgeon general of the U.S. Public Service, who testified before lawmakers, stating, "I think there is probably no experiment the Federal Government could make

which would have a greater beneficial influence on the future health of this country than appropriations such as those contemplated under the National School Lunch Bill" (Gay, 1996, p. 864). In addition to requiring all schools to offer students a nutritious meal, the bill supported American farmers by using their agricultural surpluses. Senator Russell, as quoted in the article by Gay (1996), stated, "Congress was supporting farm prices at a level of 90 percent parity on most commodities used in any nutritious diet" (p. 865). In total, the United States Department of Agriculture found that the NSLP, during the 2020 school year, fed about "...22.6 million children each day…" costing "...$10.4 billion" (National School Lunch Program, 2022, para. 2).

The Healthy, Hunger-Free Kids Act of 2010

Over 60 years later, the NSLP requirements were updated to follow the most recent updates to the United States Department of Agriculture's (USDA) nutrition guidelines and standards (Dietary Guidelines for Americans, 2010). The changes to the NSLP stemmed from First Lady Michelle Obama's passion for improving children's health, specifically reducing childhood obesity in the United States (Let's Move: America's Move to Raise a Healthier Generation of Kids, n.d., para. 9). Her work led to the creation of The Let's Move Initiative, a program to improve the health of all children in the United States by requiring each school lunch meal to include two vegetable servings and one fruit serving (Cullen et al., 2015). This initiative was implemented into the Healthy, Hungry-Free Kids Act (HHFKA) of 2010, which was signed into law by President Obama in 2011 (Wengrovius, n.d.). The HHFKA required the NSLP to improve the nutritional quality of the foods served at school while providing funding. The updated nutritional requirements require the following: fruits and vegetables recognized as separate components, five vegetable subgroups per week (dark green, red/orange, starchy (e.g.,

white potatoes, corn, peas), legumes (peas and beans), and other), grains must be 51% whole grains, decreased sodium content, and grade-level calorie requirements (USDA, n.d., Chart 1B).

Effects of the National School Lunch Program

The government funds the NSLP to ensure that all students, regardless of their family's income level, have access to a nutritious lunch. According to the Statistical Abstract of the United States 1999: The National Data Book, the Federal cost of the NSLP was 2.279 million dollars in 1980 and climbed to 5.064 million dollars in 1999 (Economics and Statistics Administration (Ed., 1999). Due to the cost increase and questions about the amount of food wasted from the NSLP, the U.S. Congress requested additional information. During the 106th Congressional session (1999-2000), the United States House of Representatives Committee on Appropriations asked for data on the effects of the National School Lunch Program on food waste in schools (Skeen, 2000). Congress declared the following:

> The Committee directs the Department to conduct a study of plate waste in the school nutrition programs and the factors associated with it, including ‘‘offer v. serve’’ in both elementary and secondary schools, scheduling of lunch hours (are they too short, are there competing activities that interfere with lunch time, e.g., recreation time after a meal versus before a meal), quality and condition of food. (Skeen, 2000)

Congressional Report Findings

Buzby and Guthrie (2002), affiliates of the Economic Research Service (ERS) within the United States Department of Agriculture (USDA), published the final report to Congress assessing food waste produced during the school lunch meal. This report intended to provide data that Congress can use to “...to develop, administer, and evaluate agricultural and rural

policies and programs" (Skeen, 2000, p. 18). Based on their literature review, Buzby and Guthrie (2002) concluded that approximately "...12 percent of calories from food served under the NSLP go uneaten" (p. 1), costing over 600 million dollars annually. Given the nutritional, cognitive, and physical benefits of eating nutrient-dense foods, these researchers examined four factors that can contribute to plate waste: (1) food delivery service models, (2) scheduling of lunch, (3) quality and/or acceptance of NSLP food, and (4) education and portion size.

Food Delivery Service Models

The NSLP allows schools to use one of two delivery models: Serve or Offer Versus Serve (OVS) (USDA, 2015). Under the Serve model, students must be served all five meal components to qualify for federal reimbursement. The components that must be included in school lunches under the NSLP are meat/meat alternates, grains, fruits, vegetables, and milks. Under the OVS model, students are required to take at least three of the five meal components, with one being a fruit or a vegetable. While the OVS provision is required for high schools, it can be used in middle and elementary schools. Buzby and Guthrie (2002) found that the USDA/Food Nutrition Services (FNS) reported that its use in middle and elementary schools had increased to about 90% during the 1997-98 school year. A 2015 report by the United States Department of Agriculture (2015) states, "The goals of OVS are to reduce food waste in the school meals programs while permitting students to decline foods they do not intend to eat" (para. 1). Research shows that the OVS model, compared to the Serve model, decrease food waste (Goggans et al., 2011). Similarly, Allaway (1994) found that plate waste decreases when the OVS provision is "...well implemented" as well as when used alongside other food waste reduction strategies, such as tailored serving sizes, plate waste also decreases (Allaway, 1994, as cited in Buzby & Guthrie, 2002, p. 2).

Timing of Recess and Lunch

The timing of school recess and its subsequent effect on food waste was also of interest to the House of Representatives Committee on Appropriations (H.R. 106-619). Based on previous research by Gettlinger et al. (1996), Ruppenthal and Hogue (1996), and Ruppenthal (1997), Buzby et al. (2002) determined that scheduling recess before lunch in elementary school decreases plate waste. Unfortunately, national data from a survey conducted in 2000 by the U.S. Centers for Disease Control and Prevention (CDC) School Health Policies and Procedures Survey (SHPPS) found that it is more common for schools to offer recess after lunch. The time of the lunch hour and the amount of time allowed to eat was also found to affect plate waste. Buzby and Guthrie (2002) found discrepancies in results among studies assessing plate waste based on the time of lunch and the time required to complete the meal. The literature reviewed by Buzby and Guthrie (2002) determined that students are typically able to complete their lunch within the time frame offered. A survey of public-school cafeteria managers, on the other hand, considered the cause of plate waste to be a lack of time to eat or lack of hunger. Long wait times to get lunch, hence less time to eat were also speculated to be the cause of plate waste.

Food Acceptance

Buzby and Guthrie (2002) also examined the effects of food quality, food appearance, and food acceptance on plate waste in NSLP meals. Results based on their literature review found four strategies that could reduce plate waste: improving the selection of commodities donated by USDA, increasing the use of produce and local foods, using commercial food service companies and/or their products, and increasing students' input. Overall, the data was minimal to none, and the study design weaknesses precluded usable evidence.

Nutrition Education and Portion Sizes

The final strategies researched were the effects of nutrition education and tailored portion sizes on plate waste during the lunch meal. The Food Waste Warrior (FFW) (2019) program found that nutrition education programs, particularly those that included preparing and tasting lunch foods, resulted in less plate waste. Research on tailored portion sizes fell into two categories, customization of serving sizes and the self-service option. While schools are required to follow minimum serving sizes for children based on age/grade, the USDA does allow for schools using a "nutrient-based meal planning approach," as opposed to "food-based approaches", to implement more narrowly defined age group food portions/sizes (p. 5). A 2000 USDA/FNS study, called the Schools Meal Initiative (SMI) Year 1 Implementation Study, found a reduction in food waste by schools using the "nutrient-based meal planning approach" compared to schools using the " food-based approach" (Buzby & Guthrie, 2002, p. 5). Also, the NSLP allows all schools to offer self-service bars (i.e., salad bars). A Louisiana-based study by Kerfoot and Fournet (1996) found that self-service produce bars increased fruit and vegetable consumption while reducing plate waste (Kerfoot and Fournet, 1996, as cited in Buzby & Guthrie, 2002). Overall, Buzby and Guthrie (2002) suggested that the lack of current data and the fact that the research predated the implementation of the Healthy, Hunger-Free Kids Act (HHFKA) necessitated further research to determine the scope of the food waste problem in school lunches.

Effects Of The Healthy Hunger-Free Kids Act Of 2010 On Food Waste

The signing of the Healthy, Hunger-Free Kids Act (HHFKA) into law in 2010 by President Barack Obama changed the meal requirements of the National School Lunch Program

(NSLP) (Cullen et al., 2015). The update was implemented to bring the school lunch meal consumed by students in the United States into alignment with the United States Dietary Guideline. The new standards increased the amount of vegetable and fruit servings from two servings (fruit and/or vegetable amount not defined) to three servings, specifically two vegetable servings and one fruit serving per meal. Additionally, the HHFKA mandated specific types of vegetables to be included each week: dark green, red-orange, starchy (e.g., white potatoes, corn, peas), other (e.g., green beans, celery), legumes, beans, and peas (legumes), and other (Chart 1B: National School Lunch Program (NSLP) - USDA). The grains had to be 50% whole grain, the total sodium content had to decrease over ten years, and calorie levels differed according to grade. These new NSLP meal requirements caused researchers and others to question the effect of the changes on food waste in schools. Cullen et al. (2015) compared the amount of fruit and waste before and after the implementation of the HHFKA in 2012. The researchers' objective states, "We compared elementary students' school lunches selected and consumed before (Spring, 2011) and after (Spring, 2013) implementation of the new National School Lunch Program meal patterns in the fall of 2012" (p. 1). The research occurred in eight elementary schools in Southeast Texas over eight consecutive weeks in the spring of 2011 and 2013. The schools were selected based on the number of students who received free or reduced-price meals (FRP) and included 716 students in 2011 and 731 students in 2013. The racial make-up of the students was comparable in 2011 and 2013, with approximately 6.5% identifying as African-American, 35.5% as Hispanic, 42.5% as White, and 10.5% as Other. Data collection was performed by trained research staff using preprinted menu checklists and a la carte items. Collectors took data from the same students in each class (each class was assigned a table) and took their information from an equal number of males and females and grade levels. The amount

of food eaten by students "...was recorded using the quarter waste method (0, 1/4, 1/2, 3/4, all), which has high inter-rater and inter-method reliability…" (Cullen et al., 2015). Food selection and consumption were measured, recorded, and entered into a computer software program (Nutrition Data System for Research (NDSR) files) that analyzed the nutrient and food group intake. Additionally, Cullen et al. (2015) used "... the Cochran–Mantel–Haenszel chi-square tests, adjusting for student sex, student grade, and school FRP" (p. 2) and a mixed-regression analysis to determine the difference in students' food group intake and calorie intake of each food group from the 2011 to the 2013 school year.

While results showed a similar calorie intake among students in 2011 and 2013, students ate a "...a significantly greater proportion…" of all meal components except starchy vegetables, following the implementation of the HHFKA guidelines, in 2013 (Cullen et al., 2015, p. 3). Of the foods students selected in 2013, intake was "...significantly greater for fruit + 100 % fruit juice…and red-orange vegetables… but significantly lower amounts of other vegetables, legumes, and protein foods…" (p. 3). Students also drank a smaller percentage of milk in 2013 than in 2011. Finally, the food waste percentage was more significant in 2013 for legumes but remained the same between 2011 and 2013 for fruits, vegetables, and whole grains. Overall, this study found that "There were no differences in waste of fruit, whole grains, or vegetables, with the exception of legumes" at the school lunch meal between the 2011 and 2013 school years. (Cullen et al., 2019, p. 3). The researchers also found that food selection increased for all foods (except starchy vegetables), but only total fruit + 100 % juice and red-orange vegetable consumption increased from 2011 to 2013. Cullen et al. (2015) concluded that further studies were needed to determine the long-term economic effects the updated NSLP standards have on

schools since cost reimbursement requires students to select at least one vegetable or one fruit serving per meal.

Offer Versus Serve

In 2015, an article by Ellsworth et al. (2015) in the Journal of School Health questioned whether the intended purpose of the Offer versus Serve (OVS) provision in school cafeterias was effective in meeting its intended goal, that of decreasing food waste and increasing vegetable and fruit consumption by students. While the Healthy, Hunger-Free Kids Act of 2010 required schools to offer a wider variety of vegetables and more nutrient-dense foods, it also allowed students to refuse the vegetable offering. As mentioned in a previous paragraph, the OVS provision gave students the choice of selecting either a fruit or a vegetable, not both. With this design, previous studies showed that students predominantly choose fruits over vegetables when given a choice. One study found that 73% of vegetables were thrown away due to not being selected by students. Ellsworth et al. (2015) stated, “Vegetables sitting on a shelf, not chosen by the student, do little to improve their health (p. 2). The researchers also learned that vegetable selection was significantly lower in schools using the OVS model compared to the Serve model, ten and 24%, respectively. With this information and knowledge that selection is only half the battle related to vegetable consumption at school, studies have shown that children are more likely to find vegetables worthy of selection after being exposed to them at least six times. Ellsworth et al. (2015) stated that schools are an excellent opportunity to give students the vegetable exposure they might not otherwise get to improve their acceptance. Two additional unpublished studies compared a school that used the Serve model (serving all five meal components, including both a vegetable and fruit) to a school using the OVS model alongside conducting taste tests. The research found that students who were offered the Serve model

consumed more vegetables compared to baseline than those that followed the OVS model. Although reviewing unpublished data is a defining limitation of Ellsworth et al.'s. (2015) commentary, it is prudent to consider the feasibility that the research offers valuable information for those invested in children's health and learning.

Finally, while the OVS model is well intended to reduce food waste and cost, Ellsworth et al. (2015) argued that the OVS provision might effectively be wasting food. The researchers also pointed out that the cost of adding vegetables to every meal is minimal (i.e., about ten cents per meal, or 18 dollars per student per school year), doing little to the bottom line of school budgets. As outlined in the previous two paragraphs, this data suggests that always serving students the vegetable component at each meal is one way to increase consumption and health with little economic hardship.

Effects of Education on Food Waste

Due to the questions centered around food waste related to the NSLP Act of 1946 and the Healthy, Hunger-Free Kids Act of 2010 (HHFKA), Prescott et al. (2019) sought information on the link between student education on sustainable food systems and the consumption of foods chosen and eaten by middle and high school students. Specifically, the study looked at "...the impact of a student-driven sustainable food systems education and promotion intervention on adolescent school lunch selection, consumption, and waste behaviors" (p. 1). The research question proposed by Prescott et al. (2019) culminated from the concerns that food waste would increase due to the HHFKA's rigorous nutritional value and serving size requirements in school meal offerings. Prescott et al. (2019) argue that uneaten foods discarded into waste containers in school cafeterias across the nation negates sustainable agricultural practices and jeopardizes the environment regarding climate change. The researchers used a mixed-methods experimental

embedded design, with quantitative data based on a non-randomized control supported by qualitative data.

The research design included a Healthy Planet Healthy Youth (HPHY) Advisory Committee, composed of school nutrition staff from three middle schools, college professors, and staff from the Colorado Department of Education School Nutrition Unit (Prescott et al., 2019). The researchers predicted that teacher and nutrition staff training, student education on sustainable food systems, and the inclusion of student participatory activities, such as voting on sustainable foods, would motivate students to make healthy choices that improve nutrient intake and reduce food waste. Study participants included two sixth-grade students in two Colorado middle schools within the same district. The schools had similar nutrition programs, including a salad bar, 30-32 minute lunch periods, and offer versus serve food selection options. The sample size was approximately 268 sixth-grade students in four science classes from two schools. (Prescott et al., 2019). Fifty-four posters and 326 coded poster messages were displayed across the two schools, and 1,596 plates were digitally photographed for food waste over six months.

The intervention included an outlined, abbreviated curriculum, posters, a one-hour training for sixth-grade science teachers selected by the HPHY committee, pre and post-intervention surveys, food (plate) waste data, and student voting on curriculum-related posters (Prescott et al., 2019). The HPHY uses Self-Determination Theory (SDT), suggesting that with education, students will develop intrinsic motivation to choose and eat healthy foods, thereby increasing nutrient intake and decreasing food waste. The education was focused on promoting the benefits and indirectly relating them to personal values. Data collection used the pre and post-intervention survey results, monthly plate waste data collection over six months using a digital photography method, and teacher interviews. Research results were mixed, likely due to

variables in classroom time constraints, delineation from the suggested delivery of homework assignments, and lack of consistency between the control and experimental groups. The study found significant differences between pre-and post-knowledge and attitudes toward food waste. An example question was, "I feel that one person's food waste is bad for the environment" (Prescott et al., 2019, p. 15). A "yes" response increased from 3.62 to 4.00 for White students, while no significant change was found from responses by non-White students. Study results showed that education and poster use decreased fruit and vegetable waste compared to the control group.

In short, Prescott et al. (2019) determined that education around food sustainability by science teachers has the potential to increase vegetable and fruit consumption during the school lunch meal and decrease food waste. Due to limitations and implementation fidelity, the researchers concluded that additional research on the relationship between food systems education and food waste reduction, specifically its inclusion into school curricula, is necessary to determine its effectiveness in reducing food waste in schools.

In 2016, Sharma et al. (2016) conducted a study "...to evaluate the effectiveness of a school-based food co-op program…" called Brighter Bites on food selection and consumption, thus food waste (p.1). "Brighter Bites is an evidence-based school health promotion program that combines access to fresh F&V with nutrition education in school and at home to increase preference and intake of F&V among children" (Sharma et al., 2016, p. 2). The curriculum was implemented in two fourth-grade classrooms at two elementary schools (one in Houston, Texas, and one in Dallas, Texas) during the 2017-18 school year to measure its impact on decreasing food and nutrient waste during the school lunch meal. A fifth-grade class at another school in the district served as the control group. Program participants were required to have had no previous

Bright Bites programming and be enrolled in the NSLP. The program differs from classroom instruction-only programs because it involves the family and "...is grounded in Social Cognitive Theory constructs" (Sharma et al., 2016, p. 2). The program included the following:

> (1) weekly distributions of 50 servings of fresh donated F&V sourced from local food banks sent home with parents; (2) nutrition education, which includes the evidence-based Coordinated Approach to Child Health program in schools, and parent education through bilingual nutrition handbooks and recipe cards; and (3) weekly recipe demonstrations at produce pickup time (Sharma et al., 2016, p. 2).

The program occurred over two eight-week periods; the fall and spring semesters. Baseline data was collected before the first day of the 16-week curriculum. Additional data points were taken at the end of the fall semester (after the first eight weeks of the program), before the implementation of the spring lessons, and at the end of the spring semester (after 16 weeks of programming). The final fruit and/or vegetable weight was weighed using a digital scale was compared to the baseline weight. The quantitative data, alongside qualitative data (i.e., observational notes), were entered into a mobile electronic data software system to determine total plate waste and nutrient loss data. Results showed that students enrolled in the Bright Bites program reduced food waste and saw "...significant, although small, reductions in waste of nutrients such as fiber and vitamins…" (p. 8). Study limitations include using a small, non-randomized sampling of participants over a short time period. This data caused Sharma et al. (2016) to suggest that further, long-term research include randomized controlled studies that consider covariates that may affect food waste levels.

Effects of Presentation on Food Waste

While Sharma et al.'s (2019) research study measured fruit and vegetable selection and waste following education and food distribution to families, Smathers and Graffagnino's (2019) study looked at the amount of food waste relative to apple presentation and consumption among students in grades Pre-K through fifth. The purpose of the study was to compare the difference in apple consumption by elementary school students when presented with a whole apple versus pre-sliced apples. The research question, "Does the amount of apple wasted differ based on the delivery of a whole apple versus pre-sliced apples?" stemmed from previous research showing that the NSLPs meal requirements contributed to food waste and had negative economic and environmental implications (pp. 1-2). The sample size was greater than 920 students (Pre-K-5) in a large urban school district of approximately 52,000 students, with 77% of students participating in the NSLP. Data were collected to determine the waste produced between whole apples and pre-sliced packaged apples from a distribution center and the waste produced between whole apples and apples pre-sliced onsite with a slicing machine.

The first set of data (whole versus packaged pre-sliced) was taken over three consecutive days, followed by data collected over three consecutive days about three weeks later. The time lag of three weeks was purposeful, so the schools had time to purchase and train staff on the apple slicing machines and reduce the novelty of introducing sliced apples. The weight of the apple consumption and hence waste was collected by trained staff from the local city health department using digital scales. Based on "...two-sample t-tests assuming equal variances were conducted with significance set at a p-value of …" less than or equal to 0.05, there was no significant difference between the selection of whole and bulk packaged pre-sliced apples (Smathers & Graffagnino, 2019, p. 5). Apple consumption was greater when students were

offered sliced versus whole apples, while food waste was more significant with whole versus sliced apples. The research concluded that using pre-sliced apples, either bulk pre-packaged and sliced onsite, increased fruit consumption. Additionally, although packaged pre-sliced does produce non-recyclable waste, the overall food waste, especially if apple cores are composted, is lower when students are offered pre-sliced apples. Smathers and Graffagnino (2019) suggested further research was needed, specifically an analysis of the cost of apple slicing equipment, staff training and preparation time, and compost hauling services to the benefit of increased apple consumption and nutrient intake by students.

While Smathers and Graffagnino's (2019) research was performed at elementary schools where 77% of students qualified for FRP lunch, Handforth et al. (2016) studied food waste in a suburban school district where only 11% qualified for FRP lunches. Demographically, 85.6% of the students identified as White, 8.4% as Asian, 3.3% as Hispanic, and 2.8% as Black (Federal Education Budget Project [FEBP], 2012, as cited in Handforth et al., p. 3). Another difference in Handforth et al.'s (2016) research is the district's use of produce grown in the district garden. The researchers set out to determine the amount of fruit and vegetables wasted by directing their research to analyze the fruit and vegetable subgroup intake across gender, grade level, and school location. A total of 693 student plates were assessed at two elementary schools, one middle school, and one high school. Handforth et al. (2016) estimated the amount of food waste using pre and post-plate digital photographs, with each tray notating student gender, school, grade level, and fruit and vegetable selection.

Handforth et al. (2016) found that fruit selection only was highest (58.2%) among students, while vegetable only and both vegetable and fruit selection were each chosen 20.9% of the time. Among all grade levels, the "Median portion consumed for all types of fruit was 90%

(n=678) and 70% for all types of vegetables (n=315)" (Handford et al., 2016, p. 6). Of the fruit choices presented (canned fruit, whole fruit, cut-up fresh fruit, and fruit juice), cut-up fresh fruit was most frequently selected. The median portion consumed, across all grade levels and gender, was 90-100% for canned and cut-up fresh fruit. High school students consumed significantly higher levels of whole fruit (e.g., apples, oranges, bananas) compared to elementary and middle, 80% and 20%, respectively. A possible reason for older students preferring whole fruit far greater than younger students is the challenge of eating whole fruits. A Food Waste Action Plan adopted at an urban school district in Minnesota identified that "Fruit served whole (like uncut apples and oranges) can be difficult to eat or too much food for smaller children" (Bloom, 2019, p. 9).

Vegetables, especially cooked vegetables, were consumed at a lower rate (45%) than raw vegetables (Handforth et al., 2016). Of the vegetable subgroups, potato products (french fries and tater tots) were the favorite, selected across grades and genders, 90% of the time. Vegetable selection increased, however, when students were presented with more options (other than potato product items), with cooked vegetables being the least preferred. The high selection level of fried potato products at schools offering them, compared to those that did not provide them, could lead one to conclude that the higher fat, less healthy vegetable option competes with more nutrient-dense, healthier vegetable options. Considering students receiving FRP school lunches receive almost one-half of their daily total calorie intake at school, districts should consider offering potato products less frequently. This recommendation seems reasonable considering statistics on childhood obesity and the health and economic implications it has on students. A recent special report from the State of Childhood Obesity: Helping All Children Grow Up Healthy, a Project of The Robert Woods Johnson Foundation, cited that 16.2% of youth ages 10-17 were diagnosed as

obese in the United States, with the rate climbing to 23.8% among non-Hispanic Black youth and 21.4% among Hispanic youth (2021 report: From crisis to opportunity, n.d.). Based on the data, Hanford et al. (2016) recommend replacing whole fruit with cut-up fresh fruit at elementary and middle schools, offering vegetables cooked in various ways, such as broiling and steamed, and surveying students to determine the most preferred vegetables.

Food Waste Measurement Methodologies

As discussed in the preceding paragraphs, food waste as a byproduct of the NSLP was of interest to many people. While many research studies have been conducted and published in scholarly journals about food waste from school lunches, there has been no consistent methodology to calculate food consumption and waste (Byker Shanks et al., 2017). Due to this and questions about the nutritional, economic, and environmental effects of food waste stemming from the NSLP, Byker Shanks et al. (2017) sought to identify and understand the methods used to measure food waste across studies conducted from 1978 to 2015. The methodology used by this group of researchers was a systematic literature review and meta-analysis of studies published through 2015. The studies reviewed were matriculated first by identifying records using keywords, screening for duplicates, and relevance of the title, then abstract information and access to full text, followed by quality of the articles. The article selection criteria used by Byker Shank et al. (2017) was "...the explicit use and description of a method to measure food waste in the NSLP" (p. 2). Food waste was measured using three methods: in-person visual estimation of food waste through observation, visual estimation of food waste through digital photography, and direct weighing of food waste. The quality of each article was determined based on the Effective Public Healthy Policy Project (EPHPP) Quality Assessment Tool. The EPHPP includes nine numerically and nominally graded criteria and an overall numerical/nominal score (one,

two, three, and strong, moderate, and weak, respectively). The total number of studies synthesized for this article was n=53. Keywords entered using Boolean operators included waste, school lunch, plate waste, kitchen, half method, quarter method, weight, and photography.

The Byker Shank et al. (2017) study had significant variations in the objectives, methods, and reporting used to determine food waste production stemming from the NSLP. The variation in methods used to collect data (in-person visual estimation, digital photography, direct weighing, and a combination of the three methods) quantified food waste in grams, ounces, percentages, calories, or serving count. "Inconsistencies were noted in key design features…and participant characteristics…" (p. 13). The results determined that a pre-post intervention or cross-sectional design was the most common method used by researchers to measure food waste and fruits and vegetables were the most popular foods measured. Overall, the wide variety of research objectives, procedures, and terminology used to measure food waste stemming from the lunches provided by the NSLP to students receiving free or reduced-price lunches hampers the ability of members of Congress, consumers, and schools to determine and understand the economic, nutritional, and environmental effectiveness of the NSLP.

Marshall et al. (2019) were interested in the long-term effects of low nutrient intake during the lunch meal. Wasted nutritious food means students may not be receiving adequate nutrients and calories necessary to grow and learn. The implications of poor nutritional intake during the school lunch meal, especially fruits and vegetables (F & V), are concerning since "...nutrition affects school performance and school absences through illness and disciplinary action due to poor behavior" (p. 2). This information reinforces the importance of the consistent use of effective data collection methods by researchers measuring food waste. Given a lack of food waste measurement consistency, Marshall et al. (2019) developed a protocol to "...to assess

longitudinal changes in F&V plate waste…" and "...to provide baseline descriptive data on school demographics and study participants" (p. 1).

> "This protocol is important because it provides a detailed, longitudinal, individual-level estimate of the amount and type of F&V wasted on the child's lunch. Many plate waste studies use bulk measurement by combining all food waste and taking one weight for an entire group [9–11]. Direct measurement of plate waste data collection is more objective than self-report dietary intake measures [12]. It is superior to visual observations, which are less sensitive to detecting change in plate waste [13]." (Marshall et al., 2019, p. 2)

Using a quasi-experimental approach, Marshall et al. (2019) collaborated with three schools among two school districts in Texas during the 2017-18 school year to measure the level of fruit and vegetable waste among participants that had been a part of a school-wide nutrition intervention program, compared to those with no intervention program (p. 2). School selection was based on a high percentage of students (90%) receiving free and reduced lunches; most students in the study identified as Hispanic (Marshall et al., 2019, p. 8). Of the three schools, two (the experimental groups) were using a nutrition intervention program called Bright Bites, and one was not using any nutrition intervention program (the control group) (p. 3). "Brighter Bites is a school-based health promotion program designed to change the behavior of children and their families to prevent childhood obesity and achieve long-term health outcomes" (Brighter Bites, 2021). The students were chosen from "...schools with a high proportion of free and reduced lunch eligibility (90%)...All three schools had mostly Hispanic students enrolled…" Marshall et

al., 2019, p. 8). Experiment materials and methods included "...weighing of individual student F & V waste, direct observation technology in the form of a collection app, and qualitative methods inclusive of field notes" (Marshall et al., 2019, p. 3). Baseline data was collected over five consecutive days in the fall of 2017. The remaining data sets were collected after eight weeks of Brighter Bites programming (end of the fall semester, 2017), at the beginning of the spring Brighter Bites programming (2018), and at the end of the remaining eight weeks of the spring programming (2018). Quantitative and qualitative data were immediately entered into a data collection app that analyzed nutritional values and allowed for photographs and other pertinent data, such as "...student status (absent, did not purchase a school lunch, or did not purchase any F&V item) as well as item status (not eaten, or entirely consumed)..." (Marshall et al., 2019, p. 6). Study results found that of the approximately five fruit and vegetable options offered, students tried about one and wasted about 59% of the items served. Marshall et al. (2019) stated that using technology, in the form of an app, to collect data in "real-time" accurately is a novel and reliable method for other researchers to use to collect data on individual food waste.

The data collection method used by Marshall et al. (2019) showed a high inter-reliability rating and differentiated from previous plate waste measurement studies in that fruit and vegetable selections were labeled/named and weighed separately. Additionally, Marshall et al. (2019) use of a mobile data tracking app that was able to synthesize nutrition information of each fruit and vegetable item allows researchers to specify the level of student nutrient intake across an extended time period, such as one school year. Access to this type of data can be used to help schools make lunch menu decisions that benefit both students and schools. For example, ordering preferred fruit and vegetables benefits student health, promoting physical health and its

impact on student learning. Economically, less food waste decreases revenue lost to food and refuse collection costs. Lastly, reduced food waste allows schools and students to be a part of reducing the environmental impact of food waste.

Similar to the work of Marshall et al's (2019) use of an app to track data, Danible et al. (2021) proposed using an app called the mobile food record (mFR™) to measure food waste. This decision was based on Elimelech et al.'s. (2019) research findings that using self-reports (e.g., dietary records, surveys, questionnaires) to measure food waste was not only costly and time prohibitive but potentially inaccurate or flawed. While aimed at extension educators, Danible et al.'s. (2019) research results apply to the concerns surrounding food waste from the school lunch meal.

Present-day concerns about food waste's global environmental, economic, and nutritional costs are a platform Dannible et al. (2021) cited to exemplify the need for accurate and easy ways to measure food waste. "The Food and Agriculture Organization of the United Nations (FAO) estimates that one-third of food produced worldwide is wasted, which contributes to the more than 820 million people who go hungry annually" (Food and Agriculture Organizations of the United Nations., n.d.). Without adequate and consistent food waste measurement methodologies, Dannible et al. (2021) argued that educators cannot effectively present data that will sway consumers to reduce food waste. Tedrow (2018) states that extension educators need reliable research data to try and solve the problem and educate the public about the causes and effects of food waste and ways to prevent it. Informed extension educators are one way for schools to get the information they need to analyze food waste in their schools and potentially reduce the adverse economic, environmental, and nutritional effects of food waste in schools (Dannible et al., 2021).

Several researchers developed the mobile food record (mFR™) mentioned above to address limitations posed by the multitude of previously used data collection methodologies (Dannible et al., 2021). According to several researchers, between 2010 and 2019, "The mFR™ is part of an image-based dietary assessment system" (Dannible et al., 2021, as cited in Daugherty et al., 2012; Fang et al., 2019; Zhu et al., 2010; Zhu et al., 2015) that allows individuals to take pictures of their meals/food before and after consumption, that are stored in the cloud, where they can be analyzed by researchers and used by educators (pp. 1-2). A similar online software application, used in Australia, had participants photograph their meals before and after eating over four days (Bathgate et al., 2017). Results presented one limitation of the study; approximately 6% of participants failed to take the post-meal photograph. Overall, that study shows the method was influential among the 4,885 participants, and its success is transferable to implementing the mFR™ in future studies in the United States. "While these studies did not involve use of the mFR™, they are relevant given the mFR™ could be used to quantify food waste in similar educational campaigns in the United States aimed at reducing food waste" (Dannible, 2021, p. 2).

From an educational perspective, using a mobile software application, such as the mFR™, can give students real-time information about their individual food waste levels across the entire school and district schools. Real-time, personalized data can change how students view their food consumption practices and relate it to food sustainability, food insecurity, and food waste's economic and nutritional costs. Utilizing previous research, Dannible et al. (2021) believed using a mobile tracking record, like the mFR™, would give students on-the-spot education that could be used to encourage less food waste. Thus, Dannible et al. (2021) concluded that a software application like the mFR™ could give data on food waste and the

specific energy and nutrient loss related to different food groups.

International Food Waste Reduction

The environmental impact of food waste created from school lunches is a concern to lawmakers, scientists, educators, and many others across the world. According to the Intergovernmental Panel on Climate Change (IPCC), "About 21-37% of total greenhouse gas emissions (GHGE) are attributable to the food system…from agriculture and land use, storage, transport, packaging, processing, retail, and consumption" (Mbow et al., 2019, para. 8). Considering the number of students participating in the NSLP, estimated at 29.49 million students per day during the 2018-19 school year, the contribution of wasted food to climate change is a problem that needs to be addressed in the United States (NSLP participation tracker, 2020, para. 2). In this study, Eustachio Colombo et al. (2020) explored the feasibility of creating a healthy, affordable, sustainable lunch menu in Sweden. The impetus to increase sustainability while providing palatable school lunches was partially attributed to efforts already underway to make these types of changes. Eustachio Colombo et al. (2020) stated that nearly one million government-subsidized school meals are eaten by students six to 15 years of age. For the study, Eustachio Colombo et al. (2020) designed a menu using sustainable foods and measured the amount of food waste before and after its implementation. Linear programming (LP) was used to develop an intervention menu that would meet the study's objectives to reduce GHGE and cost and still meet the nutritional requirements of the students.

Study participants were required to have on-site kitchens and electronically available menus lasting four weeks in duration (Eustachio Colombo et al. (2020). Each school followed the same menu with the flexibility to align with local tastes. Once the four-week baseline meals were selected, the food components were classified into 147 items, each calculated into weight,

cost (based on the average price paid per kilogram of item), and the GHGE. The GHGE was calculated using a research-based climate database. The four-week intervention period was implemented following a two-week break. Additional behavior-changing actions, such as a curriculum, were purposefully left out of the experiment to solely determine the effect of a more sustainable, healthy menu on carbon emissions (in the form of Carbon dioxide equivalent). The intervention menu was developed from a curated list of sustainable or "optimized" foods, each chosen based on its climate-reducing impact (Eustachio Colombo, 2020, p, 4).

Following data collection, which included the weight of pre-consumption food waste, the prepared meal, prepared yet uneaten foods, leftover or undistributed food, and food waste following student consumption was recorded daily (Eustachio Colombo et al., 2020). In addition to quantitative data, qualitative data was established through online questionnaires during the baseline and intervention period. The weekly questionnaire asked quantitative questions, like how often they ate school lunch and left food on the plate, and opinion questions related to taste, level of fullness, and overall satisfaction (Eustachio Colombo et al., 2020).

Eustachio Colombo et al's. (2020) goal to deliver a lunch meal to students that reduced GHGE and cost while maintaining adequate nutrients was met. While there was no significant change between plate waste (estimated at 20%) and food consumption before and after the intervention, the GHGE decreased by 40% and cost by 11% while maintaining the nutritional integrity of the meal. Meal satisfaction was found to be low during the baseline and intervention periods. The results of this study, according to Eustachio Colombo et al. (2020), suggest that linear programming alongside a "skilled and creative menu planner" is an ideal method to create environmentally and economically sustainable meals for students that meet dietary needs (p. 11).

Food waste reduction methods used in Japanese schools were explored by Izumi et al. (2020) to determine how they could be implemented at schools in the United States (U. S.) to reduce food waste. Existing data states that the U. S. and Japan are among industrialized countries' top food waste producers. The amount of food waste produced in school lunches differs greatly between the two countries. Food waste produced from the National School Lunch Program in the U. S. is estimated to be 30% of total calories. In contrast, food waste under Japan's government-subsidized lunch program has been measured at six to nine percent of total calories (Izumi et al., 2020). The researchers' interest in Japan's school lunch program was based on the program's educational component. Deirdre (2021) states that Japan's school lunch program is mandatory for all students and requires nutrition education. In Japan, "Lunch is referred to as *shokuiku,* which means "food and nutrition education" (para. 1). The law of *shokuiku* was enacted in 2005 due to the high rate of eating disorders among the Japanese. In 2007, a specified education program was implemented called "The Diet and Nutrition Teacher System" (para. 5). The educational component includes teaching children about the nutrient composition of the foods served and their role in student health. Educational lessons/activities might include "…a daily broadcast that outlines the nutritional components of the day's lunch…" for secondary students and food group sorting games in primary school (Deirdre, 2021, para. 4). Furthermore, the lunch menu is determined following the results of government-led studies on the state of the country's nutrition and eating patterns. A final difference between school lunches in Japan and the U. S. is the location of meal consumption. In Japan, lunches are served by students to one another and eaten in the classroom, whereas lunches in the U.S. are consumed in a cafeteria.

Japan's school lunch program was updated again in 2008 to reinforce the necessity of acting according to *shokuiku* (Izumi et al., 2020). Although *shokuiku* translates directly to nutrition education in English, the government wanted more emphasis on a wider-spread, interconnectedness, "holistic" approach (p. 4). The revisions include the following components: teaching appropriate nutrition/health education, encouraging good decision-making in accordance with healthy practices, increasing social and cooperative practices at school, understanding and appreciating nature in alignment with protecting the environment (natural resources), correlating and respecting the interconnectedness of the multitude of people and dynamics required to offer a healthy lunch, and increasing the understanding of countrywide and region-specific food culture and traditions (Izumi et al., 2021). These revisions to the School Lunch Act are likely related to Japan's low rates of food waste at lunch.

Due to the success of Japan's school lunch program in terms of low food waste, nutrition education, cultural practices, and food waste awareness, it is currently regarded as one to emulate. The drive behind Izumi et al.'s (2020) research into Japan's food lunch program was concern about the level of food waste in the U. S. and the loss of beneficial nutrient intake in school-age students, especially those receiving Free and Reduced-Price Lunches. Izumi et al. (2020) performed an "ethnographic study" using qualitative data to determine the association between Japan's cultural and holistic approach to food waste and how it could be used in U.S. schools. "Ethnography is a qualitative research method that allows researchers to examine social and cultural phenomena within their natural settings" (p. 5).

The study was conducted by two U. S. and two Japanese researchers at five elementary schools in Tokyo, Japan, alongside six school dietitians/teachers. Additional study participants were five dietitians and nutrition teachers, who direct the nutrition education and ensure it aligns

with all aspects of *shokuiku*. Izumi et al. (2020) collected data through interviews, lesson observations, participant/student observation, and a review of related school documents (lunch menus, food waste records, etc.). Dietitians and diet/nutrition teachers were given the interview questions one week before the hour-long interview, which was conducted in Japanese. Japanese and English-speaking translators and researchers completed translations into English to ensure agreement and accuracy. Researchers also recorded quantitative and qualitative information during the nutrition education lessons. Data was also collected in the form of note-taking from researchers who ate lunch with the students before or after the nutrition education lesson. Notes included the setting, student behaviors, conversations, answers to questions, and factual data. Photographs were also taken and used to document food consumption waste.

Izumi et al. (2020) analyzed data from each research team (Japanese and American) using thematic analyses. The final results were separated into parts; 1) a descriptive analysis of school lunchtime in Japan, followed by 2) a summary of the factors that contributed to low levels of food waste. Part one described school lunchtime, and part two included the factors that contributed to limited food waste: social norms, menu planning, integrated school curriculum, teacher lunchtime practices, and school lunch student committee.

As mentioned in a previous paragraph, lunches take place in classrooms. Students and the teacher eat the same meal using basic ingredients to create “made from scratch” foods (Izumi et al., 2020, p. 8). Every student partakes in the processes involved in eating lunch, including getting and returning the food and utensils from the food service area, serving the meal, arranging desks into small groups, and rinsing and recycling the milk cartons. Everyone also gives verbal respect for the food before and following eating, saying the following:

> Before eating, the class conveys respect and appreciation for the food with the Japanese custom of placing their palms together and saying itadakimasu ('I humbly receive') in unison; after eating, the students and teacher say gochisousama ('it was a feast') in unison to express their gratitude for the meal (Izumi et al., 2021, p. 9).

A final aspect of the lunchtime routine is measuring the weight of the leftover food that will be either composted or thrown away. The total weight is collected from each classroom by a dietitian and submitted to the school principal.

Social norms are among many factors contributing to a reduction in food waste. As noted above, researchers cite the act of gathering and recording data with the intention of distributing it to a school principal as one action reinforcing the social norm that leaving food on a plate is a negative practice. Having an inner feeling/knowing that wasting food is a bad practice is called feeling "mottainai," which contributes to students eating the food they are served at lunch (Izumi et al., 2021, p. 9). Furthermore, one dietitian noted that the principal's scrutiny of the records and questioning why there was zero food waste propelled her to increase her commitment to teaching and modeling food waste prediction practices in the classroom. The school dietitians also encouraged zero food waste through contests and rewards, in the form of extra mandarin orange, stickers, or requesting a special food on the menu. In the classrooms with a higher level of food waste, the dietitian found that her presence alone encouraged eating more and wasting less food.

School dietitians do menu planning and create a nutrition education curriculum to promote healthy eating and decrease food waste. Annual *shokuiku* plans, developed alongside teachers, steered the lessons. The lessons emphasized balanced nutrition as part of a healthy diet,

which aligned with the necessity that students need to try and eat new, disliked, and/or unpreferred foods. To improve the likelihood of student's eating disliked foods, like vegetables, the dietitians presented them in alternatively cooked formats, such as broiling and/or incorporating them with other foods. Hands-on activities and relationship-building with local food producers (i.e., farmers) were also believed to reduce food waste and promote *shokuiku.* The dietitians found that "...the experiences improved attitudes toward and increased appreciation and excitement about locally grown food (Izumi et al., 2020, p. 11). Dietitians also wrote daily lunch letters to students explaining how the nutrients in the day's meal related to their health and noted whether the foods were local or culturally significant.

Lastly, food waste reduction was related to teacher practices during the lunch meal (Izumi et al., 2020). The dietitians found that teachers who modeled food waste reduction methods, such as serving second helpings, allowing students to serve themselves the amount of food they believed they would eat, and managing the time, incurred less food waste. Lunch periods, limited to 40 minutes, included set up, serving, and clean up. Izumi et al. (2020) also noted that time management for younger students was paramount, as the 40-minute lunch period included set up, serving, eating, and clean-up. To help students manage their time, some teachers set aside five to ten minutes of silent time per lunch period to encourage mindful eating, ensuring students eat their lunch instead of socializing the entire lunch period (Izumi et al., 2020).

While all the practices and factors discussed in Izumi et al's. (2020) research encouraged healthy eating and food waste reduction in elementary schools in Tokyo, not all are practical to implement in the U. S. For instance, schools do not have dietitians on staff to collaboratively create a nutrition education curriculum, mindfully create menus that emphasize repeated exposure to disliked foods to encourage healthy living, or create daily lunch letters imparting the

correlation of foods, nutrient content, and healthy bodies. The practice of student-led lunch set-up, serving, clean-up, and weighing of leftover foods in the classroom has also never occurred in the United States. While the coordination of and time to incorporate student-led, classroom-contained lunches would be tremendous, it is one way to radically alter the attitude and atmosphere of school lunches in the U. S. Other practices, such as student lunch committees, farm-to-table activities, and nutrition and recycling/composting programs, already exist in the U.S. but perhaps could be integrated on a broader scale. Food waste reduction efforts and programs throughout the United States, including Minnesota's, *Learn about the Food Recovery Challenge,* can be found on the Environmental Protection Agencies website (Environmental Protection Agency, n.d.)

Limitations of the study by Izumi et al. (2020) include a small sample size, the use of only one off-site dietitian compared to four on-site dietitians, and the location of schools (i.e., big city), and response bias. Additionally, Izumi et al. (2020) stated that it was not an exhaustive nor economic/financial focused study. Overall, this study illustrates that Japanese culture and collaborative nutrition and waste reduction education program are central to its school lunch program. While seemingly challenging to implement established Japanese cultural practices, such as *shokuiku and mottainai,* Izumi et al. (2020) point out that negating the possibility of using some of their practices would be a disservice to the environmental, nutritional, and economic problems related to food waste in the NSLP.

Educating young people about the importance of taking action, instead of solely learning about and discussing the role people and schools play in waste production, is vital to limit the harmful effects of human behaviors on the environment. A 2017 report by The United Nations

Educational, Scientific and Cultural Organization (UNESCO) - Education for Sustainable Development (ESD) and sustainable schools includes the following objectives:

> The learner knows which human activities – on a global, national, local and individual level – contribute most to climate change. The learner is able to collaborate with others and to develop commonly agreed-upon strategies to deal with climate change. The learner is able to evaluate whether their private and job activities are climate friendly and – where not – to revise them (Rieckmann, M., 2017, p. 40).

Due to the recognition that school systems present a prime opportunity for educating future generations about the importance of sustainable environmental practices, Derqui et al. (2020) set out to determine the role of teachers, administrators, and cooking staff in sustainable food waste reduction actions. Specifically, Derqui et al. (2020) questioned if school staff and students understood the school-related behaviors causing climate change and were actually engaging in waste reduction practices. An additional purpose for the study was to create activities based on each school's "typology," or current sustainable practices category that would be feasibly accepted and practiced.

Derqui et al. (2020) emailed questionnaires to 5,441 school teachers in Caledonia, Spain, presiding at private and public schools, ranging from primary to post-secondary. Of those sent, 420 of them were included in the study. The questionnaire included 78 questions presented in categories, including factual data (e.g., type of school, number of students, sustainability certification), followed by two sections using a Likert scale to answer the questions about canteens (i.e., school) management, number of waste audits completed, level of engagement and

support. A final section asked participants not currently active in practicing waste reduction efforts to rate their interest, on a scale of one to five, in employing specific actions categorized as "Awareness, Operations, and Infrastructure and Resources" in the future (p. 4). Questionnaire results were filtered by using an Internal Consistency Reliability (ICR). The results were categorized into the following categories: Clear Sustainable Strategy, Ahead of Other Schools, Environmental Sustainability, Social Sustainability Efforts, and Canteen in Educational Project.

Additionally, the questionnaire determined that 33% of schools had never measured food waste. In comparison, 22% said food waste was measured at least once in the past, 15% indicated period measurement, with the remainder not knowing whether food waste was measured. Of the food waste intervention methods listed, 22% were employed on average, with noise reduction practices highest at 44%, flexible portion sizes at 39%, caregivers' training at 35%t, and composting at 31%. Finally, Derqui et al. (2020) grouped the results related to their sustainability views and practices into four categories: 1) Activists, 2) Environmentalists, 3) Socials, and 4) Laggards. The Activists scored highest in certification levels, strategic initiatives, and implementation. The Environmentalists scored the highest in having certification and having the resources to practice waste reduction methods. The Socials were ranked highest in volunteer practices related to sustainability and championing non-government organizations (NGOs). The Laggards were identified as the schools employing little to know education, social, or integrated sustainability practices.

The takeaways from the study by Derqui et al. (2020) were that schools take little action to promote and practice sustainability measures, specifically food waste reduction strategies. Even though the schools were labeled as taking an Activist or Social approach to sustainability, the actuality was that more food was produced than eaten, and awareness and support were

lacking. Derqui et al. (2020) determined that for schools to be at the forefront of educating future generations on their ability to improve the current trajectory of climate change issues, school staff must increase their own awareness of the problem of food waste by being present in the canteen/lunchroom.

Evidence-Based Strategies For Reducing Food Waste

While many studies have concentrated on quantifying food waste generated from school lunches, few studies have examined the association between evidenced-based school meal practices and food waste. Evidence-based strategies shown to be successful in decreasing food waste while synergistically increasing nutrient intake include scheduling recess before lunch, ensuring students have an adequate amount of time to eat, and promotional strategies (e.g., Parent newsletter, student taste tests, promotion campaigns) (Calvert et al., 2021). Bergman et al. (2004) found that students given at least 30 minutes to eat lunch consumed more food, increasing nutrient and calorie intake and reducing food waste. Given the problem of food waste from schools, Calvert et al. (2021) examined how many schools across the United States used evidence-based practices to help solve the problem.

Using a stratified random sampling method to identify elementary schools eligible for participation, Calvert et al. (2021) sent a survey to school principals inviting them to complete a 66-item questionnaire related to school meals and other wellness-related activities. Participant selection of the schools that completed the survey was based on "...state location, urbanicity, and number of students" (Calvert et al., 2021, p. 4). The questionnaire included open-ended, yes/no, and multiple choice answers. The questions included queries about the length of lunch, order of recess and lunch, amount of food waste, food categories with the most waste if used, and what

promotional strategies are used to increase food intake. Various tools were used to collect and analyze the data, including coding, sampling weights, demographic data, software (STRATA), linear regressions, composite variables, and inter-item-reliability assessment (pp. 6-7).

Data on the lunch/recess schedule indicated that of those offering recess, more than half of the schools scheduled recess after lunch and 25% before lunch (Calvert et al., 2021). Food waste quantities did not significantly differ between the two recess/lunch schedules. Of the three categories of lunch length, 39% offered more than 30 minutes, 53% lasted 20 or fewer minutes, with the remaining ranging from 21 to 29 minutes. The length of lunch includes the time to obtain, eat, socialize, and dispose of lunch. According to the Center for Disease Control (CDC), 20 minutes is the least amount of "seat time" recommended for students to be able to consume sufficient amounts of food and nutrients, especially fruits and vegetables, thus, reducing food waste (Making Time for Lunch, 2019).

This study employed six promotional strategies to increase NSLP participation and reduce food waste. The practices used to promote less food waste include the following: "student taste tests, student advisory groups, cooking club demonstrations/classes, social media (Facebook, Twitter, etc.), engagement with Parent Teacher Association (PTA) or parent groups, and newsletters" (Calvert et al., 2021, p. 10). Calvert et al. (2021) found that approximately 33% used zero evidence-based promotional practices, while 89% used one, 67% used two, 13% used three, and the remaining used between four and six strategies (p. 10). Of those measured, newsletters (86%) were the most frequent method used, followed by student taste tests (49%), social media (45%), parent engagement 33%), cooking classes (17%), and student advisory groups (11%) (p. 10). Finally, concerning food waste, about 15% chose "very much," 56% selected "somewhat," 22% said "a little," and 7% stated no food waste (p. 10).

In short, Calvert et al. (2021) correlated a higher amount of "perceived" food waste when more than one promotional strategy was used and no difference in food waste levels based on lunch/recess schedule. Demographically, the models indicated significantly more vegetable waste among schools with high Latino representation compared to those representing mainly White and in suburban and rural communities compared to urban ones. Additionally, Calvert et al. (2021) determined that although schools are using more evidence-based promotional strategies compared to the findings in previous literature, the number employed is less than ideal since their use is related to lower levels of food waste. Calvert et al. (2021) concluded that schools used fewer food reduction practices due to variables such as cost, time, scheduling, and staffing levels.

Prescott et al. (2020) conducted a mixed-methods study over two time periods at three schools in Northern Colorado to determine the interconnectedness of school lunch policies and procedures, resources, and people to food waste. The study also explored potential options to reduce food waste in three schools in different districts and determine whether the schools already had procedures in place to reduce food waste. Three school districts with varying student demographics, sizes, and kitchen types were chosen for the study. Phase one occurred over six months during the 2016-17 school year (October 2016-April 2017) and included collecting quantitative and qualitative data. Food waste data collection included the following: "...documenting each wasted pre-consumer food item, the location where waste occurred, loss reason, whether the food was edible, the disposal method, and the food weight or volume" (Prescott et al., 2020, p. 2). Interviews with school and district-level staff associated with school lunches completed the qualitative data collection. Phase two, occurring from February through May of 2017, consisted of interviews with the managers/directors of the school kitchen, waste

facility, and food bank, as well as various government officials overseeing school food waste-related departments (e.g., waste management, school nutrition programs, animal feed regulation, and environmental health), provided the qualitative data.

Prescott et al. (2020) analyzed the data using "...inductive content analysis" by assigning codes to ideas/themes that emerged from the interviews (p. 3). Additionally, all the data, including photographs, interviews, observation notes, and weights, were "...triangulated to examine consistencies and discrepancies across data sources (p. 3). Finally, food waste behaviors were categorized using descriptive statistics, and food waste was quantified into average weight per participant in each school. Several "food recovery pathways," most of them complicated, were identified following data analysis. Options for food waste collected from uneaten school lunches included food banks, pig farmers, on-site composting, off-site composting, and share tables. Additional choices stemming from the preceding options include using the compost to produce organic materials/fertilizer and/or biogas (i.e., methane gas), a renewable energy source, using anaerobic digestion. Anaerobic digestion, as defined by Prescott et al. (2020), is "...the system where microorganisms decompose organic materials including food scraps in the absence of oxygen" (p. 1).

Results from the analyzed data found barriers that reduced food recovery options for schools. One example is the rising cost of compost hauling contractions, which at one Colorado school district was eliminated as a result of a cost increase of 211%. Other hurdles included the closure of an anaerobic digestion company and school personnel not taking advantage of food banks. Numerically, Prescott et al. (2015) found that 75% of pre-consumer food waste was disposed of in landfills. While some of the waste came from self-service foods, like salad bars, which are not allowed to be reused once put out in the open, about 7% of the waste was edible.

On the other hand, post-consumer waste was less among the schools that included food waste recovery programs, such as share tables. At one elementary school in the study, Prescott et al. (2015) discovered that no consumable leftover food from students' lunches was discarded. Instead, it was reused on other school days or offered to students in need.

Qualitative data taken from the interviews found that food recovery efforts require the presence of people passionate about reducing food waste, such as committed students, volunteers, and food waste reduction advocates (Prescott et al., 2020). The help of these people was found especially important due to the considerable time and energy it takes to sort waste. Additionally, the data suggested that teachers, school administrators, and students are needed to promote a waste reduction culture. Prescott et al. (2020) found several obstacles to food waste reduction efforts, specifically, cost, waste volume variations, fear, and confusion. First, the study found the costs associated with food recovery efforts, such as following the regulations required to safely donate food to food banks or food scraps for pig feed, as well as transporting food scraps to composting centers surpassed the allowable amount in the school budget. The varying amounts of food waste daily also made it challenging for schools to schedule cost-effective food collection pick-up times. Prescott et al. (2020) also noted liability fears related to the potential to unknowingly donate spoiled food to food banks and pig farms. Lastly, school food waste recovery efforts were frequently hindered by confusing government and school-level policies and procedures.

Based on the research, Prescott et al. (2020) found that some schools reduced food waste by using onsite compost bins/tumblers and/or using onsite in-vessel anaerobic digestive systems for composting. Donating leftover milk to food banks before long school breaks was another food waste recovery option. Interview answers, especially those from food waste haulers, cited

food waste prevention efforts as a vital way to prevent the need for composting and preventing food waste in the first place. Overall, Prescott et al's. (2020) research found that few food recovery systems were being used across three Northern Colorado school districts. Of those that practiced food recovery methods, their size and location (i.e., centralized district kitchens) were instrumental in shaping the efforts. More space for composting bins and anaerobic digestion kits, alongside higher levels of preconsumer food waste at centralized district cooking facilities, make them an ideal, more cost-effective method of food waste recovery. Share tables were determined as the easiest way to prevent food waste due to limited barriers and no cost. Unfortunately, though, Prescott et al. (2020) found that few schools used them, and of those that did, strategical placement and promotion were not implemented, reducing their effectiveness.

Lastly, Prescott et al. (2020) suggested that students need to be more involved in changing the culture from food waste as the norm to food waste prevention education and practices as the priority. Limitations of the study were a lack of data on the volume of food waste sent to landfills and a study sample non-representative of other locations.

How Schools Are Addressing Food Waste

The effects of food waste on student health and its implications regarding learning and behavior are of great concern to many stakeholders, including parents, teachers, administration, and lawmakers. The large number of students receiving free and reduced price lunches, estimated to be 29.5 million students in the 2018-19 school year, suggests many families are counting on the nutrition and calories provided in school lunches for their children's well-being (NSLP Participation Tracker, 2020). Research from the Economic Research Service (ERS) of the

USDA found a correlation between NSLP participation and "...food insecure and marginally food-secure households…" (National School Lunch Program, 2022, p. 2). Additionally, Schanzenbach and Pitts (2020) found that the Covid-19 pandemic significantly increased (doubled or tripled) food insecurity for many families with children. Based on this information and the contribution of food waste to the destructive nature of climate change, many U.S. schools are implementing waste reduction strategies. Strategies, including those discussed in the previous paragraphs, include education, composting, school gardens, and promotional campaigns.

The correlation between food waste and climate change has also sparked campaigns to educate and encourage people to make behavior changes aimed at conversation practices. The World Wildlife Foundation (2019) states that agricultural-related practices, including food waste, damage the environment. "...agriculture's expanding footprint is the single largest contributor to biodiversity and habitat loss, at a time when it's estimated that 30-40% of the food we produce is lost or wasted…"(Food waste warriors, 2019, p. 5). Below I will discuss programs and strategies that have been or are currently being employed by schools today to reduce food waste and greenhouse gas emissions.

Food Waste Warriors (FWW)

The FWW program was piloted in 2019 by the World Wildlife Fund (WWF) in conjunction with the U.S. Environmental Protection Agency and the Kroger Co. Foundation to determine the effect student engagement and education had on food waste reduction. The program was implemented to increase student awareness about the connection between food waste and the environment. Students were also introduced to pollution-related scientific terminologies such as greenhouse gas emissions (GHGE) and metric tons of carbon dioxide

equivalent (MTCO2e) to familiarize them with words used when discussing the effects of food waste and pollution on global warming. Forty-six schools in eight states (nine cities total) used math and science lessons to educate students about the effects human behavior has on the environment (Food Waste Warriors, 2019). The six-month program increased student awareness through hands-on activities, like food waste audits, to make the connection between food waste and the natural environment (e.g., natural resources, wildlife). Each school collected five to six audits, and waste data were collected in groups, including a vegetable/fruit group, other (grains, meat, etc.), milk, other liquid waste, unopened/uneaten food/drink, food waste from home lunches, compostable food, garbage, and recycling. Data was calculated and converted into detailed reports, listing "...GHG and water resources embedded in the production of wasted food…" and "...GHG emission potential from landfilling wasted food…" (p. 7).

Results indicated that each school generated about 39 pounds of food waste per student per year, with organic waste totaling 19,074 pounds of waste (32% fruit/vegetable waste, 26% milk, 42% other) (Food Waste Warriors, 2019). Food waste decreased over the six months by an average of three percent, but the change from the first to the last audit was higher, with milk waste down 19%, fruit/vegetable down 32%, and other waste down 56%. In all, the FFW determined when using the sample data to estimate waste in all schools, it would be 530,000,000 tons per year, equaling "...1.9 million MTCO2e of embedded GHGs and 20.9 billion gallons of embedded water…" (Food Waste Warriors, 2019, p. 10).

Observational notes from each participating city found common themes following completion, including the following: confusion about the requirements of the Offer versus Serve (OVS), lack of time for teachers to implement in the lunchroom, low levels of administrative support, and rules around including milk in the meal for it to be reimbursable (Food Waste

Warriors, 2019). Other input included high levels of student engagement, staff awareness about the unnecessary use of food liners/double plating, the association of unripened fruit and more waste, and the success of share tables. Regarding the lack of staff time and energy to implement the program, one school solved the problem by paying for a professional development course and providing a salary increase to conduct the six audits, teach 30-45 minute food waste lessons, and create one new lesson to be added to a curriculum binder.

Recommendations for moving forward on the food waste reduction goal, the FWW team recommended the establishment of government, state, and/or city level incentive programs, reforms to some of the mandatory NSLP requirements, increased training around OVS, share table requirements, increase composting and recycling programs, collaboration programs. Recommendations for schools include education, regular food waste audits, increased levels of support, bulk milk options, food rescue programs, share tables, cafeteria staff training, and student-led programs. Lastly, some outcomes of the six-month FWW pilot program were a collaboration with other interested parties (e.g., solid waste authority, a measurement technology company) and the expansion of food waste reduction programs and practices within the schools. For example, one school partnered with the K-12 Food Rescue Program, and another partnered with local college student interns.

Smarter Lunchroom Movement

The Smarter Lunch Movement (SLM) is a California-based initiative that uses research-based evidence to promote sustainable, affordable, and healthy school lunchroom practices. The grassroots movement encourages school-aged children to eat healthy for a healthy body. The SLM was established in 2010 at Cornell University, leading to the creation of the Center for

Behavioral Economics in Child Nutrition Programs (Smarter Lunchrooms Movement, 2021). The mission statement declares, “We empower students to make healthy choices by supporting school communities and transforming cafeteria environments” (para. 5). The principles behind the SLM include “manage portion sizes, increase convenience, improve visibility, enhance taste expectations, use suggestive selling, and set smart pricing strategies” (para. 2). Some of the strategies offered by the SML include creating fun names for the vegetables, building student rapport, presenting before and after photos of the garbage, recycling, and compost bins, altering the lunchroom set-up, menu promotion, and collecting data. The website offers a variety of resources that can be downloaded and used at any school. One strategy, as noted in a YouTube video called Lunch’d, (Lunch’d, 2017), explained how a school in Ithaca, New York, changed the order of food items in the cafeteria line. Videos were taken of the same meal before and after to determine if students would make healthier choices. The result of moving fruit and vegetables from plastic bins to attractive bowls, placing the milk and water beverages to the front of the cooler, putting the pizza behind the healthy main course (burritos), and cookies just out of eyesight. As hoped, the changes were drastic: fruit consumption was up 102%, white milk increased by 46% while chocolate milk decreased by 17%, and the main course burrito sold out. Students chose fruit over cookies more often, cutting out empty calories and increasing nutrient intake. The only drawback to this experiment was a decrease in vegetable selection. The best part of this program is access to various resources and tools any school district can use.

Green Schools National Network

The Green Schools National Network (GSNN), established in 2007 by a group of principals, superintendents, and teachers, is a non-profit organization that aims to build healthy, eco-conscious, and just-minded future leaders. Their mission states, “GSNN works across the

country to transform schools so that they can prepare today's students to be tomorrow's sustainability leaders" (GSNN, 2021, para. 2). Participating schools are provided an inclusive curriculum, leadership development, and access to a variety of sustainability-related policies and procedures. The curriculum, called GreenPrint, provides all the resources for schools to become healthy, equitable, and sustainable. The health category focuses on cognitive, physical, and mental well-being. Equity is ensuring the school community has equal access to resources and opportunities. The environmental component centers on improving finances while reducing the carbon footprint. According to the Education Partnership section of the GSNN website (2021), over three hundred schools, 15 districts, 150 thousand students, 8500 teachers and allies, and 350 corporate leaders are in the GSNN.

Nora Stewart (2022) attends a school in the GSNN. The school is also a member of the Friends of the Earth's Climate-Friendly School Food Program. In a blog on the GSNN website, Stewart (2022) discusses the relationship between school lunches and climate change. Due to the escalating environmental disasters across the nation, Stewart (2022) suggests schools start offering "climate-friendly school food" (para. 1). Before introducing climate-friendly foods (e.g., beans, lentils, nuts) to students, Stewart (2022) recommends teaching students and staff how to start thinking differently about plants-based foods by teaching them about the associated health and environmental benefits and encouraging them to reconsider any negative beliefs they have about plant-based foods (e.g., does not taste good, weird). Stewart (2022) also recommends making gradual changes to the menu, such as reducing the high carbon footprint foods (i.e., animal products) and adding vegetables to combined foods, like spaghetti. Lastly, Stewart (2022) recommends staff create a friendly and aesthetically pleasing lunchroom environment, conduct

taste tests for students and staff, use flavor-enhancing spices, and hang appealing yet educational posters.

National Farm to School Network

Like the GSNN, the National Farm to School Network is another non-profit organization that champions health, environmentally friendly eating practices, racial equity, and education. Animal warfare, local economies, and workers' rights are also at the forefront of their mission. The About section of the National Farm to School Network (2022) states that Farm to School is a practice that fosters a connection between health, the land, and the local community. The program includes purchasing foods from local farmers, teaching students the relationship between agriculture, health, nutrition, and food), and building school gardens. The website states, “Farm to school empowers children and their families to make informed food choices while strengthening the local economy and contributing to vibrant communities” (About, 2022, para. 2). The Network includes resources on various topics (e.g., curriculum, food safety, environmental sustainability, multicultural, menus, peer-reviewed articles, policy, hunger, non-English resources, recipes, etc.), in a variety of formats (e.g., document, video, webinar). The Farm to School program reaches 23.6 million students in 42,587 schools (42% of U.S. schools) in 50 states, the District of Columbia, and two U.S. territories and includes approximately 42,587 schools (42% of U.S. schools) (About, 2022).

Minnesota is one state where the Farm to School program is gaining momentum. According to the USDA Farm to School Census (Home: USDA-FNS Farm to School Census, n.d.), 523,467 students in 1,008 schools were active participants in the school-to-food programs during the 2018-19 school year (para. 4). Of those, about 58% “...provide food, nutrition, or

agricultural education" and about 39% "...have edible gardens" (para. 4). Minnesota schools participating in the Farm to School program during the 2019-20 school year include, but are not limited to, the Moundsview school district (ISD #621), Academy For Science & Agriculture (AFSA), Minneapolis Public Schools, White Bear Lake school district (ISD #624), DeLaSalle High School, and North Branch school district (ISD #138).

School Gardens

As noted in the Farm to School paragraphs above, school gardens are becoming a common practice among schools nationwide. School gardens are a prime opportunity for students to be actively involved in planting and harvesting fresh produce while learning the science behind growing food. Teaching students how to grow and harvest their food is another way to prevent food waste in schools. According to the University of Minnesota Extension website (School gardens, n.d.), 198 Minnesota schools grew edible gardens in the 2014-15 school year. As part of its True Food No Waste initiative, Minneapolis public schools have over thirty school gardens.

While the actual number of school gardens being used worldwide is unknown, an article on the Food Tank website highlights 16 school garden programs around the world. Food Tank is a nonprofit organization working to eliminate hunger, poverty, and obesity by reforming the food system (May et al., 2019). May et al. (2019) share the practices employed by and successes of 16 gardens to bring awareness to the positive impact of school gardens on children's social, mental, and physical wellbeing. While all the gardens have benefitted students and their communities, their methodologies and level of outreach differ. For example, the Green School garden in Indonesia reaches 400 hundred students, while one public school in Sao Paulo, Brazil, "...is one

of several thousand schools in more than 700 cities across Brazil that are home to urban school gardens…" (May et al., 2019, para. 15). Other school garden locations include Finland, Ireland, Kenya, Japan, the United States, Zambia, Australia, Bolivia, Indonesia, Canada, and Africa.

True Food, No Waste

True Food, No Waste is a food waste reduction initiative implemented by schools in the Minneapolis public school (MPS) district in Minnesota (Bloom, 2019). The initiative is a continuation of the ongoing evolution of the district's nutrition services program. Bloom (2019) stated that the district believes that "...sensitizing kids to avoid waste is a vital part of their food education" (p. 5). It is based on the U.S. Environmental Protection Agencies Food Recovery Hierarchy, an upside-down pyramid depicting the most to least preferred food recovery options. Changes include adding onsite kitchens and preparing food from scratch, thus reducing prepackaged food use and purchasing healthier foods. The True Food, No Waste program is funded by the Natural Resources Defense Council, alongside two recent recycling grants. Bloom (2019) stated that aside from reducing costs and improving the dietary quality of school meals, the program aims to educate students about the benefits of eating healthy foods and the relationship between food waste and climate change.

The Minneapolis public school district drafted the three-year food waste reduction plan following qualitative (i.e., observation, interviews) and quantitative (i.e., food waste measurement) data collection. Once these "key drivers" of food waste were determined, the three-year action plan was developed to reduce the amount of food that goes to waste (Bloom, 2019, p. 9). Stage one, labeled Setting the Stage, included 25 actions, many logistical, including details around communication, training, and education, food waste prevention strategies,

recycling, and waste collection contractors. Year two included 14 initiatives centered around implementing food waste prevention practices and processes, composting, and food sharing among students and the community. Year three initiatives included lesson and training refreshers, growing school gardens, reaching kids through hands-on activities within and outside the classroom, and increasing promotional campaigns to encourage sustainable actions. Current data on the MPS True Food, No Waste initiatives is unavailable. The Covid-19 pandemic likely interrupted the program's implementation.

New Hampshire House of Representatives Bill 500 (HB500) and its Amendment

The problem of food insecurity and data on food waste and composting regulations led Senator Megan Murray of New Hampshire to author an amendment to House Bill 500 (New Hampshire HB500: 2021: Regular session 2021). Senator Murray's participation in a 2019 committee increased her understanding of the epic amounts of organic material being dumped into landfills, estimated at "several thousands of tons" from school each year (Ward, 2021, 36:56). Additionally, Senator Murray, based on data and her own experiences, that food insecurity causes stigma, shame, decreased energy, and anxiety. The amendment, read by Senator Murray to the Senate Education Committee in 2021, addresses food insecurity and food waste by allowing schools, alone or in partnership with a non-profit agency, to "...safely package and freeze unserved foods from schools that are leftover but never served to students, thus offering them as pre-portioned frozen food for families seeking to receive them" (39:38-39:46). The amendment also allows the flexibility to offer nonperishable foods, in accordance with food safety regulations, to families. The amendment was passed and adopted into law on April 22, 2021 (New Hampshire HB500: 2021: Regular session 2021). There is no current data on the effects of the amended HB500.

School Food Recovery Act of 2021

Several congressional members authored a bill called the School Food Recovery Act in September of 2021 (School Food Recovery Act, 2022). Also known as H.R. 5459, the bill provided schools funding to support education, practices, and procedures related to reducing food waste. Specifically, the bill would "...fund up to 75% of the total cost of a food waste reduction program…" that would incorporate the USDA's Food Recovery Hierarchy in curriculum and activities to foster lifelong waste reduction habits (School Food Recovery Act, 2022, para. 3). Collaborative efforts among community members, including non-governmental organizations and tribes, were also included in the bill. The bill was introduced by the U.S. House of Representatives and referred to the House Committee on Education and Labor on September 20, 2021. The bill did not get a hearing, so no further action was taken (School Food Recovery Act, 2022).

The number of food waste reduction programs, initiatives, and legislation currently being undertaken are exciting and encouraging. The ongoing awareness of the damaging effects of food waste has spurred many people to take notice and find ways to reduce food waste in schools. The availability of grants and access to educational and structural support are increasingly available and implemented by schools. The studies researched in this literature review provide detailed information on the causes of food waste and the subsequent environmental, economic, and nutritional effects it has on human life. Fortunately, as seen by the numerous programs discussed in the preceding paragraphs, food waste reduction programs and initiatives are growing. Youth are being educated to help solve the problem and become leaders in living sustainably (Buzby, n.d.).

CHAPTER III: CONCLUSION

This chapter will provide a summary of the literature reviewed in this paper, address professional applications and limitations of the review, and conclude by offering recommendations for further study.

Summary of the Literature

Food waste in schools was the topic explored in the literature review. The National School Lunch Program, begun in the 1940s, is a federally-funded program that ensures that all students, regardless of income level, receive a nutritious lunch (Gay, 1996). While well-intended, the number of uneaten foods thrown away each school day keeps growing. One estimate of food wasted each school year was 530,000,000 tons (Food Waste Warriors, 2019). Additionally, the cost of the NSLP is roughly 1.7 billion dollars per year. Environmentally, the greenhouse gas emissions (GCGE) generated from uneaten foods contribute to the damaging effects of climate change (Eustachio Colombo et al., 2020). Large quantities of uneaten foods mean that students are missing the necessary calories and nutrients the school lunch provides. According to the School Nutrition and Meal Cost Study: Summary of Findings 2019 report by the Food and Nutrition Service sector of the U.S. Department of Agriculture (2021), "...about one-fifth (21 percent) of the calories available in NSLP lunches overall were wasted, as well as one-quarter or more of the available vitamin A, vitamin C, vitamin D, calcium, and potassium" (p. 22). Based on this data, the environmental, economic, nutritional, and health implications stemming from food waste at lunch have become an increasing concern to school districts, lawmakers, and community members.

The NSLP stemmed from the Works Program Administration (The WPA), a program implemented in 1935 after The Great Depression to improve the economic conditions, build

infrastructure, and feed children healthy lunches (Martin, 1996). Following the conclusion of the WPA in 1943, President Truman signed the Richard B. Russell National School Lunch Act into law. The NSLP was a program that provided students in need with free and reduced-price lunches. Due to the rising costs of the NSLP and questions related to food wasted by the program, Congress requested data to determine the factors associated with and amount of food waste derived from the NSLP. The main findings of this report determined the order of recess and lunch, the Offer Versus Serve provision (OVS), and the quality of and serving size of food played on food waste. Buzby and Guthrie (2002) found that the OVS provision, which reduced the required number of meal components selected from five to three, with one being a fruit or vegetable and the other the main entree, decreased food waste. The researchers also determined that food waste decreased when recess was scheduled before lunch, students were able to comment on preference following taste tests, and serving sizes were tailored to the nutrient components per food when compared to standardized serving sizes. Calvert et al. (2021), however, found that the order of lunch and recess did not correlate with significant differences in the amount of food wasted.

The effect of the Healthy Hunger-Free Kids Act on food waste was also of interest due to its strict requirements (Cullen et al., 2015). The most concerning requirements were that five different vegetable subgroups had to be served each week, two vegetable servings and one fruit serving were required, sodium had to be limited, and grains must be at least 51% whole wheat. Cullen et al. (2015) compared the level of food waste before and after the implementation of the HHFKA. They found no difference in calorie intake and an increased selection of all vegetables, except legumes. Schwartz et al. (2015) gathered data over three years (one before the HHFKA and one after) in an urban school district and found an increase in fruit and entree selection and a

small decrease in vegetable selection. While the HHFKA requires at least one vegetable serving per meal, the requirements change to one fruit or one vegetable when schools use the OVS model. In these instances, Ellsworth et al. (2015) found an increase in vegetable waste, particularly because unselected food gets thrown away.

It is also important to note that researchers frequently use different food waste collection methods, making it hard to effectively compare food waste across studies. Byker Shanks et al. (2017) completed a systemic literature review to get a better understanding of the various methods. They concluded that comparing food waste across studies is hampered by the variety of methodologies used. Commons methods included visual estimation via observation and photographs, surveys, and direct weighing. Moreover, the comparisons were complicated by the variety of ways researchers labeled the end-weight results, including calories, percentages of nutrients, grams, ounces, or serving count.

Other factors affecting food waste were education, promotional campaigns, presentation, and taste tests (Sharma et al., 2019). The researchers found that food education in classrooms focusing on sustainability and nutrition increased vegetable selection and decreased fruit and vegetable waste following extended lessons (16 weeks showed a decrease in food waste). Prescott et al. (2020) and the Food Waste Warrior program (2019) also found less food waste and an increase in vegetable selection with a science-based food education curriculum compared to students in a control group. In Sweden, Eustachio Colombo et al. (2020) found no change between food waste and intake following education but did see a 40% decrease in Greenhouse Gas Emissions (GHGE) following education on food systems and sustainability. Researchers Izumi et al. (2020) looked at the effect of education on food waste in Japan. Education is a required component of Japan's Government subsidized lunch program. The program is holistic in

nature and includes a student-led, family-style meal eaten alongside the teacher in the classroom. Giving respect and appreciation to all aspects of the meal, including the people growing, preparing, and paying for the meal, is very important in Japanese culture (Izumi et al., 2020). These factors, as well as allowing school districts to prepare region-specific foods, decreases food waste. In total, food waste produced from school lunches in Japan is estimated at eight percent of calories. A study conducted in Spain found that little education or other efforts were being done to reduce food waste. Derqui et al. (2020) suggested that if reducing food waste is the goal, students would benefit from facts and stories to increase their awareness about the effect food waste has on their life.

Prescott et al. (2020) found that promotion campaigns, like poster-making competitions and hanging colorful posters throughout the lunchroom, increased fruit and vegetable selection. Handforth et al. (2016) found that presliced apples were favored over whole apples. The researchers cited the challenge of eating whole apples, due to braces or fruit size, as hindrances responsible for food waste. Taste tests, though not performed often, were also found to decrease food waste.

Due to the high levels of food waste and resulting consequences, several food waste reduction programs are currently helping schools reduce food waste. Among them is the Food Waste Warriors pilot program, which incorporates hands-on student activities to bring awareness to the effect and amount of food waste produced from school lunches (Food Waste Warriors, 2019). The Smarter Lunch Movement (SLM) is a California-based program that promotes evidence-based practices to reduce food waste, such as taking pictures of the garbage, recycling, and compost bins for students to see, altering the lunchroom set-up, creating a positive lunchroom environment, and promoting the menu (Smarter Lunchrooms Movement, 2021). The

SLM website provides resources and tools for schools across America to use. A non-profit organization, the Green School National Network (GSNN), aims to provide an inclusive curriculum, leadership development, and access to a variety of sustainability-related policies and procedures (GSNN, 2021). The program is currently used by over 300 schools in the United States. A similar program is the National Farm to School Network, a social-justice-oriented program that champions healthy people and communities. Farm to School programs are used in 42% of schools located in the United States (About, 2022).

A district-led program in Minnesota is a three-year food waste reduction initiative that includes school lessons, staff training, school gardens, promotional campaigns, and hands-on activities to reduce food waste in its schools (Bloom, 2019). Creating school gardens for educating and eating the food in school meals is also being employed by schools across the world (May et al., 2019). Lastly, some state lawmakers have introduced bills to reduce food waste. A law was recently passed in New Hampshire to reduce food waste by allowing schools to freeze and distribute leftover perishable foods to families in need (YouTube, 2021). A bill in Minnesota called the School Food Recovery Act was introduced during the 2022 legislation, but no further action (School Food Recovery Act, 2022).

Professional Application

The environmental, nutritional, and economic effects of food waste generated in school lunches around the world are well-known. While several studies have shown that food systems education and promotion campaigns reduce food waste, many schools do not use these tools. The economic costs as well as the time and energy it takes to install and maintain these practices have been shown to be a deterrent to their use and/or continuation. The updated requirements of the

NSLP are already complicated and costly, and the amount of food-staff training, administrative work, curriculum development, and money needed is a barrier to food waste reduction efforts.

Although many food waste reduction initiatives have been created and employed in schools, such as Farm to School programs, school gardens, and recycling/composting programs, more could be done to increase awareness about the nutritional, environmental, and economic implications of food waste in school lunches. Unfortunately, schools face many barriers to implementing successful food waste reduction campaigns. Monetary support is likely the most important component needed to reduce food waste in schools. Installing a food systems education in schools requires a curriculum that meets academic standards, staff buy-in and training, coordinated efforts across school staff, money, time, and energy. Schools across the United States are already short-staffed and economically strained. However, with proper support, there are things that can be done to educate students and staff about the importance of food waste reduction practices in the school lunchroom.

One change schools can make to reduce food waste and support a healthy environment is to utilize local composting and recycling programs. Gants are often available to schools from local waste/recycling/organics programs to fund waste reduction efforts. One example is a public program called BizRecycling. Located in Minnesota, upon application, the company provides funding and education to schools to set up recycling and organics stations in school cafeterias (Biz Recycling Story, 2022). The program offers the bins, signage, and staff education and instruction on how to implement the program successfully. Schools can also search the U.S. Department of Agriculture for school-related recycling/composting grants. A Charter School in Minnesota has integrated the BizRecyling recycling/composting program with student interns. Junior and Seniors in high school are eligible to apply for an intern position in the lunchroom. In

addition to earning money and serving as role models to younger students, these students get to practice employment-related skills, such as interviewing, receiving a paycheck and tax forms, and practicing workplace skills. Schools can also start a school garden to teach students how to install a garden and then plant, grow, and harvest the produce. Taking students on a field trip to a local apple orchard is another way to integrate food systems education into a hands-on, tasty adventure.

Other actions that can be taken include working with the science, math, and health teachers to integrate food to sustainability, nutrition, money, and nutrition. While this would take time and energy, websites like the above-mentioned Green School National Network might have pre-made curricula, visuals, and other ideas to create a solid multi-unit food systems curriculum. As noted in the previous Food Waste Warrior section, one school solved the problem of lack of time and energy to create lessons and conduct food waste audits, schools could pay for a professional development course to learn how to implement such a program and increase the salary of the point people.

Some final applications of the literature review include educating lunchroom staff about the required components of a reimbursable lunch, which does not include milk, can also reduce food waste, distributing pre-made School Lunch Program Surveys to gain insight into student thoughts about the school lunches, conducting a food waste audit (this could be performed by the student council or other school-affiliated group), moving the high-sugar, high-fat, less healthy food options to a less visible location in the lunch line, and instruct homeroom teachers to discuss the problem of food waste during daily announcements, specifically when the daily lunch menu is announced.

Limitations of the Research

There are several limitations in the literature review. One of the main challenges of determining the levels of food waste in schools is the variety of angles that can be taken to answer the question. Similarly, the objectives of various studies differ in the specific questions they are seeking to answer, the many assessment procedures available to them, and the variety of methodologies employed by the researchers. For example, some researchers studied the total amount of food wasted from each meal, while others concentrated their efforts on measuring single components of the meal, like fruits and vegetables. In addition to researchers using a variety of qualitative and quantitative assessment methods, the unit label to measure the weight varies (e.g., grams, ounces, calories). The methodologies used in studies ranged from extensive literature reviews to using digital photographs to estimate pre- and post-food waste to implementing computer software systems to provide detailed data on calories and nutrients wasted. Additionally, some researchers used t-tests to analyze data, while others used linear regression or mixed-methods regressions to analyze data.

Other limitations include collecting few data points over a short time period (16 weeks) or only annual measurements over a few years. In some studies, data collectors received formal training, and in others, training was minimal. The methods of serving students and determining portion sizes vary from school to school due to the flexibility allowed in the HHFKA regarding menu planning approaches. Finally, some researchers collected data in elementary schools, which do not require schools to employ the OVS meal selection option, versus high schools, where the OVS option is required.

Implications for Future Research

Food wasted in schools is a current problem in the United States. The researchers discussed in the literature review are aware of the problem and seeking answers to help solve the problem. While determining the amount of food wasted in school lunches served under the NSLP requirements is the underlying goal of the research, the methods used to collect and analyze data, and the results wanted from researchers vary. Since the main areas of focus are on the environmental, nutritional, and economic effects of food waste produced from the NSLP, the research from the individual studies should be reviewed by a team of researchers, one from each subject area, to consolidate the information into one study.

Researchers may consider collaborating to determine the best data collection methods available and group them according to efficiency, cost, and time. The emergence of easy-to-use sophisticated mobile software applications that can synthesize data into finite components, such as caloric value and nutrient component, suggests that their use in studies has the potential to be more universal. This type of technology would also simplify converting the weight of food into different unit conversions (i.e., volume, weight, calories). The information taken and questions asked in surveys should also be standardized and made into two to three universally understandable and used assessments.

Additionally, the creation of a standardized food systems curriculum could be developed, or the current ones being used could be studied to determine their effectiveness in reducing food waste. Pre-made lesson plans would make implementing them into academic and social-emotional learning would increase the odds that they would be used. Limited time, energy, staff, and money would make it more likely for schools to employ such a program.

Finally, including special education students in food systems instruction and food waste reduction initiatives is a prime opportunity to support them in making the connection between their daily living practices and the environment. A food system, as defined by the University of Vermont's Food Systems Research Center (2022), "...is an interconnected web of activities, resources, and people that extends across all domains involved in providing human nourishment and sustaining health, including production, processing distribution, marketing, consumption, and disposal of food (What is a Food System?, para. 1). Teaching students how their selection, consumption, and disposal of food, whether at home or in the school lunchroom, affects personal, community, and global health is an entry point to making independent, educated, and sustainable life choices. Students of all abilities can be a part of reducing food waste and creating a healthier environment. Imagine a student with low cognitive abilities as a part of a sustainable action team that teaches their peers how to sort uneaten consumable foods for reuse. Special education students could also make food waste reduction posters and take part in collecting and weighing uneaten food. All students have the power to influence others to make healthy life choices. Furthermore, food waste reduction methods can be integrated into purposeful Independent Education Plans (IEP) goals and objectives. Transferring student instruction into action is one way to integrate a student's understanding of food systems and food waste reduction methods into action. A special education student with paraprofessional support could have an IEP goal centered on understanding the food components required to be selected at lunch and then taking only the food they know they will eat. Another student's IEP goal could infuse math computation with food systems knowledge through weighing and computing daily, weekly, and monthly plate waste measurements. With creative thinking and collaboration among a student's IEP team,

independent living goals can be practiced and achieved throughout their educational continuum. Overall, students of all abilities can take part in understanding their role in making healthy, sustainable food choices.

Conclusion

This thesis sought to answer the following research question, "What are the effects of food waste in schools?" falls under a wider range of questions and concerns about the data of the world today. The current environmental, economic, and health crises faced daily by all people are monumental problems (Food Waste Warriors, 2019). While food waste stemming from the NSLP is a small part of the equation in reducing climate change, monetary waste, and poor health, reducing it is still a valid goal and need. Some main takeaways from this literature review are that the topic of food waste can be measured in many ways and data collection and analysis methods vary widely (Danible et al, 2021; Marshall et al., 2019). The overall results show that food waste in schools is a problem and that there are ways to minimize it. Since comprehensive research takes time and money, simpler methods could be used in schools to increase awareness of food waste. Educating students with grade-level information and getting them involved in hands-on activities is an effective way to teach students about the problems associated with food waste (Prescott et al., 2020; Izumi et al., 2020). Students today respond more to information that affects them personally rather than long, fact-based, educational lessons (Rieckmann, 2017). Students need to see the amount of food wasted at lunch each day (Smarter Lunchrooms Movement, 2021). Getting students involved in collecting food waste provides concrete data they can see, smell, and feel. Discussing current topics in the news associated with the effects food waste has on the environment and the domino effect on the economy and people's livelihood and health on a weekly basis will provide students with small

pieces of digestible information they can use to make positive changes (PBS LearningMedia, 2020).

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