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The Feasibility of Local Food Procurement in Advancing Sustainable School Meals



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Report Disclaimer: All views expressed by interviewees in this report are personal opinions and are not representative of the organizations, schools, companies, affiliates, or employers that the interviewees may work for or be associated with. Some interviewees have requested to remain anonymous in this report for privacy reasons. Sustainability recommendations made by the authors of this report are not intended to replace or be equivalent to medical or professional child nutrition assessments.

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Executive Summary

Problem Statement

The food production system largely contributes to biodiversity loss and carbon emissions. In the United States, over 30 million school meals are served to children daily. Therefore, through meal services, schools have the opportunity to foster a positive impact on equity and environmental issues, in addition to meeting children's nutritional needs. A clear action plan is needed to advise school districts, as well as policy makers, on how to implement sustainable meals.

Research and Data Collection

Research was conducted through a literature review of 178 different peer-reviewed articles, reports, case studies, as well as 50 interviews with subject matter experts in the private and nonprofit sectors, in addition to government agencies on a local and federal level. Thirty-one of these interviews were conducted with representatives from a students' wellbeing program and from individual schools and school districts across sixteen states, either through phone or email communications, with the goal of collecting hard data about school menus. Additionally, three school districts were selected as case studies to exemplify the data further. These school districts are Richfield Public Schools (Richfield, MN), School District of Beloit (Beloit, WI), and Fennville Public Schools (Fennville, MI).

Proposed Solutions

The proposed solutions are based upon the successfulness of past or current measures used for improving school meals, feasibility, and the degree to which measures lessen the environmental impact of food systems. Based on the research and data collection process, below are concrete recommendations that can guide school districts and policy makers.

The following recommendations apply to school districts:

1. Incorporating educational opportunities into school curriculums specific to eating habits, nutrition, gardening, and cooking;
2. Implementing operation strategies to increase student choice and acceptance of plant-based options;
3. Implementing training programs for kitchen staff about the cooking methods and the benefits of plant-based meals;
4. Utilizing a centralized kitchen to prepare, preserve, and distribute meals to schools.

The following recommendations apply to policy makers:

1. Removing the cow milk mandate in USDA school meal programs;
2. Enforcing policies that would make plant-based meals the "default" option;
3. Investing in local food hubs that would aggregate produce from small local farms.

Impact

These recommendations can help children develop healthier eating habits, make school meals more environmentally sustainable, and address the equity issues embedded in the food production system.

List of Abbreviations

BIPOC	Black, Indigenous, and People of Color
CDC	Centers for Disease Control and Prevention
DoD-Fresh	Department of Defense's Fresh Fruit and Vegetable Program
FTS	Farm to School
FSMCs	Food Service Management Companies
FY	Fiscal Year
GAP	Good Agricultural Practices
GHG	Greenhouse gas
HHFKA	Healthy, Hunger-Free Kids Act
HEI	Healthy Eating Index
LCA	Life Cycle Assessment
NSLP	National School Lunch Program
PCRM	Physicians Committee for Responsible Medicine
SBP	School Breakfast Program
SFA	School Food Authority
SY	School Year
The Center	The Center for Biological Diversity
USDA	United States Department of Agriculture

List of Key Definitions

For the scope of this research, the following definitions apply:

Competitive Foods:
A selection of snacks and meal options (e.g., à la carte items, vending machines, school stores) available for students to purchase with their own funds, as an alternative to the government-subsidized foods served by the school.

Farm to School Programs:
Farm to School (FTS) programs are school-wide initiatives that support local farms, enrich the connection within the community, and promote healthy lifestyle choices for children by incorporating fresh food directly from farmers into school menus. These initiatives might include produce from on-site school-managed gardens.

Food Resiliency:
In the context of food systems, resiliency is the ability to produce and distribute reliable access to safe and sufficient food to everyone at all times, even when shocks and stressors such as natural disasters and extreme weather events affect the system.

Local Food:
Local food is determined by the distance between where the food is grown and where it is consumed. In line with some individual United States Department of Agriculture (USDA) programs (Tropp, 2016), products that travel less than 400 miles from the origin or within the state in which they are produced will be considered local for this study.

Meat Analogs:
Plant-sourced food products that mimic the structure, appearance, and flavor of animal-based meats.

Plant-based Food:
Food that does not contain any animal products or byproducts, such as meat, poultry, fish, dairy, or eggs.

Processed Food:
Processed food is any food that has been altered from its original fresh or whole state in some way during preparation.

Scratch Cooking:
The process of preparing meals using whole, fresh ingredients, in lieu of using pre-assembled or processed meals.

Small Farms:
The USDA defines a small farm as a commercial and noncommercial farm with gross cash farm income under $250,000 (MacDonald, 2021)

Sustainable Agriculture:
Food-production system accounting for its impact on the environment and on the society, generating "sustainable food" (see definition below).

Sustainable Food:
Food that is produced, processed, distributed, consumed, and disposed of in ways that:

1. Avoid or minimize environmental impacts and damage to Earth's climate system, atmosphere, ecosystems, and natural resources (water, land, vegetation).
2. Minimize contribution to climate change and biodiversity loss.
3. Is oriented toward environmental justice, social equity, human and labor rights throughout its production, and improving the well-being of workers, tenants, and owners in the food, farm, and agriculture industry in rural and urban communities (Global Impact Investing Network, 2021).

School Food Authority:
The governance responsible for the administration of individual or multiple U.S. schools, which has the legal authority to operate a nonprofit school food service for the purposes of the NSLP (USLegal, n.d.).

Introduction

1. The environmental, health, and community impact of K–12 school food menus

In the United States alone, nearly 30 million school lunches are served to children every day (Ralston et al., 2008). Due to its large volume, lowering the greenhouse gas emissions of school meals would significantly decrease the impact of food production on the environment and raise more conscious adults with environmentally friendly eating habits. Additionally, school food meals have the potential to shape children's health and long-term eating habits and increase access to healthy food for children from low-income backgrounds. Finally, food procurement practices for school meals can positively affect underserved communities by increasing food security and supporting small, local farmers.

2. The Client: The Center for Biological Diversity

Since 1989, The Center for Biological Diversity (The Center), a nonprofit organization, has been fighting a growing number of national and worldwide threats to biodiversity (Center for Biological Diversity, n.d.). Their mission is for those who come after us to inherit a world where the wild is still alive. The Center has taken a bold stance on food policy and sustainability, and developed campaigns that call for meat reduction and sustainable consumption and production. The Center is headquartered in Tucson, Arizona, with several other offices and staff across the United States.

3. Research methodology and goals

This project aims to provide The Center with resources that compile practical and theoretical information in order to support the transition of schools and school districts towards more sustainable, locally-sourced, and ethically-produced school meals. The report consists of collected information and data from relevant literature, interviews with subject matter experts, analyzed the strategies of successful case studies towards implementing more sustainable, locally-sourced food programs, and concludes with potential solutions for stakeholders. To support The Center's long-term efforts, this project includes a searchable database, interview summaries, a selection of positive case studies, and recommended next steps. Including a sample of schools across the country in this assessment, to the best of the research team's ability, was important in producing useful recommendations and beneficial advice for the client. The findings are based on real-life experiences and existing programs from other school districts.

This project sourced subject matter expertise at the federal, state, and local government level, at the school district and individual school level, and in the private and nonprofit sectors.

The goal was to create actionable recommendations and best practices for the client and all potential stakeholders, including school districts' representatives and policy-makers.

Most of the challenges of this research have stemmed from the fact that there is little quantitative data available about school meals because school districts are rarely able to keep track of the amount of specific food items that are consumed or wasted. Based on conversations with school administrators during this project's research phase, the lack of measurement and tracking of school meals and food items can be attributed to staffing issues, limited resources/funding, and lack of or inadequate cafeteria tracking tools. Another possible reason why verifiable quantitative food data is challenging to obtain is that schools may be hesitant or unwilling to publicly share records over concerns of how their data will be used. Regardless of why school meals and food data are widely unavailable, the lack thereof is indicative of the larger issue of underfunding within public school systems. However, asking interviewees the same questions and comparing the responses has provided us with the much-needed quantifiable data to use in this analysis. Additionally, the critical interpretation of outside case study data has allowed us to add supplementary substance to the quantitative analysis of the report.

Another significant challenge in this research is assessing the potential intersectionality and contradictions between local, sustainable, healthy, and equitable food sourcing. Specifically, this project strived to understand and convey to the client how the current school lunch program impacts different socio-economic groups, and how the program can be refined so that children in underserved low-income communities will receive greater benefits from school meals.

Additionally, funding is a core issue identified as a result of this research. As one of the main obstacles in changing school lunch programs across the country, this analysis has addressed these issues in detail. In alignment with compliance, funding concerns may restrict a school district's compliance with federal and state regulations and requirements. This research is designed to help schools strategically transition into incorporating more sustainable, locally-sourced meal programs.

PART 1 - Background Research

1. A short history of the United States Department of Agriculture school lunch and breakfast programs

In 1900, when school lunches in the United States began to gain traction among Americans, 34 out of 45 states had mandated education requirements for students under 14 (Rude, 2016). People soon realized that schools could provide for children, especially poorer children who needed access to food. One catalyst for this realization was Robert Hunter's book, *Poverty*, which noted:

> ...the poverty of any family is likely to be most serious at the very time when children most need nurture, when they are most dependent, and when they are obtaining the only education which they are ever to receive…learning is difficult because hungry stomachs and languid bodies and thin blood are not able to feed the brain. The lack of learning among so many poor children is certainly due, to an important extent, to this cause. (1904)

Philadelphia and Boston were the first two American cities to institute school lunch programs. These two cities implemented these programs largely through welfare organizations, such as the Women's Educational and Industrial Union in Boston, and the Starr Center Association in Philadelphia. In 1894, Philadelphia began serving school lunches costing $0.01 (Kennedy, 2020). The idea was to both provide nutritious foods and teach children healthy eating habits.

The federal government became involved in school meals during the Great Depression. During that time, farmers faced financial ruin, laborers were out of work, and poor children experienced malnutrition. To simultaneously solve these issues, the federal government started to purchase surplus crops from farmers and employ women to cook and serve food to hungry students. By 1941, there were federally supported school meal programs operating in all states, with approximately 64,000 individuals serving 2 million lunches daily (Rude, 2016). However, these numbers declined by World War II, as food supplies dwindled and labor became more scarce (Rude, 2016).

In 1946, Congress recognized the importance of healthy, well-fed children, and passed the National School Lunch Act. This policy officially provided states with assistance, funding, adequate food supply, and other facilities to expand nonprofit school lunch programs. This action was considered a measure of national security. In 1966, the Child Nutrition Act added more subsidies for low-income children, including school milk and school breakfast programs. As a result, budgets increased under both President Eisenhower and Nixon in the 50s and 60s (Rude, 2016).

In 1981, President Ronald Reagan unsuccessfully attempted to cut school lunch spending by $1.5 billion (Bentley, 2021). He sought to compensate for this cut by shrinking portions and reducing the number of children eligible for free or discounted lunch. Throughout his campaign, Reagan infamously proposed to allow ketchup to count as a vegetable in school meals. Realizing he had little support, Reagan withdrew his proposal (Weisman, 1981).

In the 1980s and 1990s, lunches were privatized, and nutrition standards subsequently declined. Concurrently, obesity rates increased (Bentley, 2021). In 2010, the Healthy Hunger-Free Kids Act (HHFKA) was implemented by the Obama Administration (Bentley, 2021). This policy allowed the USDA to strengthen standards for school meals by setting sodium-reduction targets, calorie and saturated fat limits, total sugar content limits for snacks, and removing full-calorie sodas (Center for Science in the Public Interest, 2020). Policy critics argue that these measures create more food waste and fewer earnings for lunch programs, while proponents assert that the plan is working, and therefore, students are receiving healthier foods (Center for Science in the Public Interest, 2020; Kelly & Stier, 2015).

2. The current state of the United States Department of Agriculture school lunch and breakfast programs

The National School Lunch Program and the School Breakfast Program, scale, and coverage

The USDA supports U.S. nutrition programs and agricultural producers by purchasing agricultural products for use in schools and institutions. USDA-purchased food is provided to several child nutrition programs. The most extensive of these programs are:

- The National School Lunch Program (NSLP) is the second-largest food and nutrition assistance program, serving around 30 million low-cost or free lunches every day in over one hundred thousand public and nonprofit private schools, and residential child care institutions. The program is supported by $8 billion of federal funding per year. Approximately 60% of U.S. children aged 5–18 participate in the program once per week. Schools in the United States are not required to offer NSLP meals, but 94% of both public and private schools opt to participate in the program (Ralston et al., 2008).

- The School Breakfast Program (SBP) is also a federally assisted meal program operating in public and nonprofit private schools, as well as in residential child care institutions. The SBP offers low-cost or free breakfast to 15 million children every day, from 91,000 schools and institutions (USDA Food and Nutrition Service, 2020).

According to the U.S. Census Bureau's Public Elementary-Secondary Education Finance Data, the Elementary-Secondary School System received a total of around $58 billion from federal sources, which includes funding for all school operations (U.S. Census Bureau, 2019).

Figure 1 displays the appropriations for the Child Nutrition Programs and Selected Activities for Fiscal Year (FY) 2021. The USDA reported that FY 2019's federal reimbursement to schools was $14.2 billion (USDA Economic Research Service, 2021b). 6.6% of the total funding, around $1.7 billion, was spent on Commodity Procurement and on the Fresh Fruit and Vegetable Program, a USDA program subsidizing the purchase of fresh produce to be served in schools.

Figure 1

Funding Appropriations for Children Nutrition Programs in Fiscal Year 2021

Table 2. Appropriations for Child Nutrition Programs and Selected Activities, FY2021

	Type of Funding	FY2021 Funding ($ in millions)
National School Lunch Program (NSLP)	AM	13,540
School Breakfast Program (SBP)	AM	5,039
Child and Adult Care Food Program (CACFP)	AM	4,015
Commodity Procurement	AM	1,461
Summer Food Service Program (SFSP)	AM	552
State Administrative Expenses	AM	317
Fresh Fruit and Vegetable Program (FFVP)	M	203
Summer Meal Demonstrations	D	42
School Meal Equipment Assistance Grants	D	30
Special Milk Program (SMP)	AM	7
Total (includes categories not shown)		**25,118**

Source: CRS, based on the Consolidated Appropriations Act, 2021 (P.L. 116-94) and House Rules Committee Print 116-68, explanatory statement accompanying Division A, December 21, 2020. Aside from FFVP, child nutrition activities with mandatory funding (direct appropriations) are not included in the total.

Notes: AM = appropriated mandatory, M = mandatory spending provided in authorizing law, D = discretionary. Figures rounded to the nearest million.

Note. Figure 1 is from *School Meals and Other Child Nutrition Programs: Background and Funding*, CRS Report, by the Congressional Research Service, 1 Apr. 2021.

Meal costs, reimbursement mechanisms, and funding opportunities

Schools participating in the NSLP and the SBP receive cash reimbursements from the federal government for every meal that they serve. USDA's Food and Nutrition Service, Child Nutrition Division, is responsible for reimbursing States for every eligible meal served in schools

and overseeing state agencies. The state agencies, in turn, operate the program with SFAs. In order to qualify for reimbursement, meals served through the NSLP and the SBP must meet stringent nutritional requirements. Federal reimbursement amounts change according to the Federal Register, as shown in the table below.

Figure 2

Federal reimbursement amounts for school programs from July 1, 2021–June 30, 2022

Federal reimbursement amounts to schools for every school meal		
Lunch Category	60% or more free & reduced meals served (High Lunch)	Less than 60% free & reduced meal served (Low Lunch)
Paid	$0.37	$0.35
Reduced-price	$3.28	$3.26
Free	$3.68	$3.66

Breakfast Category	Severe Need	Non-severe Need
Paid	$0.33	$0.33
Reduced-price	$2.05	$1.67
Free	$2.35	$1.97

Note. Figure 2 is adapted from *National School Lunch, Special Milk, and School Breakfast Programs, National Average Payments/Maximum Reimbursement Rates* by the USDA Food and Nutrition Service in the Federal Register, Vol. 86, No. 134, 16 July 2021.

Other funding opportunities are available to schools at a federal level. Besides cash reimbursements, schools receive USDA-donated commodity foods through Section 32 funds. The Section 32 funds refer to the section of the Agricultural Adjustment Act of 1935 that authorizes the USDA to support prices of commodities in surplus by purchasing them in the marketplace and distributing them domestically (USDA Economic Research Service, n.d.). The majority of the funds go to the USDA's Child Nutrition Program, with a total of $465 million designated to purchasing commodity foods, as set by the National School Lunch Act (Monke, 2015). The commodity entitlement funds can only be used to purchase surplus fresh produce, such as fruits, vegetables, grains, dairy, and meat (USDA Economic Research Service, n.d.).

The commodity entitlement dollar from the Department of Defense's Fresh Fruit and Vegetable Program (DoD-Fresh), an interagency program with the USDA, also allows schools to purchase fresh fruits and vegetables locally and receive cash reimbursements for it (USDA Food and Nutrition Service, Office of Community Food Systems, 2017). The $25 million cap was lifted in 2010, allowing more flexibility and greater potential to be better utilized by schools as a main source of revenue for fresh and local produce (Defense Logistics Agency, n.d.).

Moreover, the USDA 2022 Budget has allocated $23.2 million in funds specifically for the FTS programs. Out of this budget, $6.2 million is allocated to FTS teams, $5 million to the Richard B. Russell NSLP FTS Grant, $12 million to general provision, and an additional $500,000 to encourage program expansion, pushing more schools to set up FTS programs (USDA, 2021).

The Richard B. Russell National School Lunch Act enacted in 1946 dedicates grants to schools to assist the funding of local food sourcing, specifically from small and medium farms for school meals. The overall FTS grant is designed to fund activities such as staff training, operations support, planning, equipment purchasing, school gardens development, partnership development, and FTS program implementation. However, the establishment of FTS dedicated funds illustrates future opportunities for additional funding in the long run. Additionally, the federal government's call on program expansion suggests the intent to support the long-term development and the institutionalization of a more sustainable food culture and system in K–12 schools.

Since the 1980s, schools have seen budgetary pressure following cuts in subsidies, and furthermore, school meal reimbursement rates increased more slowly than the growth in costs, especially the health benefit component of labor costs. For example, in SY 2014–2015, reported costs for a reimbursable meal in most schools exceeded the federal subsidies for free meals. On average, the mean reported cost for schools to produce a reimbursable lunch was $3.81, compared to the average federal free lunch subsidy of $3.32, equal to 93% of production cost. This issue is more accentuated for breakfasts, where the mean reported cost for schools to produce a reimbursable breakfast was $2.72, compared to the average federal subsidy of $1.88, equal to 82% of production cost. SFAs reported meal costs to include food and labor costs, which individually make up approximately 45% of the total. Supplies, contract services, and capital expenditures account for the remaining 10% (Fox et al., 2019).

Figure 3

NSLP and SBP reimbursement rates and costs ratio

	Reported cost of production per meal	Federal Free Meal Subsidy per meal	Percentage of meal cost covered by reimbursement
Lunch	$3.81	$3.32	93%
Breakfast	$2.72	$1.88	82%

Note. Figure 3 is adapted from *School Nutrition and Meal Cost Study Summary of Findings* by the USDA Food and Nutrition Service, Fox, M. K., Gearan, E., & Mathematica Policy Research, Apr. 2019.

The USDA's 2022 Budget Summary allocates budget distribution for all Child Nutrition Programs based on estimated participation levels, providing a total of $26.9 billion (USDA, 2021). The 2022 budget projects that the program will be serving 5.24 billion lunches (an increase of 1.13 billion over the current estimate of 2021), as well as 2.59 billion breakfasts (USDA, 2021). The estimated participation level for NSLP is 30 million per day and is projected to reach a 59% total participation rate by 2022 (USDA, 2021). However, in FY 2020, due to disruptions to the program and school closures caused by the COVID-19 pandemic, the participation rate was at only 43% (USDA, 2021) and served 33.4% fewer meals than in the same period of FY 2019 (USDA Economic Research Service, 2021b). While the overall NSLP participation level for FY 2020 decreased by approximately 24% from FY 2019 (USDA Food and Nutrition Service, 2021), the number of NSLP meals served at a free or reduced-price increased by nearly 3% (USDA Economic Research Service, 2021b), which may be due to families needing additional assistance during the COVID-19 pandemic.

Research shows that the participation rate in NSLP is directly proportional to the revenue associated with federal reimbursements. For instance, data from March 2021 released by the USDA showed that the 1.7 billion decreases in served meals during the pandemic from the same period in 2019 led to a $2.1 billion loss in federal revenue for schools (Pratt-Heavner, 2021). The graph below from the School Nutrition Association further illustrates the correlation between the decreased NSLP participation rate and the low school revenue from the federal reimbursement program.

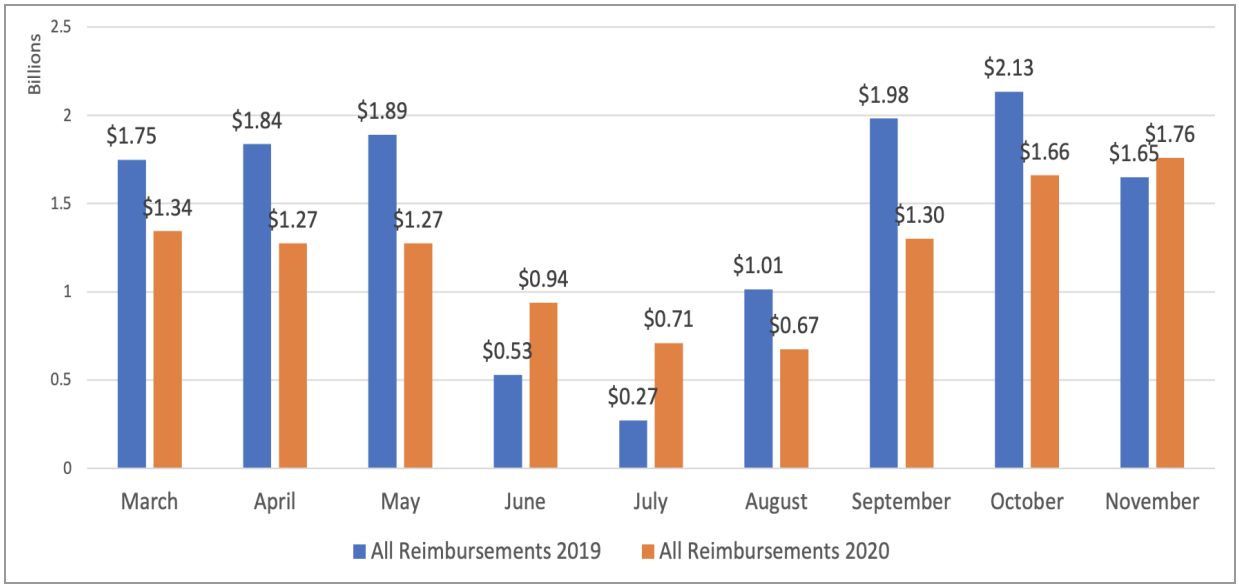
Reimbursements in 2020 were lower due to declining participation in the NSLP, with school closures due to COVID-19 in comparison to the same period the year before. Therefore, schools' ability to increase program participation rates will help them generate higher revenue from reimbursements, allowing them to have additional funds for food service operations.

Several food service representatives from various school districts interviewed for this report confirmed that if school meal programs had higher participation rates, the federal reimbursement would provide schools with the amount of funding required to provide better-quality food and meal service.

According to Michael Manning, the Director of Food and Nutrition at the Richfield Public Schools District (Richfield, MN), this funding scheme has a direct impact on schools' motivation to serve healthy food. As school nutrition budgets are based on the number of meals served daily, schools are incentivized to boost participation rates by serving children delicious, but unhealthy food (Manning, personal communication, 2021).

Figure 4

Total NSLP, SBP, and SFSP Lunch and Breakfast Reimbursement ($), 2019 vs. 2020



Note. Figure 4 is from the report *School Nutrition Meals Served And Reimbursements during the COVID-19 Pandemic* by the School Nutrition Association, 16 Mar. 2021.

The USDA's School Nutrition and Meal Cost Study based on 2014–2015 SY data highlighted that only 57% of total school revenue came from USDA meal reimbursements, and total revenue on average covered only 97% of all costs reported to produce the school meals (thus, there was a 3% average deficit in SY 2014–2015 study). This finding suggests that schools are often required to generate additional revenues to cover the cost of school meals through other activities outside of the food services and to move funds from other school operations into food services to support their meal programs.

Figure 5

Composition of School Food Authority Revenues, School Year 2014–2015

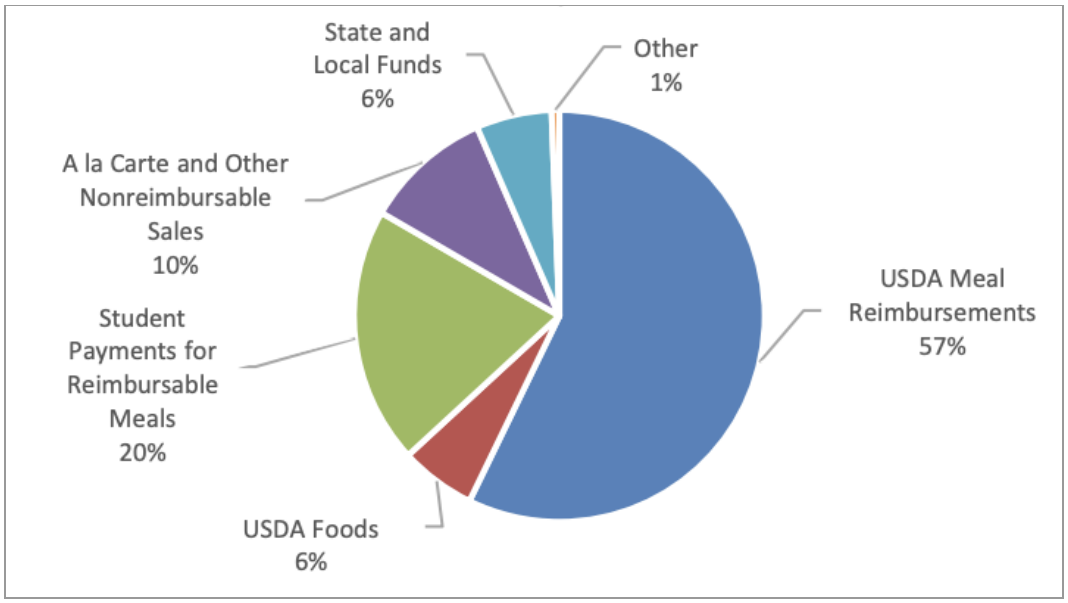
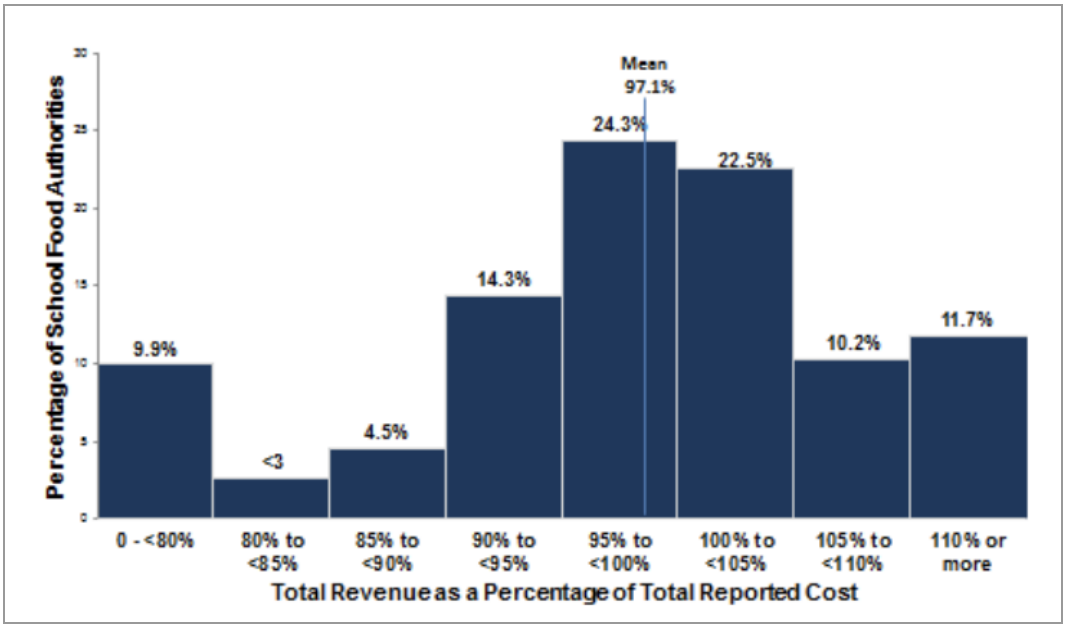


Figure 6

Total Revenue as a percentage of Total Report Cost, School Year 2014–2015



Note. Figures 5 and 6 are from *Food and Nutrition Service School Nutrition and Meal Cost Study: Volume 3 - School Meal Costs and Revenues* by the USDA Food and Nutrition Service, Apr. 2019.

In addition to federal funding, schools cover the costs of operating kitchens by relying on state and local funding. However, according to the USDA's 2021 State Funds documentation, there are currently 16 states that offer no additional funding to school meals programs (FRAC, 2021). While increasing the price of competitive foods is a viable, legal option to generate additional income, additional efforts to generate revenue through competitive foods could potentially jeopardize NSLP participation rates, as children might prefer competitive foods over subsidized school meals. Additionally, promoting the sale of competitive foods over subsidized school meals to generate school revenue goes against the NSLP's intent of providing students in need with free or reduced-price meals.

Another revenue source is represented by the sale of competitive foods, such as "à la carte" menu items or vending machine products that students pay with their own money.

In SY 2014–2015, the USDA meal reimbursement for both the NSLP and the SBP across the United States accounted for 56.7% of total meal costs in schools, while state and local funds accounted for 5.9% (Fox et al., 2019). Additionally, the sale of competitive foods accounted for 10.9%, and student payments for reimbursable meals accounted for 20% of total meals' cost (Fox et al., 2019). These percentages change between each state's or district's School Food Authority (SFA). Therefore, under current legislation, a one-size-fits-all fund sourcing for all schools in the United States is not a feasible recommendation as individual school districts rely on different funding sources.

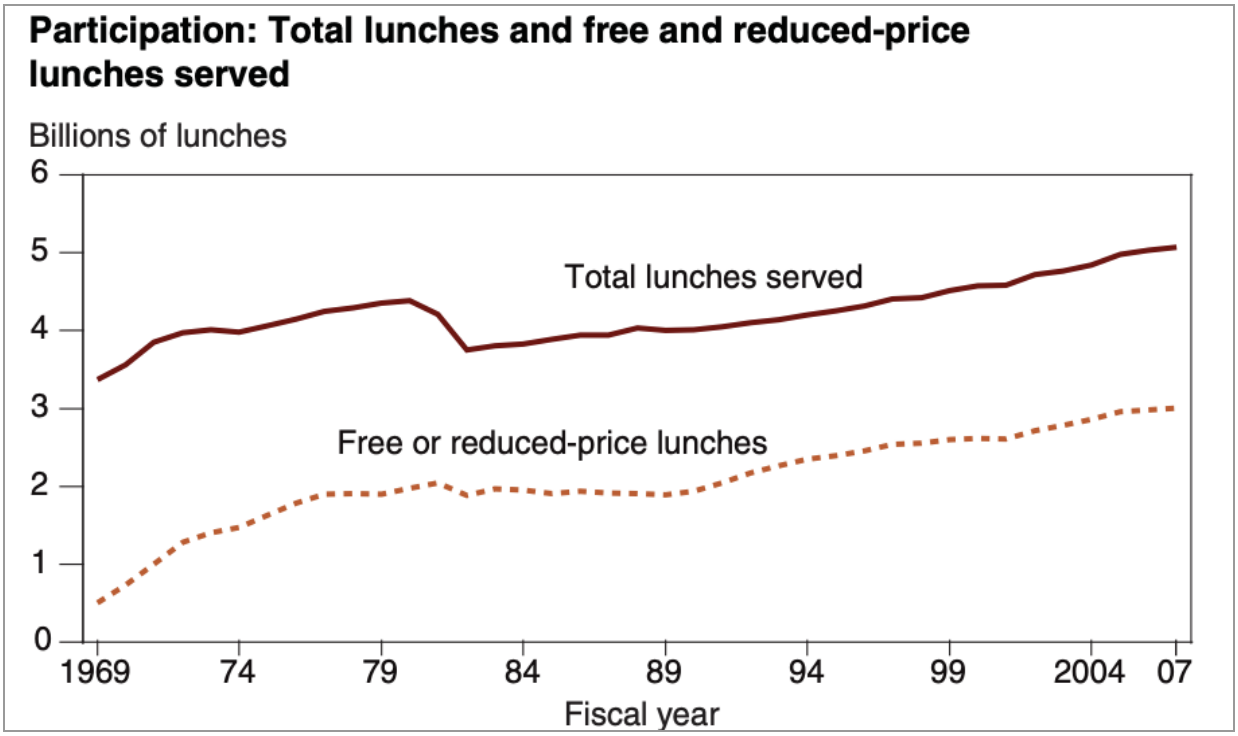
School meal program eligibility

The NSLP and SBP face the constant challenge of encouraging eligible households to apply for participation while protecting the program's viability. Legislation such as the 2004 Child Nutrition Reauthorization Act aims to increase participation by students eligible for free school meals. Provisions from this policy include direct registration for children in households participating in the Food Stamp Program, Temporary Assistance for Needy Families, and the Food Distribution Program on Indian Reservations.

Student participation trends have changed since the beginning of the NSLP, but the number of total lunches served per year has been consistently growing in parallel with school enrollment growth at an average annual rate of 1.3%, from 3.4 billion meals in 1970 to over 5 billion meals in 2007 (Ralston et al., 2008). On the other hand, participation by students eligible for free and reduced-price meals has increased at a higher rate, of 1.9% per year (Ralston et al., 2008). Additionally, participation rates have been declining or stayed constant in the 90s, but they have been increasing steadily since 2003, to about 62% in 2008 (Ralston et al., 2008).

Figure 7

NSLP participation levels and number of free or reduced-price lunches served from 1969–2007



Note. Figure 7 is from *National School Lunch Program: Background, Trends, and Issue* by the USDA Economic Research Service (report number 61), Ralston, K., Newman, C., Clauson, A., Guthrie, J., & Buzby, J., July 2008.

The SBP has also grown over the years, from serving half a million breakfasts in 1970 to 14.57 million breakfasts in 2016 (USDA Food and Nutrition Service, 2017).

It should be noted that during the COVID-19 pandemic, federal waivers allowed schools to serve a greater number of free meals. However, because participation rates were inconsistent to pre-pandemic years, without state-level legislative changes in permanent funding for school meals, the long-term viability of this solution is a point of contention for lawmakers and organizations (Blad, 2021).

According to the USDA's guidelines, eligibility to free meals at school is determined by the following characteristics:

- Eligibility for free lunch and breakfast: children from families with an income that is less than or equal to 130% of the Federal poverty level; or participating in Temporary Aid to Needy Families, Food Stamp Program, or Food Distribution Program on Indian Reservations; or children that are homeless, runaway, or migrant are eligible for free lunch and breakfast (Ralston et al., 2008; USDA Food and Nutrition Service, 2019).

- Eligibility for reduced-price lunch and breakfast: children from families with an income between 130–185% of the Federal poverty level are eligible for reduced-price lunch and breakfast (Ralston et al., 2008; USDA Food and Nutrition Service, 2019).

Federal poverty thresholds are updated each year by the Census Bureau, and they change by state and by family composition. For instance, in 2021, 130% of the poverty line for a three-person family is $2,379 a month, or about $28,550 a year (Center on Budget and Policy Priorities, 2021).

3. The nutritional value of food served in public schools through the National School Lunch Program and the School Breakfast Program

The main nutrition problem for children has changed from poor nutrition to being overweight, and the public has increasingly started questioning the NSLP and SBP's ability to promote healthy food for children (Ralston et al., 2008). There has been increasing concern on whether there is a connection between childhood obesity and the quality of the food served in schools. In response to these concerns, in SY 2012–2013, the school meal programs began to undergo extensive changes, mainly stemming from the HHFKA of 2010. This policy updated nutrition standards to improve the nutritional quality of school meals, with the following rules being put in place by the SY 2014–2015:

- Grain products must contain at least 50% whole grains
- Foods must not contain more than 0.5 grams of artificial trans fat per serving
- There are weekly minimum lunch meal requirements for five vegetable subgroups
- Meat must meet both min and max calorie requirements for age group served
- Regular and flavored milk must be nonfat or 1%
- School districts must create a health & wellness policy (Fox et al., 2019)

Meal improvements have been measured through the Healthy Eating Index (HEI). The HEI is a measure of how well a set of foods aligns with key recommendations of the Dietary Guidelines for Americans released by the U.S. Departments of Agriculture and Health and Human Services. Scores range from 0–100 (a score of 0 reflects that a set of foods does not align with dietary recommendations). The HEI was first developed in 1995 to evaluate the extent to which Americans are following dietary recommendations, and it has been regularly updated across the years. Based on the 2010 HEI, mean total scores for NSLP meals increased 41% between SY 2009–2010 and SY 2014–2015. Additionally, the mean total HEI score for SBP meals provided rose 44% between SY 2009–2010 and SY 2014–2015 (Fox et al., 2019).

Despite the improved nutritional values, studies found no significant association between the introduction of the HHFKA and childhood obesity trends overall. However, for children in

poverty, the risk of obesity declined each year substantially after the act's implementation (Kenney et al., 2020). Therefore, while nutritional values in the NSLP and SBP have improved, the number of children who are overweight or obese is continuing to increase (Dehghan et al., 2005), indicating that significant changes to school meals may still be required to address the nationwide childhood obesity epidemic.

4. The role of Food Service Management Companies in the United States Department of Agriculture school meal programs

A Food Service Management Company (FSMC) is an organization other than a public or private nonprofit school, contracted by an institution for preparing and delivering meals or use in the school meal programs (Law Insider, n.d.). The largest food service management groups serving K–12 schools include Compass Group North America, Sodexo Inc., Aramark Corp., Elior North America, Southwest Foodservice Excellence (Buzalka, 2021). Of these firms, Aramark serves more than 2.5 million students daily (Aramark, n.d.), while Chartwells K–12, a subsidiary of Compass Group, serves more than 2 million student meals daily (Chartwells K–12, 2021). After reaching out to three of the largest firms, only Chartwells K–12 responded to the authors' initial communication but failed to follow up with the interview questions after repeated contact requests. Therefore, no comments from the largest K–12 food service management groups are included in this report.

Outsourcing K–12 food service programs to private management companies were prohibited by law in the past: Congress thought that for-profit operators had no place in the not-for-profit world of the federal lunch program (Gaddis, 2020). Outsourcing restrictions were lifted in the 1970s (Gaddis, 2020). Faced with increasing demand for school meals and a lack of funding to build new kitchens or upgrade existing facilities, SFAs have turned to Food Service Management Companies as a cheap and easy way to feed students. Additionally, staff shortages have made outsourcing an attractive measure for school districts to supply meals. However, this approach differs by region. Currently, school districts in the Mid-Atlantic region are the most likely to rely on FSMCs, with 48% of total schools doing so (Gaddis, 2020). On the other hand, school districts in the Southeastern United States are the least likely to rely on FSMCs, at less than 1% (Gaddis, 2020). Nationwide, the states of New York, New Jersey, Illinois, Ohio, Michigan, Pennsylvania, and Arizona account for almost 50% of all food service outsourcing in K–12 education (Gaddis, 2020).

School officials consider high labor costs to run school cafeterias the main reason for outsourcing (Jacobs & Graham-Squire, 2010). While FSMCs are able to achieve lower labor costs compared to school districts, they do so at the expense of their workers. According to a 2009 report on contracted food service workers in New Jersey's K–12 public schools, employees hired directly by school districts earned $4–6 more per hour than those hired by FSMCs (McCain, 2009).

Another strategy that FSMCs use to lower their service cost is to utilize rebates, bulk discounts, and other benefits, making food prices lower than what an individual district would pay on its own. Compared to individual school districts, FSMCs have access to lower food prices thanks to their bargaining power over food suppliers due to their large-volume food purchases for multiple school districts. Therefore, thanks to low labor and food costs, FSMCs represent one of the least-expensive options for budget-strained school districts to serve meals to their students.

Despite being competitive from an economic standpoint, FSMCs present hidden costs associated with children's wellbeing and academic performance. When working with FSMCs, schools are often unknowingly subsidizing companies that turn fresh, healthy food into processed, less nutritious items. For instance, a 2011 *New York Times* report noted that San Bernardino schools pay FSMCs and food processing companies almost fifteen dollars to create french fries out of six dollars' worth of potatoes (Kosimar, 2011). The high frequency of processed food items served by FSMCs, which are typically high in fat and sugar, have a significant impact on children's health. Additionally, studies have found that privatization of school food management was linked with lower school test scores, hypothesizing that high-fat and high-sugar foods served by FSMCs might be a contributing factor (Kosimar, 2011).

Thus, school districts should not solely rely on the commonly held notion that using FSMCs equates to lower food costs and should instead consider a variety of factors (in addition to price) when determining whether to use FSMCs, such as food quality and its impact on students' health and academic performance.

According to research that conducted over 40 interviews with food systems advocates and FSMCs staff members, FSMCs are acknowledging that there is significant momentum behind the local food movement due to rising customer demand. Therefore, it is to their competitive advantage to provide local food options where feasible. While there are some potential obstacles to making that actionable such as produce seasonality, food safety and high insurance requirements, some FSMCs are creating initiatives to meet customers' demand for more local produce (Obadia, 2015). For instance, Sysco, one of the largest food service distributors in the world, has started the FreshPoint Inc. brand. This brand includes a system for tracking provenance, allowing customers to determine their local range, and prioritizing produce from within the selected radius (FreshPoint Inc., A division of Sysco Corporation, n.d.).

5. Differences in school food according to geography, socio-economic status, ethnic background, the role of competitive food in schools

Several studies support the presence of variances in school food menus and environments. One study focusing on this issue in the journal *Nutrients* affirms that demographic aspects such as poverty level and race/ethnicity influence the school food environments (Bardin et al., 2020). Firstly, the study acknowledges the importance of the passage of the Healthy Hunger-Free Kids Act in 2010 and the impact it has had in terms of raising the nutrition

standards for reimbursable meals and competitive meals in public schools. Utilizing findings from a sample population consisting of 1207 schools, the authors established that school food environments varied by both the schools' poverty level and racial/ethnic composition (Bardin et al., 2020). More specifically, two major factors supported the possibility that high poverty, majority Black, and majority Hispanic schools had healthier school food environments than other school types. These aspects included lower access to competitive foods for the demographic and having effective school and SFA wellness policies. Hence, because high poverty, majority Black, and majority Hispanic schools have lower access to competitive foods, this suggests that they offer a healthier food environment for their students compared to other schools with higher access to them (Bardin et al., 2020).

Another study which consisted of approximately 800,000 public school children in New York City, found that Black, Hispanic, and Asian students lived closer to food outlets than White students (Elbel et al., 2019). While this finding only applied to Black, Hispanic, and Asian students from non-low-income families, it implies that they had greater access to healthy food options (Elbel et al., 2019). Nonetheless, the most problematic issue when looking at the currently available research on the nutritional quality of children's diets in the United States is that overall, studies exploring the association between ethnicity, race, and income display mixed results and a lack of consistent patterns (Gearan et al., 2020).

However, in 2015, a national nutrition standard called "Smart Snacks in School" was implemented by the Centers for Disease Control and Prevention (CDC), seeking to improve the nutritional quality of competitive foods available in schools. In response to this policy, however, many big food manufacturers reformulated their products and promoted Smart Snack-compliant versions of popular snacks, with the same logos and brand names as the original, less-healthy items. However, students were confused about the healthfulness values of these look-alike healthier versions of the manufacturer's snacks, undermining the schools' ability to teach good nutrition (Harris et al., 2016). More thorough and updated research is needed to accurately determine the current relationship between access to competitive foods offered in schools under these new standards and the health of students who consume them.

With respect to differences in the nutritional quality of the NSLP, the study found very few differences amongst schools in each subgroup (Bardin et al., 2020). The data implied that the general nutritional content of NSLP lunches had no correlation with school poverty rates or different races/ethnicities. In fact, the average sodium content for NSLP lunches in Hispanic and varied schools was 10% lower than in majority White schools. This finding has an impact on children's health, as high sodium levels lead to high blood pressure, cardiovascular disease, congestive heart failure, and kidney disease (Heitkamp, 2019). According to the CDC, 90 percent of children in the U.S. consume too much sodium and are potentially affected by these health complications (Heitkamp, 2019).

Dawn Smith, the Food and Nutrition Director at the School District of Beloit (Beloit, WI), highlighted that the majority of the students in her school district come from low-income

families and many children do not eat outside of school (personal communication, 2021). The activist and Executive Director at Chilis on Wheels (headquartered in New York, New York), Eloísa Trinidad, echoed this sentiment and highlighted that these underserved communities are often not given a voice in the food system (personal communication, 2021). She explained that health and nutrition are intrinsically linked but that many families in low-income neighborhoods do not feel empowered to speak out against unsuitable and low-quality meal provisions (Trinidad, personal communication, 2021). However, when provided with plant-based and culturally-appropriate groceries, many families will embrace these whole-heartedly. In the interviewee's opinion, this highlights that the narrative of underserved communities not being interested in healthy, plant-based meals is false and misguided (Trinidad, personal communication, 2021). On the contrary, a 2018 Gallup poll has shown that vegan and vegetarians in the United States tend to come from lower-income families, while these diets are rarer among the higher economic brackets (Reinhart, 2018).

Studies have also found that 8% of African Americans are strict vegans or vegetarians, compared to just 3% of the general U.S. population (BBC News, 2020). Additionally, a 2020 poll highlighted that 31% of non-White Americans had reduced their meat consumption, compared to only 19% of White Americans (BBC News, 2020). While anecdotally, school district representatives reported that children from low-income backgrounds prefer meat, these findings underscore how it cannot be assumed that students and parents coming from non-White or disadvantaged backgrounds are generally unsupportive of plant-based diets.

6. The potential impact on the environment of making school menus more sustainable

The National Environmental Policy Act of 1969 committed the United States to environmental sustainability, establishing a national policy "...to create and maintain conditions under which [humans] and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

Adopting sustainable agricultural practices, such as restructuring the U.S. food system, can have a significant impact on the environment. Food production is destroying, damaging and degrading ecosystems, resulting in mass biodiversity loss which makes food growth harder and further exacerbates the climate crisis (Benton et al., 2021). By following a "cheaper food paradigm," the food industry's goal has been to produce more food at lower costs to increase revenues. Methods to achieve this paradigm include increasing inputs such as fertilizers, pesticides, energy, land, and water use. This strategy has led to an unsustainable feedback loop: as food cost lowers, it becomes accessible in larger quantities to a wider group of people. Consequently, there is a bigger demand for food that must be produced at a lower cost through intensifying inputs and land clearance (Benton et al., 2021). Therefore, efforts in improving crop yields have led to contamination of water and soil from excessive pesticide use and eutrophication from agricultural runoff (Fanzo et al., 2021). Additionally, food production has

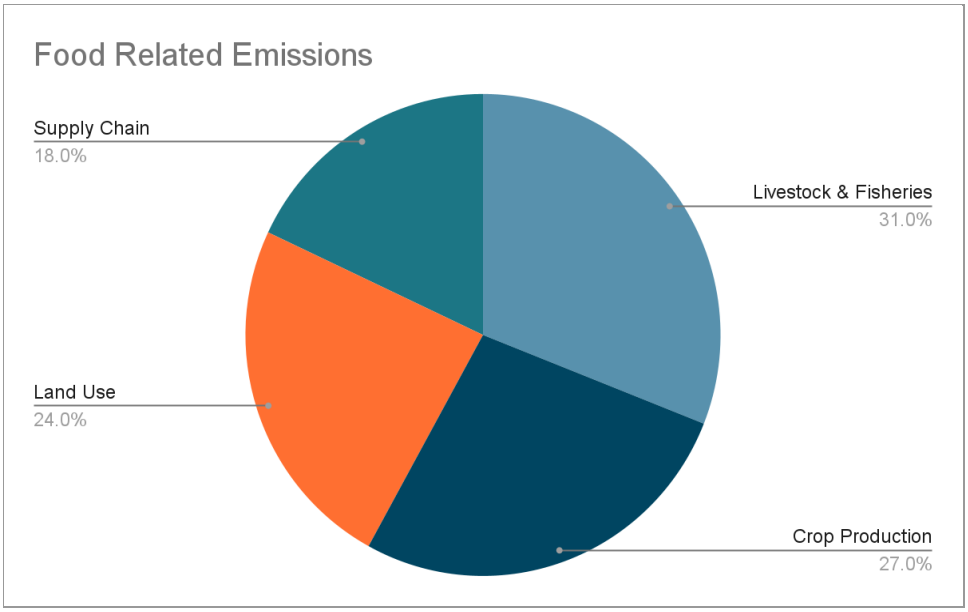
caused half of the world's ice and desert-free habitable land to be converted to agricultural use, and led to 70% of global freshwater withdrawals (Ritchie & Roser, 2020).

Draining and polluting natural resources, and turning natural habitats into crop production or pasture land has resulted in habitat destruction and biodiversity loss. The clearance of natural ecosystems, such as forests, is denying wildlife species the sources of shelter and food that they need to survive and thrive. As a consequence, the food production system threatens 86% of species at risk of extinction (Fanzo et al., 2021). Specifically, the number of species close to extinction is now potentially hundreds of times higher than the average rate from the last 10 million years, with approximately a quarter of species in most animal and plant groups already risking extinction (Benton et al., 2021). While wild animals struggle to survive, the global biomass is now dominated by a narrow number of farmed animal species. For instance, cows and pigs account for 60% of all mammal species by mass, and farmed chickens represent 57% of all bird species by mass globally (Benton et al., 2021). Food systems are also affected by this loss of genetic diversity, causing decreased capacity for withstanding pests, pathogens, extreme weather, and climate change (Benton et al., 2021).

Food production is also responsible for one-third of the world's greenhouse gas (GHG) emissions (Gilbert, 2012). Livestock & fisheries account for the greatest percentage of food production-related GHG emissions (31%), closely followed by crop production (27%), land use (24%), and supply chains (18%) (Ritchie & Roser, 2020). Increasing GHG emissions and concentrations in the atmosphere affect the Earth's climate system and cause global warming—leading to sea-level rise, ocean acidification, and more frequent, severe weather conditions and natural disasters—all of which affect modern agriculture systems and the functionality of food supply chains. Since optimal food production requires specific conditions, disruptions to the environment can negatively affect crop yields and quality, and put the global food supply at risk (Fanzo et al., 2021).

Figure 8

Percentage of food related emissions by sector



Note. Figure 8 was created for this report from *Environmental impacts of food production*, Our World in Data, by Ritchie, H., & Roser, M., Jan. 2020.

Three interdependent actions might curb the environmental impact of the current food production system: shifting to plant-based diets, conserving and preserving land for nature, and implementing wildlife-friendly farming practices (Benton et al., 2021). While these actions are needed at a global level, the large and increasing volume of food required to feed K–12 students in the United States (nearly 30 million school lunches are served each day alone through the NSLP [Ralston et al., 2008]) has the potential to drive system-wide change in the national food-supply chain and have a substantial positive impact on the environment.

7. Strategies for more sustainable school menus

Reducing greenhouse gas emissions from food production, and the impact of local food and "small-scale" farms

There is an overwhelming consensus that reducing GHG emissions from food production requires reducing the consumption of meat and dairy-based products (Hamerschlag et al., 2018). The Intergovernmental Panel on Climate Change made policy recommendations to reduce meat consumption as it found that plant-based diets represent a major opportunity for mitigating the negative effects of climate change while providing significant benefits to human health (Shukla et al., 2019). Animal products are the most carbon and resource-intensive foods in modern

human diets, as their production needs significant amounts of water and energy inputs (Hamerschlag et al., 2018). Consequently, making school menus more sustainable means reducing the consumption of meat and dairy-based products.

Reducing children's meat consumption may also positively impact their health, as public health representatives generally agree on the need for Americans to lower their red meat consumption (Brenton et al., 2021). Diets that include high levels of red meat consumption are linked to increased rates of cancer, heart disease, obesity, diabetes, and a shortened life span (Hamerschlag et al., 2018). On the other hand, diets high in vegetable consumption prevent these diseases (Hamerschlag et al., 2018). Specifically for children, shifting eating habits earlier in life encourages longer, healthier lives for the next generation (Forum for the Future and the Protein Challenge 2040 Future Plates initiative, 2020). Additionally, as schools struggle to prepare affordable meals within the federal budget reimbursement limitations, reducing meat in school menus has the potential to reduce total meal costs. Projections show that volatile weather and shifting subsidies will increase the cost of animal products in the future. Therefore, plant-based proteins will become more cost-effective over time (Hamerschlag et al., 2018).

While considering various strategies to make school food menus more sustainable, studies point out that "local food" cannot simply be equated with "sustainable" food. Intuitively, under the concept of "food miles," local food is considered more sustainable because it reduces GHG emissions that are correlated with traveling long distances. However, transport-related carbon emissions constitute only 5–6% of total emissions related to food production (Stein & Santini, 2021).

Transportation's contribution to GHG emissions is even less significant for meat: for instance, it typically accounts for less than 1% of beef's GHG emissions (Ritchie, 2020). Therefore, many other elements determine a product's carbon footprint in addition to transportation, including land use, production processes, and storage. Even when only considering transportation, cargo ships or trains can be less polluting over longer distances than small trucks over shorter distances as they transport a relatively larger amount of produce, reducing the trip amounts per produce item. Additionally, if consumers individually visit local farms, their combined carbon emissions from transportation can be greater than the emissions from the transportation system of large-scale suppliers (Stein & Santini, 2021).

In a study published in *Environmental Science & Technology*, the authors estimated that substituting one day per week's calories from beef and dairy products to chicken, fish, eggs, or a plant-based alternative results in less GHG emissions than consistently buying food from local sources (Weber & Matthews, 2008). Specifically, replacing red meat with plant-based alternatives just one day per week would save 0.46 tCO_2eq (Tonnes of CO_2 equivalent) per year, while replacing red meat with chicken, fish, eggs just one day per week would save 0.3 tCO_2eq per year (Ritchie & Roser, 2020).

Small-scale farming is also widely argued to be more sustainable than large corporate farming (Wuepper et al., 2020). However, this common association between small farms and

environmental sustainability is not well supported by available research and empirical evidence, primarily due to uncertainties on how to categorize farms and accurately measure environmental sustainability (Wuepper et al., 2020). Moreover, a sustainability model that is successful for one individual farm may not be useful for another, due to differences like geographic location, agriculture type, or production needs (Zahm et al., 2008).

Food grown or raised on small farms is also frequently associated with or considered the same as what this project has defined as "locally grown foods," although the two are not always mutually inclusive. Locally sourced food does appear to generate carbon emission savings in most instances, although scientific Life Cycle Assessment (LCA) studies and data are limited (Striebig et al., 2019).

One study concluded that the greatest difference in emissions occurs at dining locations where large amounts of foods are consumed, such as chain restaurants or university dining halls (Striebig et al., 2019). Specifically, the researchers found that over the course of one school year at a single college, a 10% increase of locally-sourced food resulted in a decrease of more than 4 tCO_2eq (Striebig et al., 2019). In this case, one of the primary reasons that locally-sourced food results in lower carbon emissions is because items are typically transported by road versus air, which is less fuel-intensive (Striebig et al., 2019).

Regardless of size and whether independent or corporate-owned, all farms can be responsible for pollution and waste. However, third-party certification systems can identify farms, both small and large, that are minimizing environmental and natural resource impacts by using sustainable agriculture methods.

In the United States, there has been a historical lack of support from the government for small and mid-sized farms, which has contributed to racial, gender, and ethnic disparities in farming and labor. "People of Color, Hispanic and female owner-operators and tenants tend to operate smaller farms [compared to] their White, non-Hispanic and male counterparts," as described in the journal of *Agriculture and Human Values* (Horst & Marion, 2018). So, while small and mid-sized farms may not always have lower environmental impacts than large ones, more inclusion and support for smaller farms from the USDA may help improve disparities in the American agricultural industry.

Small and mid-sized farms also tend to positively impact rural communities by creating job opportunities and supporting healthy local economies (Lurie & Brekken, 2019). Furthermore, they provide educational opportunities for local schools and residents. For instance, school districts interviewed for this project have consistently expressed that an impactful way of teaching children about food systems and the environment is represented by students visiting small, community farms and actively participating in gardening or other farming activities as part of the school's nutritional curriculum.

Schools are increasingly purchasing locally-sourced foods, which tend to come from small to medium-sized farms, not necessarily for sustainability reasons, but because it supports the state and local economy, and there is a higher degree of product transparency, as noted by

Montana State University, FTS Coordinator, Aubree Roth (personal communication, 2021). By incorporating locally-sourced foods and FTS programs, districts can make more informed decisions and choices when it comes to food purchasing (Roth, personal communication, 2021).

Overall, the carbon footprint of food systems is significantly more impacted by consumers' dietary choices than by the "localness" of the food they purchase and the size of the farm producing the food. Therefore, dietary changes, especially if they include reducing meat consumption, have a much greater potential in reducing food's environmental impact than purchasing from local suppliers. However, the positive economic and societal implications for communities to engage small, local food suppliers cannot be denied (Stein & Santini, 2021).

Reducing meat and dairy within school menus while increasing plant-based options

There are various ways to reduce meat and dairy while increasing plant-based options in school menus. Besides the above-mentioned environmental benefits of plant-based diets, eating plant-based meals in schools can be significantly more nutritious for students. Considering that most U.S. children fail to meet national recommendations for fruit and vegetable consumption, an increased focus on plant-based meals may have long-term health benefits for students across the country (Centers for Disease Control and Prevention, 2018). It should be noted that this issue is relevant to adults too, as only 12.2% meet the daily recommended fruit intake, and only 9.3% meet the daily recommended vegetable intake (Centers for Disease Control and Prevention, 2018). Additionally, the U.S. cannot even provide enough of the vegetables that Americans are supposed to eat. A 2010 study in the *American Journal of Preventive Medicine* shows that the U.S. vegetable supply needed to increase by 70% to satisfy the recommended daily allowances (McMillan, 2015).

Strategies for increasing plant-based options in school menus and reducing meat include increasing the quality and quantity of plant-based protein options in school cafeterias in place of animal meat-based proteins. Plant-based protein can fully replace animal meat, or it can be blended in the menu to reduce the amount of animal protein required to prepare a meal. For instance, bean pulse or minced mushrooms can be mixed with minced meat when preparing a meat patty to minimize the amount of meat needed for the recipe. Based on interviews with several school district representatives, this is a strategy used by various schools across the country that has proven successful and has not decreased students' meal acceptance.

Additionally, replacing animal meat with meat analogs can help increase plant-based options in school menus. Unfortunately, switching to meat analogs does not require a shift in consumers' behavior and, therefore, does not effectively educate children towards having healthier, plant-based diets. However, the environmental benefits of this strategy are significant, and, therefore, schools should consider it when transitioning to more sustainable school meals.

Another strategy to implement plant-based options in schools involves supporting the current shift in attitudes to plant-based food, especially if driven by the student body. Some

estimates show that nearly 70% of Americans are already attempting to boost their plant-based protein consumption (Forum for the Future and the Protein Challenge 2040 Future Plates initiative, 2020). Specifically, 16% of students want more plant-based options from their school menus (Forum for the Future and the Protein Challenge 2040 Future Plates initiative, 2020). Additionally, shifting to more sustainable menus can be particularly significant to teenagers, as 54% of them are engaged in environmental issues, with 1 in 4 partaking in environmental rallies or protests (Forum for the Future and the Protein Challenge 2040 Future Plates initiative, 2020). Therefore, schools should aim to address the mismatch between the current meals offered to students and their desired eating habits.

The issue of milk waste in schools

To meet nutritional standards, schools participating in the NSLP and SBP are required to offer students 1 cup of pasteurized, flavored or unflavored cow milk per day with their meals (Code of Federal Regulations, 7 CFR § 210.10, as amended in 2020). In addition, Federal law requires that schools do not "directly or indirectly restrict the sale or marketing of fluid milk products in any way by the school...at any time or place (Plant Power Task Force, 2018). Therefore, schools could even be cited for placing other beverages, such as water or plant-based milk, near the milk on the lunch line (Plant Power Task Force, 2018).

While the USDA provides cow milk to children through its federally-funded programs, over one-quarter of the milk served in the NSLP and almost half served in the SBP is discarded and not consumed (Blondin et al., 2017). There are several factors that may influence milk waste in schools such as portion size, the number of times it is served per day at school, or flavor preferences.

For instance, a study in Florida that tracked food/beverage waste in three schools found that the amount of dairy milk wasted was significantly different at each one (Wilkie et al., 2015). The results revealed that milk waste was higher at the public elementary school than at the public high school included in the study, probably as a result of the common portion size (a half pint—the amount required by law to be served with each school meal), which may be too much liquid for the average child (Wilkie et al., 2015). Therefore, a factor contributing to school beverage waste is that schools do not adjust the milk portion sizes based on students' age or grade.

Another factor contributing to school milk waste is determined by whether the milk is flavored or not. An Oregon-based study showed that as of 2014, 68.3% of all milk served in schools was flavored, of which more than 90% was chocolate milk (Hanks et al., 2014). When chocolate milk was eliminated from schools, milk consumption declined by 9.9%, and students wasted 29.7% more of the white milk they selected compared to when chocolate milk was available (Hanks et al., 2014). Therefore, when chocolate milk was removed, fewer students took milk, and students wasted more of the white milk they selected. Based on these studies, schools

may be able to significantly reduce milk waste by serving smaller portion sizes, or by increasing the availability of the most popular milk flavors.

Another option to reduce milk waste would be to eliminate the requirement that makes it mandatory to be served with federally subsidized meals, and serve cow milk only to students who want or request it. The federal government spends more money on dairy products than any other food items in the NSLP (Physicians Committee for Responsible Medicine, 2012). The USDA Dairy Margin Program has provided over $500 million in program benefits to dairy operations in 2019–2020 (Byrne, 2021), representing approximately 73% of the farmers' marketplace revenue (Grey, Clark, Shih and Associates, Limited, 2018).

However, Ann Cooper of the Chef Ann Foundation noted in an interview that the dairy lobby is strong, and the USDA may never go against them (personal communication, 2021). As a result, milk requirements may be a significant factor in persistent beverage waste and social equity issues. However, the Physicians Committee for Responsible Medicine (PCRM) has filed a petition with the USDA asking for cow milk to be banned from school lunches. In the petition, the PCRM asserts that the high sugar, fat and protein content in cow milk is harmful to children, and there are other ways for children to get their daily calcium (Hibbard, 2012). Additionally, over 1 million children in the U.S. have milk allergies, which is the second most common food allergy (Physicians Committee for Responsible Medicine, 2012).

Some schools have reduced milk waste by implementing strategies such as "sharing baskets," a method used in the Pierre School District (Pierre, SD) (Kostas, personal communication, 2021). In the sharing basket strategy, students place unwanted food items that have not been opened or partially eaten in a storage container instead of the garbage, as Tessa Kostas, the Food Service Director of Pierre School District (Pierre, SD), explained (personal communication, 2021).

The collected foods and beverages are then made available to students during meal or snack periods (until they expire), helping reduce food waste. However, schools can still accumulate excess milk (that is often subsequently wasted), even when using this sharing strategy, because the amount of milk served with free/reduced-price meals may be more than what students drink.

Replacing cow milk with plant-based milk options: comparing greenhouse gas emissions of cow and plant-based milk

When considering the emissions from producing cow's milk, overall dairy beverage waste becomes more than a practical problem. Making dairy milk generates approximately 3.2 kg of CO_2e per liter (Poore & Nemecek, 2018). When comparing this value to popular plant-based milk alternatives, dairy milk emissions are multiple times higher. For instance, producing almond milk, the most common plant-based milk (Winans et al., 2020), only generates 0.7 kg of CO_2e per liter (Poore & Nemecek, 2018). Even when reviewing more carbon-intensive

milk alternatives such as rice milk, which emits 1.2 kg of CO_2e per liter, the emissions of dairy milk are significantly higher (Poore & Nemecek, 2018). While the emissions of dairy milk can be decreased with organic farming, adjusted feeding, and improved waste management (Forleo et al., 2014), these practices represent a small segment of the current dairy market and are typically still more carbon-intensive than producing plant-based alternatives. Additionally, dairy milk producers following these practices often sell their products at a higher price, which would make their milk inaccessible to most budget-strained schools (Sherpa, 2010).

Replacing animal meat with meat analogs: comparing greenhouse gas emissions of standard meat and plant-based meat analogs

Interest in plant-based meat products, referred to as "meat analogs," has proliferated over the past decade. As a result, a variety of alternatives exist to mimic the texture, flavor, and nutrients of animal meat. These products could include natural foods that resemble certain meat characteristics, such as meshed lentils and minced mushrooms, or products that are not meant to resemble meat but could be used in similar ways, such as tofu, tempeh, seitan, and bean burgers, all of which are plant-based foods (Santo et al., 2020). The composition of these meat analogs differs according to the product. In the case of plant-based meat, it typically includes soy, wheat, or peas as their primary protein source. Plant-based meat might also include products derived from fungi and lupin beans (Santo et al., 2020).

Plant-based meat analogs have a lower environmental impact. When comparing the LCA of plant and beef-based patties, vegetarian burgers have a significantly smaller environmental footprint than beef burgers (Saget et al., 2021). Meat analogs can be considered an excellent "transition" food. Transition foods are products that can help individuals change their eating habits. In the case of meat analogs, while they do not teach consumers to eat meatless, plant-based meals, they can be a key component in helping meat-eaters transition towards a more sustainable diet (Saget et al., 2021).

While plant-based meat is an environmentally-friendly alternative to animal meat, meat analog substitutes are more GHG-intensive than the less-processed plant proteins, such as tofu, pulses (excluding peas), and peas (Santo et al., 2020). Moreover, according to Karen Spangler, Policy Director at the National Farm to School Network, despite meat analogs having the potential of lowering the GHG emissions of school menus, there are some concerns on how the meat analog industry could become another version of the current meat industry, with large-scale suppliers dominating the market and smaller distributors struggling to remain competitive (personal communication, 2021).

There are several challenges in implementing meat analogs in schools. First, there is no scientific consensus on whether meat analogs are nutritionally equivalent to animal meat and if it is appropriate for schools to serve meat analogs to children, nor is there agreement on the correct amount. Possible reasons as to why nutritional disagreements exist over plant-based meat may be

because substitutes sometimes have a higher sodium content than animal meat, and they may include a series of additives that are not necessarily beneficial to human health (Santo et al., 2020). Additionally, plant-based meat substitutes can be high in saturated fat due to the use of coconut and palm oils to give products a texture similar to beef (Santo et al., 2020). However, both animal meat and many other items currently served in school menus present the same, if not worse nutritional problems. Since plant-based meat analogs are generally not marketed as a health food, from a sustainability standpoint, the massive environmental gains from replacing plant-based meat with animal meat outweigh the potential health or nutritional concerns.

Second, the strict regulations about nutritional values in school menus can be a hard barrier to overcome in trying to introduce meat analogs. For instance, Alt: Meat Lab explored the inclusion of plant-based burgers on school menus but concluded that the USDA guidelines about school lunch menus were too restrictive to implement this change on a national scale (Benson, 2019). However, the political scenario is quickly changing. In May 2021, Impossible Foods secured a Child Nutrition label from USDA, allowing its meatless Impossible Burger to be served for breakfast and lunch in K–12 schools nationwide as part of the federal reimbursement plans (Watson, 2021).

Moreover, price competitiveness can represent an additional challenge for introducing meat analogs in schools, considering the limited budgets for reimbursable meals. While meat analogs were noticeably considered more expensive than standard meat, producers are struggling to become cost-competitive with real meat. For example, a pound of ground Beyond Meat typically costs around six dollars, while ground beef can be nearly two dollars less per pound (Reiley, 2021). However, this cost difference is a result of federal subsidies supporting the meat industry, making the cost of animal meat and milk artificially more competitive (Simon, 2013).

Additionally, plant-based meat is a novelty, and it does not necessarily offer the rich and meaningful connection to traditional foods that bean and lentil dishes can offer. Despite these challenges, the environmental damage posed by the consumption of animal meat is far more concerning than the potential questions about meat analogs' nutritional values.

Nutritional values of plant-based diets, meat and milk analogs

An important challenge presented by introducing plant-based meat alternatives and plant-based milk in schools is a lack of consensus by medical and nutritional authorities on whether plant-based substitutes are nutritionally equivalent or healthy for all children. This lack of consensus and agreement on what is healthy or nutritious also exists for traditional and conventional school foods such as chicken nuggets, hamburgers, and flavored milk.

When replacing cow milk with plant-based milk substitutes, it is recommended that the beverage be fortified to match the protein and nutrient content of cow milk to meet growth and development needs in children (Sethi et al., 2016). Thus, plant-based milk can be given to children without potential negative health effects if the plant milk is fortified to be nutritionally

equivalent to cow milk. In addition, allergies should be taken into consideration when parents and schools are considering giving children new or different food and beverages.

Regarding the impact of plant-based diets on children, articles in *Nutrition Reviews* and *Frontiers in Sustainable Food Systems* conclude that plant-based diets without appropriate precautions can negatively affect vulnerable populations such as women and children (Hunt, 2002; van Vliet et al., 2020). In contrast, other research demonstrated the benefits of plant-based diets and meat alternatives, such as increased nutrient uptake of fiber, magnesium, and folate (Vatanparast et al., 2020).

Reducing the environmental impact of food and serving tool-related waste

School cafeterias generate significant amounts of waste. Uneaten food represents a significant portion of waste coming from school meal programs. Poor waste management contributes to climate change and air pollution, which affects the Earth's ecosystems. Thus, reducing waste streams is an important component in decreasing the environmental impact of school meals.

Case studies that have evaluated organic food waste in school cafeterias show that 20–50% of food being served in lunches is thrown away. Typically, fruit and vegetables comprise the greatest amount of organic waste in schools, while the lowest volume is represented by animal meat (Wilkie et al., 2015). Unfortunately, there is currently no data available that the authors of this report could find pertaining to the specific rate at which animal meat is wasted in school cafeterias. However, meat-heavy school menus are particularly environmentally harmful. The high volume of natural resources required to produce meat are wasted when the meat is not consumed, and cause additional harm to the environment by contributing to the waste stream. Additionally, when students are required to take fruit, there is typically a higher percentage of food waste (Wilkie et al., 2015). Another study found that the average daily organic waste (food, milk, and paper) "contributed 81.5% of the overall per student mean waste generation rate." Across the study, each student averaged 102.3g of cafeteria waste daily, of which 52.2g consisted of food alone (Wilkie et al., 2015).

There are several strategies to reduce food waste in school cafeterias. For instance, Kevin Silva, the Food Service Director at Lexington Public Schools (Lexington, MA), found that when fruit is chopped into smaller pieces, there is a higher likelihood that children will eat it (personal communication, 2021). Recycling can be another option to reduce food waste in school meal programs. For instance, a study performed on three public schools in Alachua County, Florida, found that approximately 75% of all cafeteria waste could have been recycled through composting or anaerobic digestion, both of which could have produced relevant end products, such as bioenergy or soil fertilizers (Wilkie et al., 2015). In general, the large amount of food waste that is produced daily in schools across the country can be abated through education on waste management and the creation of school recycling programs (Wilkie et al., 2015).

Plastic, aluminum, cardboard, paper, and styrofoam packaging materials are also some of the most commonly observed and reported waste types in school kitchens (Palmer et al., 2021). While pre-consumer packaging (packaging in bulk) is more likely to be recycled by schools, postconsumer lunch materials such as sandwich wraps, pizza boxes, styrofoam trays, paper napkins, plastic water bottles, and plastic silverware are not typically recycled or composted, often for reasons related to costs, feasibility, and contamination (Palmer et al., 2021). School staff often view single-use kitchen materials and utensils as necessary for expediting food preparation, serving, and clean-up (Palmer et al., 2021).

Packaging waste was increasing, even before the COVID-19 pandemic. Unfortunately, food products for children have shifted to small, individual, ready-to-eat packages (Hartle et al., 2016). Consequently, school cafeterias are serving more prepackaged and plastic-wrapped items, reducing food waste costs by prolonging shelf life and limiting the spread of infectious diseases like COVID-19 (Palmer et al., 2021). However, because of the impact of the pandemic on the supply-chain, meat packaging facilities closed or reduced working hours, limiting product availability and affecting producers throughout the country (Ijaz et al., 2021). By purchasing locally-grown foods, schools may not be affected by supply-chain issues and have lower meal costs as less packaging and food processing are required (Demas et al., 2010).

While kitchen and food waste in schools are problematic for the environment, researchers are also concerned that children eating pre-packaged food are being exposed to higher levels of contaminants such as Bisphenol A, an endocrine-disrupting chemical, which is frequently used to line food containers and packages (Hartle et al., 2016). In addition, because food assistance programs tend to serve highly-packaged foods, children from lower-income families may consume more foods stored in packaging containing BPA and other endocrine-disrupting chemicals (Hartle et al., 2016).

Since the environmental impact of food and serving tool-related waste in schools is but a limited aspect of the broader unsustainable practice of the current U.S. food system, this problem is beyond the scope of this project.

Children's acceptance of more sustainable and healthy food options

There are evident synergies between making food more sustainable and healthier for children, as both require shifting towards a more plant-based diet. However, the challenge of evaluating strategies involving more sustainable and healthy school meal options is represented by the scarcity of significant data on whether children will find more plant-based meal options acceptable.

A limited number of studies suggest that children are increasingly welcoming sustainable meal options. For instance, a recent study showed that there is potential for schools to reduce meat and dairy products in their menus to achieve a 40% reduction in GHG emissions from the baseline, without increasing food waste and consumption, nor impacting children's meal

satisfaction (Eustachio Colombo et al., 2020). Additionally, a positive indication from recent child nutrition research found that children are becoming more willing to try or accept healthier food choices. For example, a study of kids' meals sold at Walt Disney World over three years found that the default healthier meal options, lower in calories, fat, and sodium, accounted for nearly 50% of sides and almost 70% of beverages (Peters et al., 2016). In food service, default options refer to sides and beverages that automatically come with a meal unless the consumer requests a substitute item. Therefore, changing default sides and beverages to healthier options such as fruits, vegetables, or water, is a useful strategy for improving kids' eating habits (Profitable Food Facilities, 2013).

Despite these encouraging results, children's food preferences differ greatly depending on the food group. As evidenced in a questionnaire study, children preferred less than half of the listed choices among the vegetable and meat alternative food categories, while they liked 60% or more of the listed choices among bread, pasta, dessert, fruit, juice, dairy, meat, and cereal (Skinner et al., 2002). In another taste rating study, researchers found that although children preferred steamed broccoli over steamed spinach, strawberry yogurt and applesauce were preferred over steamed broccoli (Tauriello et al., 2021).

By speaking to several school district food service directors, the shared perception was that children simply do not like plant-based food items, and that they need to be "tricked" into eating healthy food. However, some school district representatives expressed the opinion that social status and cultural background might impact children's preference for plant-based food options.

For instance, Melanie Moyer, the Menu Systems Development Dietitian at San Diego Unified School District (San Diego, CA), has noticed how children in affluent areas of their school district prefer non-meat items from their school menus, while children in less affluent areas generally prefer meat items (personal communication, 2021). Children from wealthier families typically have access to a greater diversity of food choices and protein and may not be as reliant on school meals for their daily nutritional needs, whereas for children from lower-income families, the school lunch may be their only meal for the day. Therefore, it would make sense that these children who are dependent on school meals for their survival would reach for what they perceive to be a more substantial meal option, such as animal meat.

Additionally, In Moyer's opinion, there is a difference according to cultural background, as some schools with students from specific backgrounds prefer plant-based meals (personal communication, 2021). As of 2018, White students in public schools represented 47% of the student body, while 15% were Black and 27% were Hispanic. Asian, Pacific Islander, American Indian, and two-or-more-races students represented the remainder of the student body (National Center for Education Statistics, 2021). Therefore, it seems reasonable to assume that more than half of the student body might come from a cultural background with dietary preferences different from the standard "American" diet, generally characterized by high intakes of dairy and red meat.

While a growing body of research indicates that children are becoming more receptive to healthy meal options, insufficient research exists to determine the acceptance rate of meat alternatives among children. Plant-based meat alternatives could help reduce the environmental impacts and damage caused by traditional meat production systems. Research also suggests that decreasing the prevalence of meat-based meals in schools may help reduce a child's risk of developing chronic diseases such as diabetes or heart disease, which are linked to excessive meat consumption (Demas et al., 2010).

Strategies to increase children's acceptance of more sustainable and healthy food options

There are several possible strategies to increase children's acceptance of more sustainable and healthy food options. According to Susan Silverman, Project Technical Specialist, Food Services Department, Tucson Unified School District (Arizona), children who participate in school garden programs are more likely to eat plant-based meals. For young students, the experience of seeding, growing and then eating the plants that they grow, gives a greater value to the fresh produce that they have access to in school meals. Produce grown in school gardens is nutritionally advantageous for students and school-based farmers markets allow families living in poverty to purchase low-cost fresh foods. School-garden-produce can be served in school cafeterias and distributed in take-home meal kits that students can prepare and share with their families. The younger that students can be educated about good nutrition, the more likely it is that they will make healthy food choices throughout the rest of their lives (Silverman, personal communication, 2021). Several studies agree with Silverman's statement, suggesting that while participation in a nutrition education program leads to an increase in nutrition knowledge, gardening programs trigger increased preference for and consumption of fruit or vegetables (Langellotto & Gupta, 2012).

Another critical component to increasing children's acceptance of plant-based meals is meals' presentation. According to Jessica Shelly, Director of Student Dining Services at Cincinnati Public Schools (Cincinnati, OH), methods for presenting food in school menus are an important part of cafeteria staff training. Children will not eat food that is not appropriately presented (Shelly, personal communication, 2021). Amie Hamlin, Executive Director at the Coalition for Healthy School Food, also pointed out that schools cannot be successful by simply telling kids to eat something. The food needs to look and taste good (Hamlin, personal communication, 2021). These claims are supported by a study suggesting that the way food is presented or arranged on a plate impacts children's acceptance of a particular meal (Shoup, 2018).

Peers' influence can also increase children's acceptance of plant-based food. According to Tina Byrd, Food Service Director at Jasper School District (Jasper, AR), what works best in enticing children to eat plant-based meals is having children see teachers and friends eating them as well (personal communication, 2021). Hamlin agrees with this statement, noting that the more

excited principals, teachers, parents, and caregivers are about healthy foods, the more likely kids are to try and like them. Studies also confirm that the people around children influence their food preferences and willingness to try new foods (Eliassen., 2011; O'Neill, 2012). Specifically, parents can have the greatest influence on students' dietary habits, based on their ability to make some foods available at home rather than others, and by acting as models of eating behavior. Therefore, among other factors, parental engagement and inclusion in the chain of food provision can play a meaningful role in helping children adopt healthier long-term dietary habits.

Research shows that schools' kitchen staff also significantly impact students' food preferences (Forum for the Future and the Protein Challenge 2040 Future Plates initiative, 2020). A study focusing on eleven primary schools stratified into socio-economic quartiles found that there is an opportunity for catering staff to influence the nutritionally poor choice behaviors evident at the service point. In the study, school meal staff used strategies such as verbal encouragement and praise to encourage children to try the nutritionally-balanced school meals. Since repeated taste exposure increases liking for foods, and liking is associated with consumption, this approach can address situations where children fail to consume nutritionally balanced meals even if they are available (Moore et al., 2009). Therefore, while training kitchen staff in schools usually focuses on cooking skills, educating them about the value of healthier, sustainable diets would ensure that they feel invested in supporting new plant-based menu options when catering to children.

Additionally, giving children options impacts their food acceptance. When children can choose what they want, they tend to eat more fruits and veggies (Mallard, personal communication, 2021). For example, children might not choose a whole cup of celery because they may only want one stick. However, when they have the choice in size and item types, they may choose more of them (Mallard, personal communication, 2021). As noted by the Director of Student Dining Services at Cincinnati Public Schools (Cincinnati, OH), empowering children with choice and variety by giving them build-your-own meal options (like salad bars) leads to them being willing to try more things (Shelly, personal communication, 2021).

Another strategy that might positively impact children's acceptance of more sustainable and healthy food options is creating alternative versions of popular and familiar dishes by replacing the meat component with analogs or plant-based items. Some consumers might consider these replacements unfamiliar. However, according to a study on the effect of expectations on the acceptance of unfamiliar foods, the acceptance of an unfamiliar food was influenced by how it relates to familiar foods from an individual's diet. Therefore, it can be assumed that integrating unfamiliar items in familiar recipes might lead to increased acceptance of these items (Elzerman et al., 2011).

Furthermore, findings on language use to help restaurants and the food industry boost sales of plant-rich menu items might apply to school menus as well. For instance, using the words "meat-free" to describe plant-based items in a menu may not be appealing because highlighting that something is missing from a dish can evoke people's aversion to loss. A

specific example is when the U.K.'s second largest retailer tested several names to describe a vegetarian sausage by characterizing each name with different sales amounts. The most successful dish, called "meat-free" sausage, increased sales by 76% (Wise & Vennard, 2019).

Using "vegan" in describing meal options also negatively affects a meal preference due to its political and social identity connotations: a U.S. study found that of 21 different labels used to describe food and beverages, "vegan" was considered the least appealing of all the options (Wise & Vennard, 2019). The adjective "vegetarian" also drives consumers away from selecting a specific food as some people might perceive it nutritionally unbalanced, boring, bland, and not tasty enough. A study shows that meat-eaters are 56% percent less likely to select a plant-based dish at a restaurant if its name contains the word "vegetarian" (Wise & Vennard, 2019).

However, language can also help drive people's preference towards plant-based meal options. For instance, leveraging a food's provenance, such as geographic location or natural environment where it is grown, is a powerful tactic to create positive associations with a product. For example, when Sainsbury in the United Kingdom changed the name of "Meat-free Breakfast" to "Field Grown Breakfast," sales grew by 17% (Wise & Vennard, 2019). Another strategy involves including flavorsome ingredients, flavor-enhancing cooking methods, or an interesting combination of flavors in a dish name to communicate an attractive flavor profile and get people's mouths watering. A study from Stanford showed that dish labels such as "Rich Buttery Roasted Sweet Corn" and "Zesty Ginger Turmeric Sweet Potatoes" were selected by diners 41% more often compared to identically prepared dishes with healthy labels, and 25% more often than those with standard labels (Wise & Vennard, 2019). When labeling a dish, emphasizing culinary qualities that make that dish delicious and distinctive, such as flavor, appearance, and mouth-feel, can also alter consumers' preferences. Specifically, color is the single biggest cue people use to set their expectations of what a dish might taste like (Wise & Vennard, 2019), and it is also an important component that sets plant-based meals apart from meat-based meals. Therefore, school directors might achieve an increased selection of a dish by incorporating terms like "creamy," "warming," "crunchy," "smooth," and "sticky" in the dish name (Wise & Vennard, 2019). While research on this topic has not specifically targeted school students, its findings can have powerful consequences in driving children's preference towards plant-based food options.

Finally, cultural background also plays an important role in children's acceptance of healthier, plant-based foods. Studies show that culture is one of the main factors determining an individual's overall attitude toward foods (Jeong & Lee, 2021). Food is deeply linked to the history and culture of people across the world, and vegan farming and cooking are one of the most widely distributed traditions internationally. Jessica Shelly, Director of Student Dining Services from Cincinnati Public Schools (Cincinnati, OH), understood that plant-based meals are accepted differently in various schools from her school district, depending on children's cultural background. Therefore, she introduced optional spices that allow children to customize their plain vegetable dishes to their different cultural backgrounds and taste. She found this strategy

effective in increasing the acceptance of plant-based meal options (Shelly, personal communication, 2021). Her intuition is confirmed by several studies showing that seasonings or sauces with familiar flavors have been shown to increase individuals' liking and the willingness-to-try unfamiliar foods (Elzerman et al., 2011).

Food is deeply linked to the history and culture of people worldwide. Food crop-based agriculture and plant-based cooking are among the most widely distributed traditions across the globe. Trinidad, the activist and Executive Director at Chilis on Wheels New York, outlined the large successes her work has had in convincing students to move towards more plant-based diets by educating them on the importance of food in their cultural history (personal communication, 2021). An example that she gave was that Africans were initially enslaved and transported to the Americas by Europeans for their extensive agricultural skills and knowledge (Trinidad, personal communication, 2021). Unfortunately, many Americans are unaware of this part of history which can help Afro-descendant children feel more connected to their roots (Trinidad, personal communication, 2021).

8. The potential impact on society of making school menus more equitable

Equity issues related to school meals

There are several equity issues related to school meals in the United States. For instance, the promotion of dairy consumption raises racial equity concerns. Many ethnic groups have high rates of lactose intolerance. In the United States, 95% of Asian Americans, 50–80% of Latin Americans, 60–80% of African Americans, and all Native Americans are estimated to be lactose intolerant (Better Food Foundation, n.d.). However, cow milk consumption is actively promoted by the USDA, despite estimates showing how large demographics of children in the United States are lactose intolerant, especially children of color (Better Food Foundation, n.d.).

The prevalence of meat and dairy consumption in school meals represents another equity issue related to school meals, as it does not account for cultural and religious differences. Incorporating culturally vegetarian food options in schools would acknowledge and appreciate the experiences, traditions, and diverse preferences of different groups of people who are not comfortable with "American" food.

Equity issues related to the food system

Inequities are spread systematically throughout the food system in the United States. In the agriculture and food industries, there are significant racial/ethnic disparities when it comes to representation, land, and money. Farmland ownership and management remain an overwhelmingly White profession, while farm labor is heavily non-White/Hispanic and exploited (Farmworker Justice, 2019). According to a National Agricultural Workers Survey, 78% of

workers are foreign-born and crossed a border to get here (National Farm Worker Ministry, n.d.). Farmworkers are mostly from poor socioeconomic backgrounds and subsequently "have the lowest annual family incomes of any U.S wage and salary workers" (National Farm Worker Ministry, 2019). 83% of farmworkers identify as Latino/Hispanic, 6% identify as indigenous (Farmworker Justice, 2019). Moreover, Black and brown peoples have historically been denied ownership of land. Denial of ownership and dispossession has prevented such communities from growing and accessing healthy food. Local food movement advocates argue that increasing urban agriculture initiatives in underserved communities can reduce food insecurity and provide individuals with access to land (Gazillo, 2017). Therefore, community gardens and local farms are a way to encourage ownership and control the food and economics in underserved areas.

Additionally, local small-scale farmers cannot compete with the massive volume, low market prices, and government subsidies enjoyed by larger farmers. Therefore, by increasing the amount of locally sourced produce in school menus, schools have the opportunity to contribute to lifting underserved communities from poverty and creating a new food economy sensitive to environmental justice, labor rights, immigration rights, food justice, climate justice, and human rights.

Food-supply systems' resiliency

Uncertainty in food production is common, and the risks are high. When considering the unpredictability of food supplies, communities that emphasize local sourcing face less disruption to shocks than those reliant only on long or global supply chains. One of the reasons this creates greater resiliency in communities is because highly concentrated supply chains controlled by global companies tend not to be motivated by the public interest. Moreover, local farms tend to be motivated by the public interest versus large, corporate-owned ones, and thus may better support communities (Lilliston, 2021). For instance, the control of the U.S. food supply by corporations became evident during the pandemic, as these companies expanded their global exports while warning of shortages in U.S. food supplies (Lilliston, 2021).

Another reason why local sourcing can be considered more resilient is that a decentralized system with locally-owned farms helps create a food-supply system based on redundancy (Lilliston, 2021). For instance, if one food supplier fails in the event of a market shock, many other alternatives would be available to provide food to communities. However, in areas with a large-scale, centralized food supplier, there would be no alternative to it in case of failure, leaving entire communities at risk of being food deprived (MacFall et al., 2015).

Lastly, local and regional food systems can be characterized as more flexible and connected to the communities that they serve because of the short supply chain of local markets. Shorter supply chains enable producers to develop direct, personal relationships with their buyers and collaborators. In the case of market disruptions, these relationships allow local producers to pivot quickly and with a targeted approach and rely on community networks for necessary inputs

such as finding labor, reaching out to new buyers, and escalating promotional activities through word-of-mouth (Thilmany et al., 2021).

Local farming also provides resilience to local economies by using geographically-linked, skilled jobs created by farming activities. In the large-scale food systems, where food is grown far away from consumers and aggregated by centralized corporations, these job opportunities are not available locally. On the other hand, increasing non-transferable, geographically-dependent jobs improve the resilience of the local economy (MacFall et al., 2015).

Areas with limited food access

As discussed by Sophia Rose, Farmer Programs Coordinator at the New Mexico Farmers' Marketing Association, local farmers and community or school gardens represent a direct line of food to vulnerable communities in moments of need (personal communication, 2021), which is particularly relevant in the case of areas with limited food access. In the United States, 5.6% of the population lives in an area affected by food apartheid (USDA Economic Research Service, 2021a). More concretely, this means that a significant number of families live in a community where more than 20% of the inhabitants live below the poverty line and further than 1 mile from a supermarket in an urban area or more than 20 miles in a rural setting (USDA Economic Research Service, 2021a).

Factors that drive communities to become areas with limited food access include a lack of transportation opportunities, vacant buildings, and low-density urban development (Hamidi, 2020). Denser areas have a lower chance of becoming a place with limited food access as walkability increases mobility and allows community members without access to a private vehicle to reach stores more easily (Hamidi, 2020). In response to this issue, new zoning laws could limit access to fast foods while allowing stores with healthier food options and groceries to settle in affected neighborhoods (Cooksey-Stowers et al., 2017).

Another study in the *International Journal of Environmental Research and Public Health* highlights how areas with limited food access disproportionately affect non-Hispanic, Black residents (Cooksey Stowers et al., 2020). The racial disparity in access to healthy food often ties into other structural problems concerning access to transportation, green spaces, and public safety, which exaggerate the effects of developing areas with limited food access (Karpyn et al., 2020).

9. The benefits of Farm to School programs and local food sourcing

According to the National FTS network, FTS programs have many benefits, such as furthering local economic development, improving overall public health, providing additional educational opportunities to students, maintaining a healthy environment, and fostering greater

equity and community engagement (2020). In order to measure just how beneficial FTS programs are, researchers performed a meta-analysis of 119 peer-reviewed studies over a span of 20 years (eeWORKS et al., n.d.). The review found clear evidence that FTS programs were beneficial and have led to numerous examples of positive impacts, such as improvement in academic performance, emotional and social skills, demonstration of environmentally conscious behavior, motivation and enthusiasm toward learning, and civic interest and engagement (eeWORKS et al., n.d.). According to the eeWORKS, a program of NAAEE, Stanford University, and other partners, the meta-analysis results of environmental education resulted in 98% knowledge gain, 90% increased skills, 86% positive change, and 83% enhanced environmentally-related behaviors (n.d.).

Public health benefits of Farm to School programs and local food sourcing

Another of the key benefits of FTS programs is their ability to increase student health and knowledge surrounding healthy foods, which positively impacts public health. Currently, childhood obesity is a serious public health issue in the United States, affecting 17% of K–12 children (Sanyaolu et al., 2019). There are many risk factors or comorbidities for childhood obesity, such as diet, lack of exercise, stress, location, psychological factors, and socioeconomic factors. However, research has shown that having a low socioeconomic status, resulting in marginalization and discrimination, is arguably one of the strongest predictors for developing obesity because there is more exposure to family dysfunction and stress (Hemmingsson, 2018). Furthermore, individuals living in low-income communities of color often have limited access to fresh and healthy foods because of the distance from healthy food sources or financial means.

According to the USDA Economic Research Service:

> Of all U.S. households, 2.3 million, or 2.2 percent, live more than a mile from a supermarket and do not have access to a vehicle. An additional 3.4 million households, or 3.2 percent of all households, live between one-half to 1 mile [from a supermarket] and do not have access to a vehicle. (2009)

This inadequate access, specifically for low-income communities of color, increases reliance on convenience stores and fast-food restaurants, creating a nutritional deficit.

The most significant prevention strategies for obesity are raising public awareness, increasing physical activity, and improving diet through the integration of fruits and vegetables (Moss et al., 2013). Fruits and vegetables are an essential part of an individual's diet, as they provide antioxidants, fiber, minerals, and vitamins (Moss et al., 2013). Research indicates that FTS programs increase the consumption of fruits and vegetables, which in turn minimizes the

risk of childhood obesity, especially for low-income students of color located in areas with limited food access (National FTS Network, 2020).

Furthermore, 76.9% of all NSLP meals were served free or at a reduced price in SY2020 (USDA Economic Research Service, 2021b). Children from food-insecure households are more reliant on the program and receive more food and nutrient intake from school meals than other children, which further highlights the significance of providing free and sustainable healthy school meals.

Mental health benefits of Farm to School programs and local food sourcing

Activities related to nature, such as gardening, which are sometimes incorporated into FTS programs, also greatly benefit people's health and well-being (Maller, 2009). According to the National Institutes of Health, the presence of childhood depression and anxiety rose 20% since 2015, resulting in 1 in 3 of all adolescents experiencing anxiety or depression, especially from ages 13 to 18 (McCarthy, 2019). Many risk factors are connected to mental health struggles, such as poor nutrition, lack of sleep, lack of exercise, stress, psychological factors, and socioeconomic factors. While there are many preventative measures to avoid poor mental health, evidence has indicated a relationship between lack of contact with nature and its effect on physical and psychological health (Kruize et al., 2019; Lee & Maheswaran, 2011). For instance, research has shown that natural environments improve cognition, alleviate the effects of depression, reduce stress, improve self-esteem, encourage imagination and creativity, and strengthen social relationships (Maller, 2009).

FTS activities, such as school gardens, can positively impact a child's well-being. For instance, physical activity involved in FTS programs can improve mental health by reducing anxiety and depression, self-esteem, and cognitive functioning (Kruize et al., 2019; Lee & Maheswaran, 2011; Pretty et al., 2005). It can also improve physical health by reducing the risk of developing diabetes, cancer, and cardiovascular disease (Pretty et al., 2005). Children's wellbeing might also improve thanks to the contact with nature, sunlight, and fresh air in FTS activities. On one hand, it influences children's physical and psychological health by providing a place for them to socialize and maintain social ties (Lee & Maheswaran, 2011). On the other hand, contact with nature can reduce stress hormones in children by physiologically lowering their blood pressure (Berezowitz et al., 2015).

Academic performance benefits of Farm to School programs and local food sourcing

Another of the key benefits of FTS programs is their ability to enhance overall academic performance, as shown through a study that compared schools that integrated FTS initiatives to those that did not. Since healthier school meals improve nutrient intake, they can have a positive effect on cognition and therefore, result in higher academic scores. The researchers found that enthusiasm for learning, attendance, levels of concentration, and standardized test scores and

grade point averages were higher in 92% of schools that implemented FTS programs compared to schools that did not (Blair, 2009).

In a study performed by the Nutrition Policy Institute, experts investigated the extent to which nutrition impacts students' academic performance over five years. The study looked at test results from the California Standardized Testing and Reporting exam, which is a state-wide exam given to all public school students in grades 2–11. Data from 9,700 elementary, middle, and high schools were retrieved and analyzed over the course of the study. It was determined that there was a clear correlation between healthy school meals and academic achievement. Overall, schools using healthy meal vendors saw a statistically significant increase in academic achievement (Anderson, 2017). This suggests that proper nutrition leads to improved academic success.

Additionally, if FTS programs integrate outdoor learning into their programs, there can be significant cognitive benefits through the reduction of stress. For instance, FTS programs that integrate nature into their curriculum, such as by implementing school gardens, give students access to fresh air, which is vital for optimal functioning of the nerve cells involved in cognitive processes (Smeds et al., 2015). When students are outdoors, their oxygen levels are much higher than in a classroom. One research study showed that carbon dioxide (CO_2) concentration outdoors was 350 parts per million (ppm), compared to classrooms with insufficient ventilation having levels as high as 3,000 ppm CO_2 (Smeds et al., 2015). These high CO_2 levels from inside a classroom are associated with cognitive fog and drowsiness, impairing academic performance (Smeds et al., 2015). This work suggests that children who spend more school time outdoors do not experience the negative effects of excessive levels of CO_2, making them an ideal setting for learning where conditions allow.

Economy/Community benefits of Farm to School programs and local food sourcing

FTS programs allow students and their surrounding communities to learn and develop new attitudes towards local foods and vegetable consumption. This process, which is derived from the social learning theory developed by Albert Bandura, is described as the individual knowledge acquired through direct observation or experience of others' behaviors (1965). This theory heavily emphasizes the importance of modeling behaviors in the learning process (Bandura, 1965). Social modeling is a compelling method in education and can be applicable in reconnecting communities with their food, food production, and food producers. For example, as seen above, FTS programs increase the consumption of fruits and vegetables in children (National Farm to School Network, 2020). Social learning may occur amongst the parents of the students in the program through watching their children develop healthier eating habits, creating a rippling effect of better eating habits in families.

Another benefit of programs is their ability to contribute to local economies. Numerous studies have suggested that food grown and consumed locally creates more economic activity in

an area than comparable food produced and imported from a non-local source (Becot et al., 2017; Dunning, 2011). As programs increase communities' awareness about sustainable food systems, local economies benefit from the increased investment and interest in locally grown produce (Edoka, 2017). Furthermore, with increased revenue in the community, farmers and community members are able to reinvest more money back into the community, which ensures that dollars remain and circulate locally (Becot et al., 2017). Additionally, when food is grown, processed, and distributed locally, it creates and sustains community-based jobs (Edoka, 2017). According to the National Farm to School Network, for every job created by school districts purchasing local foods, additional economic activity creates another 1.67 jobs (2020).

10. Challenges and opportunities of potential collaborations between community and local farming programs with school districts

Kitchen equipment upgrades and lack of staff

Cost is a common barrier that has impeded schools from serving local, cooked-from-scratch, healthy food options to students. The high initial upfront investment in equipment, infrastructure, training, transportation, and other fees has also led to slow progress in creating plant-based, more sustainable food menus.

Certain school districts cannot afford to pay for the necessary upgrades to infrastructure and equipment that are needed to prepare cooked-from-scratch food options for students, as required to turn fresh produce into healthy and sustainable plant-based meals. In 2013, the Kids' Safe and Healthful Foods Project released a report entitled *Serving Healthy School Meals*, which outlined the necessary equipment and infrastructure upgrades in K–12 schools across the United States. All data collected in the report was retrieved from the USDA database pertaining to schools participating in the NSLP. Approximately 3,372 SFAs responded to the survey used in the report, which is over half of those taking part in the NSLP (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013). According to the survey, the majority of schools rely on existing infrastructure and equipment that has far exceeded its life, and 85% of the SFAs reported to be utilizing inefficient equipment (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013).

A significant finding within the research conducted by the Kids' Safe and Healthful Foods Project was that 88% of SFAs were in need of at least one new piece of kitchen equipment, and nearly 60% were in need of electrical upgrades (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013). According to the survey, the most commonly needed equipment were utility carts, serving utensils, sets of knives with cutting boards, and large-capacity food processors (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013).

Figure 9

Top Five Pieces of Equipment Needed in School Kitchen by SFA Size

Equipment	Percentage of SFAs					All SFAs	Estimated unit cost (dollars)
	Very small (Fewer than 1,000 students)	Small (1,000-2,499 students)	Medium (2,500-9,999 students)	Large (10,000-24,999 students)	Very large (25,000 or more students)		
Utility cart	38.7*	44.4	48.5*	55.6*	50.3*	43.1	490
Serving portion utensils	38.9*	41.9	46.0*	50.7*	51.6*	41.9	32
Sets of knives with cutting boards	39.7	43.6	42.6	45.3	45.6	41.6	530
Large-capacity food processor	34.1*	45.1*	46.0*	48.1*	35.9	39.8	1,941
Industrial scale	35.4*	38.3	48.8*	44.4	34.5*	39.3	848
Walk-in refrigerator	30.2*	42.6	49.2*	63.3*	56.1*	39.1	29,056
Walk-in freezer	27.8*	40.8*	46.1*	55.9*	51.7*	36.4	31,500
Salad or fruit/vegetable bar (free standing, self serve)	30.9*	43.3*	36.4	32.8	33.8	35.0	10,829
Software program	38.6*	28.0*	29.9	27.2*	21.2*	33.5	750
Reach-in refrigerator	22.5*	28.0	37.0*	49.6*	50.5*	28.7	6,117
Number of SFAs (unweighted)†	1,021	1,327	496	344	184	3,372	
Number of SFAs (weighted)†	6,855	5,009	991	645	313	13,813	

Note. Figure 9 is from *Serving Healthy School Meals* by The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013.

Lack of storage capacity was also the most common problem within school kitchens, with SFAs reporting about manually slicing fruits and vegetables, using coolers to keep dairy products, and transporting produce daily because of the lack of storage space (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013).

"Making do" with inefficient equipment and lack of infrastructure can be detrimental to schools in the long run. Inefficient, outdated equipment can become increasingly expensive to run and repair, while investments made to modernize school kitchens may lead to yearly energy, maintenance, and labor savings. As stated by Mary Rochelle, the School Food Project Events and Food Procurement Coordinator at Boulder Valley School District (Boulder, CO), "upfront investment in efficient kitchen equipment can significantly increase production speed and lead to high savings in labor and energy costs" (personal communication, 2021).

In terms of being able to afford infrastructure upgrades, nearly 42% of SFAs reported having a kitchen budget, yet only half of those SFAs considered their budget to be sufficient enough to meet the needs of the schools (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013). Around 33% of all SFAs that responded to the survey did not know whether they even had a budget set aside for kitchen needs, and approximately 38% of them did not know whether their regional educational agency had the financial resources to provide schools for kitchen related upgrades (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013).

The federal government has been responsible for funding school kitchens since the NSLP was founded in the 1940s; however, it was not until 2009 that the USDA began providing financial support for kitchen upgrades. As a result of the American Recovery and Reinvestment Act of 2010, the USDA gave $125 million to SFAs across the country in order to help replace existing equipment and infrastructure that were failing to meet standards (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013). Unfortunately, the funding that has been offered to schools does not come close to the amount requested by school districts ($630 million annually) (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2013). While the requested amount of funding sounds like a lot, the need far exceeds it. For instance, as of 2014, Wisconsin alone required an estimated $97.5 million worth of food service equipment upgrades, and New York state required an estimated $204.5 million (The Pew Charitable Trusts & Robert Wood Johnson Foundation, 2014).

In the case of schools in need of equipment upgrades, Emily Gallivan, Director of Programs at the Chef Ann Foundation, suggested that salad bars can be an easy way to engage schools lacking equipment to serve more plant-based food. Salad bars are the “low-hanging fruit” for schools that do not have the equipment, the staff, or the funds to prepare more elaborate types of plant-based meal options (Gallivan, personal communication, 2021).

Another challenge in implementing sustainable school meals is represented by the lack of adequate staffing. Schools may not have the capacity to pay for skilled personnel to work in the cafeterias, nor can they afford the training costs associated with hiring new employees. The School District of Beloit (Beloit, WI) identified a solution to this issue. This school district outsources the cutting of their fruits and vegetables to a specialized facility that cuts the produce to the desired size (Smith, personal communication, 2021). By doing that, they can still use fresh fruits and vegetables that are cut exactly the way they are needed for cooking, while saving the costs of labor and training (Smith, personal communication, 2021).

Relationship with local farmers and food hubs

Another challenge for school districts participating in programs is managing farmers’ fresh produce for their school menus. As emerged from interviews, some school districts buy directly from farmers, giving them the opportunity to get to know local producers and create a

sense of community personally. Purchasing produce directly from farmers eliminates the cost of a third-party acting as a mediator within the transaction. On the other hand, single farmers might not be able to meet the demand of some school districts requiring too much volume of fresh produce. In that case, school districts might purchase local fresh produce through a "food hub," a distributor that collects produce from multiple farmers and sells it to school districts. As claimed by the USDA, 81% of food hubs focus on increasing opportunities for local farms and allow small-scale producers to pool their products and fulfill contracts requiring a large volume of produce (Neal, 2017).

Furthermore, 91% of food hubs are located near cities, and therefore, become the connection point between rural farmers and urban communities (Neal, 2017). Food hubs also have the potential to address equity issues associated with the current food system. According to a 2019 survey, 54% of food hub management positions are held by women, and 14% are held by people of color (Bielaczyc et al., 2020). Additionally, according to the survey, Pre-K food service represents the second largest market for hubs to reach low-income customers with 50% of total sales, while K–12 schools is the fourth largest market with 42% of total sales (Bielaczyc et al., 2020).

According to Karen Spangler, Policy Director at the National Farm to School Network, having a centralized "hub" for small farmers can make the program more equitable if the hub has the relationships and expertise to serve Black, Indigenous, and People of Color (BIPOC) producers. That would open opportunities for marginalized farmers that would not otherwise be able to reach the volume of produce needed for school districts. In recommending scaled-up investment in food hubs and local food infrastructure, it will be important to channel resources toward organizations that have been working with BIPOC communities to reach a more equitable outcome. Additionally, she claims that food hubs take the burden of managing different sources of fresh produce for school districts (personal communication, 2021).

Developing and maintaining direct face-to-face relationships with local farmers is extremely demanding and time-consuming for food procurement managers, leading them to favor "one-stop-shops," "offering competitive prices, financial incentives, streamlined services, and convenience of having food and non-food items" (Izumi et al., 2009). Furthermore, building new relationships with farmers has posed a challenge, especially during the pandemic (Wiggins, personal communication, 2021). Therefore, food hubs make the program accessible to under-funded schools that might not have the management capabilities needed to take advantage of the program (Spangler, personal communication, 2021). A study also outlined that working with regional distributors allows the "increase in scale and scope of local food procurement," with around 70–95% of all foods purchased directly from local farms (Izumi et al., 2010).

Sophia, Farmer Programs Coordinator at the New Mexico Farmers' Marketing Association, also stressed the role of food hubs in relation to the New Mexico Grown ASP, and how they act as hubs for not only food but centralizing management, marketing, and training services for small scale farmers. Small farmers who lack the resources to integrate these services

into their own business would be able to focus on farming (Rose, personal communication, 2021).

According to a 2019 survey, sales from school hubs to K–12 schools show growth and 55% of the school hubs in the survey expressed interest in increasing school sales, but they experience some challenges in pursuing that specific market. The top barriers for food hubs to expand into the K–12 School food service are represented by, in order of importance, struggling to meet buyer pricing requirements, seasonality of fruits and vegetables, and meeting product volume needs (Bielaczyc et al., 2020). In that context, the USDA has intervened to support food hubs by publishing a series of resources such as the *Regional Food Hub Resource Guide* in 2012 and the financial guide *Running a Food Hub: Assessing Financial Viability* in 2016, and by creating an online Food Hub Directory. Furthermore, in 2021 USDA announced the availability of $76.9 million to the Farmers Market and Local Food Promotion Program, a competitive grants program supporting indirect-to-consumer markets like food hubs through the economic crisis caused by the COVID-19 pandemic (USDA Press, 2021).

Produce seasonality

In addition to obstacles that might arise from working with small farmers, certain school districts around the country experience large barriers in food procurement, which can be predominantly caused by seasonal changes in climate. Jamie Humphrey, who is an administrative dietitian at Colorado Springs School District (Colorado), voiced her concerns regarding school food procurement in her region, which experiences long winters. In an interview with Humphrey, she mentioned:

> Unfortunately, in Colorado, our growing season is significantly shorter compared to more mild climates, such as you see in California. The majority of local produce is harvested in the fall season, which occurs over a four-month period. We do what we can when we are able to, but the seasonality of the climate in Colorado greatly limits our ability to provide local produce year-round. (personal communication, 2021)

Humphrey further suggested that the seasonal changes in climate can also influence the relationship between farms and schools, due to concerns of meeting school demands (personal communication, 2021). Depending on the season and regional variations in weather, farms may not always be able to meet the continuous demands of schools.

Due to the time and budgetary constraints of school districts regarding food procurement, the shift from sourcing with large distributors to local farms can be extremely costly and can also lead to inconsistency and increased risks of instability. "Local Fresh!", a regional distributor outlined in a study, distributed local produce to the Goosefoot Central School District, stating that the major barriers to complete integration of programs is the seasonality and profitability of

the program (Izumi et al., 2010). Regional distributors require certain levels of benefit from their operations, which can lead to rising prices of the products procured by school districts, and the variability of availability of food during winter and spring months. Studies conducted by the Iowa State University outlined that limited awareness of what is available locally also plays a large role in the lack of local sourcing in food procurement (Berkenkamp, 2006).

Since agricultural production cycles differ based on climate and geography, the lack of synchrony between school academic calendars and varying produce availability in North America limits local farm purchasing options for U.S. schools. With the exception of apples, winter fruits and vegetables are not typically purchased in school cafeterias due to the lack of perceived demand (Izumi et al., 2010). For instance, an article in *Agriculture and Human Values* noted that fresh vegetables available during the winter season, such as winter squash and root vegetables, were not currently included in the school menus also due to the excess labor and equipment costs to food preparation (Izumi et al., 2010). Though sourcing from indoor and vertical farming is a viable option when produce availability is scarce, there are concerns with high upfront costs, high energy intensity, and quantity. For instance, container farms from Freight Farms, a Boston-based agriculture firm that developed vertical farming in shipping containers, cost up to $85,000 per container, and use 80 kilowatt-hours of electricity a day, which translates to emitting 20 tCO_2 per container per year from electricity alone (Foley, 2018).

Despite these challenges, school districts with access to existing, established indoor farms can cooperate with them for year-round fresh produce. However, for those that do not, expanding their menu, utilizing seasonal vegetables, and training their staff on how to cook them would be the most cost-effective and efficient way to overcome issues regarding produce seasonality.

Budgetary constraints

Budgetary constraints have always been the main barrier for schools to transition to local food procurement, programs, and more sustainable school meals. Research shows that school food services must often be "self-supporting" to cover expenses not only with food procurement and labor, but also equipment, costs of utilities, trash removal, rent, and building maintenance (Izumi et al., 2009). While schools can use additional funding from programs such as the DoD-Fresh, designed to subsidize schools with purchasing fresh produce, unfortunately not all schools apply for the program. Additionally, "schools can use 100% of their entitlement dollars to purchase non-produce commodity foods," meaning that there are no actual restrictions on what the funds can be used for. Therefore, schools may choose to continue to buy from commodity food vendors out of convenience, especially if items such as frozen meat or produce are less expensive than what is offered in the market (Izumi et al., 2009). One school district nutritionist disclosed that the budgetary constraint is the key barrier that even prohibits them from making any changes within their system, and that they have no choice but to use large food distributors with pre-packaged, less healthy meals (Anonymous, personal communication, 2021).

According to Tina Byrd, Food Service Director at Jasper School District (Jasper, AR), while locally-purchased food might be of better quality than commodity food, commodity food is given to schools at a much lower cost or at no cost (personal communication, 2021). Therefore, USDA commodity food represents unfair competition to fresh, locally-sourced food as "it is hard to compete with free food" (Byrd, personal communication, 2021).

Additionally, research has shown that the existing federal commodity programs disproportionately benefit the large-scale growers, who also have the production advantage with larger economies of scale and more available assets and established infrastructures for transportation and manufacturing of the produce (Allen et al., 2005). However, there are opportunities in which regional distributors can be used to counteract issues with distribution, transportation, costs, and instability regarding direct programs.

Additionally, interviews with school districts gave this project insight into whether purchasing from local farms is more expensive than purchasing food from large-scale food suppliers. There were significant disagreements on whether that was the case, but several school districts mentioned how seasonality and product demand is a key determinant of the cost of the produce coming from local farms. Moreover, some farms prefer to sell their produce to whoever is willing to provide the highest offer, which is understandable considering that profit margins are notoriously poor for U.S. farmers.

Restaurants and hotels usually have more purchasing power than schools and can pay local farms more. Thus, schools are limited in their ability to purchase locally-grown foods when competing against private companies in the open market.

Centralized kitchens

A school district-based centralized kitchen is a structuralized system that can potentially be the solution to all the problems mentioned previously in the report, such as lack of funding and high operation costs. A centralized kitchen is a facility that consolidates the processing, cooking and distribution of school meals for multiple individual schools within a school district. Once meals are cooked and prepared at the centralized kitchen, they are then transported to individual schools, where kitchen staff will portion, reheat, and serve the prepared food (FIG, 2018).

An amalgamated facility can increase the preparation efficiency and the economic feasibility of school meals by allowing the site to have higher purchasing power, negotiate produce costs, and concentrate transport infrastructure. Rather than having individual schools purchasing small quantities from different local farmers, a centralized kitchen can foster relationships with farmers and order larger quantities of produce as needed for the entire school district, gaining comparative economies of scale. By working with a centralized kitchen, individual schools would not have to bear the costs of equipment updates required for on-site scratch cooking and storing fresh produce. Moreover, they would no longer be required to bear

staff training costs related to scratch cooking techniques and menu upgrades, since all preparation and cooking would be performed in advance at a centralized kitchen facility.

Centralized school kitchen facilities have become more popular among school districts in the United States. For instance, the Boulder Valley School District (Boulder, CO) has built a $16.3 million centralized kitchen with the support of taxpayer dollars. This facility has revolutionized the way in which food is produced and distributed to schools in the district. Mary Rochelle, The School Food Project Events and Grants Coordinator at Boulder Valley School District, expressed her support for the new facility in an interview:

> The new central production facility has drastically increased scratch cooking abilities across our district and has shown significant labor savings, since days' worth of production has been condensed into hours' worth of work. Additionally, food storage within the new facility has increased food safety across the district; we are able to keep ingredients for longer periods of time, due to the contained temperature system of the building. (personal communication, 2021)

While there are several benefits associated with centralized kitchens, the high upfront investment is the main barrier to their widespread adaptation. The Food Insight Group's feasibility study on a centralized kitchen for the Durham Public School District shows that a $12–13 million capital investment is required to build a 30,000 square foot-facility with a centralized kitchen, a food storage facility, an incubator, training classroom for students, a car park, and a loading dock for food transportation (Food Insight Group, 2021). Another example is the Sacramento City Unified School District's centralized kitchen project, with an estimated cost of over $30 million (Nutrition Services, SCUSD, 2012), while the Oakland Unified School District's estimated cost was over $70 million (OUSD, 2019). The cost disparity between school kitchen investments may be due to factors such as the age of the school (older infrastructure tends to be more expensive to renovate) and student population size (more space and equipment is needed when cooking in-house for large numbers of students).

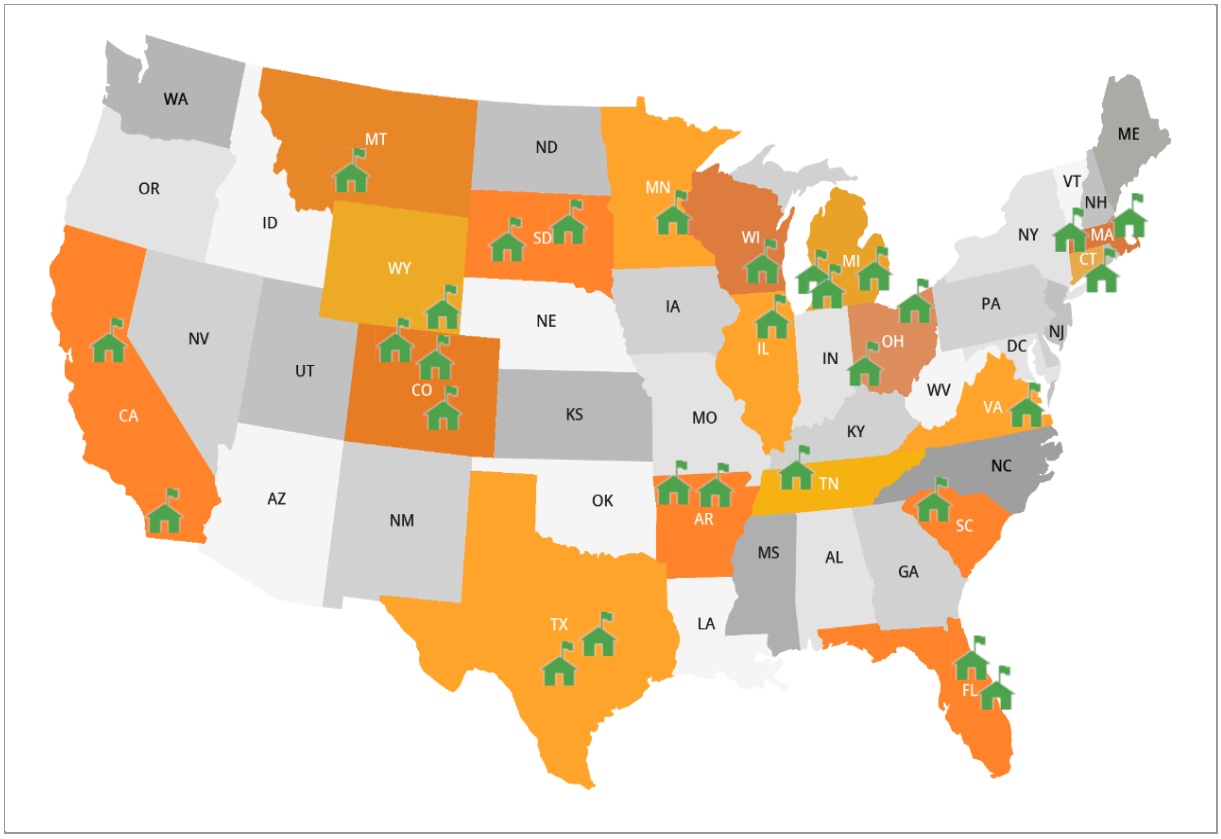
PART 2 - Hard Data Collection and Case Studies

1. Data collected from interviewed schools and school districts

For this report, respondents were several individual schools, school districts, and one program that operates in various states/districts/schools. Answers were collected from thirty-one respondents around the country and across different demographics. Respondents were interviewed about the challenges and opportunities of implementing sustainable, plant-based school lunches. The research team spoke mostly with food service and nutrition directors, as well as dieticians, chefs, and sustainability experts.

Figure 10

Map of schools and school districts in the United States from which data was collected



Note. Figure 10 was created by the authors of this report using the generalized geographic locations of schools/districts that were interviewed or from which data was obtained, 2021.

Statistically significant results are those in which researchers have confidence that the findings are not due to chance. From analyzing the data, the following sample size formula was

used to determine the statistical significance relative to a confidence interval based from population size:

$$\text{Sample size} = \frac{\frac{z^2 * p\,(1-p)}{e^2}}{1 + \frac{z^2 * p\,(1-p)}{e^2 N}}$$

"N" is the population size, and there are approximately 13,800 public school districts across America, so this is used as the population size (Bouchrika, 2021). "z" is the value from the standard normal distribution determining the confidence level that will be used, for a confidence level of 95%, z = 1.96. "e" is the desired margin of error and "p" is the proportion of success in the population. If there is no information to approximate "p," then p = 0.5 is used to generate the most conservative, or largest, sample size. The sample size from this data was 31 school respondents. From this information, the formula is populated as follows:

$$31 = \frac{\frac{(1.96)^2 * 0.5(1-0.5)}{e^2}}{1 + \frac{(1.96)^2 * 0.5\,(1-0.5)}{e^2 13{,}800}}$$

Rearranging the formula to solve for the confidence interval, e, will look as follows:

$$\text{e} = \sqrt{\frac{((1.96)^2(0.5)(1-0.5)) - \frac{(1.96)^2 * 0.5(1-0.5)}{13{,}800}}{31}} \approx 0.18$$

The sample size of 31 gave a margin of error value, e, of 18%. This means that there is a 95% confidence that the results are accurate within 18 percentage points.

The main findings of the interview process

- Almost every school or school district serves fresh vegetables every day. This finding is not surprising considering that schools need to serve a specified quantity of fruit and vegetables every day in order to receive the federal reimbursement for their meals. On average, only 21% of entrees proposed to students did not include meat, while 96% of sides were meatless.

- There were mixed responses as to whether students prefer meat or non-meat meal options. Twenty-one school respondents out of thirty-one said that children preferred meat meal choices. There were two reasons given for the children's preferences. First, if students often eat meat at home, they are more likely to choose meat in the cafeteria. Second, in lower-income districts, students gravitate towards meat. This finding hints at a link between meat preference and students' socio-economic status. For instance, Taylor Pirog, a nutritionist in the affluent area of Andover, Massachusetts, noted that the school responds to pressure from parents requesting the school to serve more organic, non-genetically modified organisms, and plant-based options. On the other hand, some school districts from low-income areas noted that parents pressured schools to serve meat with every meal option, as they did not consider a meatless meal nutritious enough for children. However, without more details and further information related to instances of schools reporting pressure from parents to serve animal meat, it is difficult to determine the primary causes of parental opposition to meatless meals.

- Four school districts (located in the Midwestern United States) out of thirty-one mentioned that parents openly opposed plant-based meal options. Only one school district indicated that parents were big supporters of plant-based meal options. However, it should be noted that the question about whether parents support plant-based meal options was not asked directly. Instead, respondents were asked about the greatest limitations to implementing plant-based meals in schools.

- That there was no consensus on whether vegetable food menu options were wasted more compared to meat food options. Without knowing what the students discarded, it became difficult to discern their preferences. However, there was a suggestion of some patterns in the responses that favored vegetarian options. Nine districts mentioned that students enjoy salads across several varieties: salad bars, composed salads, caesar salads, and kale caesar salads. Five schools mentioned broccoli and baby carrots, and four mentioned potatoes.

- Twenty-two school districts out of thirty-one mentioned a lack of skilled staff as one of the main factors limiting food choices, or as one of the factors that would greatly improve food quality. Only five school districts named additional funds as a component to improve food procurement and preparation.

- When asked about meat analogs, only eleven school districts confirmed that they have served them or that they currently serve them. The main reasons for not serving meat analogs are that they are perceived as "too processed" and more expensive than conventional animal meat. Nevertheless, "too processed" could not be defined as it regards meat analogs specifically or in comparison with other processed products

currently served in school meals (such as processed meat items). Three school districts mentioned that they had explored the option of serving tofu-based items, but that they were either not motivated to make the change, or that these items were extremely unpopular among children (the causes for these reasons given could not be determined based on the information and responses available for this report).

- Taste testing has a popular technique to entice students to consume unknown and healthier foods. In total, thirteen districts use the method regularly to introduce foods. Incorporating student opinions was also named as a strategy to reduce waste as dishes that students did not enjoy during the taste testing will not make it onto the menu. The strategy of taste testing was overall positively perceived.
- Fourteen school districts mentioned that they needed to upgrade their cafeterias and purchase better equipment to cook food from scratch. This information highlights the unpreparedness of many schools to cook fresh produce and prepare plant-based meals.
- Finally, local food sourcing for lunch menus varied by district, with some schools sourcing 0% and others 95%. Most schools agreed the percentage changed based on seasonality, as well as the volume of product availability. School districts in Florida, Massachusetts, Wisconsin, Colorado sourced 30% or more of their food products locally.

All in all, most school districts showed the willingness to integrate new food sourcing and preparation practices to facilitate students' eating habits and wishes. While the approaches and motivations behind actions differed significantly, the wish to provide students with better meals and challenges such as staffing and equipment shortages could be widely echoed. Three districts stood out for their commitment and creativity to integrate more sustainable and culturally-inclusive meal practices into the meal programs. These case studies are highlighted in the next section of the report.

2. Selected case studies

The case studies below were selected because of their unique solutions to tackling issues related to the creation of sustainable lunch menus. The three case studies listed below are examples of school districts successfully incorporating sustainable lunch options within their menus; these case studies have the ability to inspire other school districts across the country. All three represent lower-income communities that lack necessary budgets, parental influence, or previously established school lunch programs. Despite the lack of investment in establishing sustainable lunch menus, each case study represents the material impact of food service directors' resourcefulness and creativity, both with and without government grants.

Figure 11

Data from selected case studies collected during interviews

School district	**Beloit**	**Fennville**	**Richfield**
State	Wisconsin	Michigan	Minnesota
% of non-White students	47%	53%	72%
% of students eligible for free lunch	100%	76%	70%
Lunches served (daily)	10,000	525	800 - 900
% of non-meat entrees	17%	20%	10%
Most popular vegetable item on menu	Broccoli	Any potato-based dish	Black bean bowls, chana masala

Note. Figure 11 was created by the authors of this report on the basis of interview data collected from the selected school districts, 2021.

Fennville Public Schools, Fennville (MI)

Fennville Public Schools in the State of Michigan is an example of a district doing "more with less" when it comes to serving sustainable and nutritious meals. The district is located in a rural "meat-and-potato country," according to Food Service Director George Siedis, meaning most kids primarily eat meat at home and prefer meat-based meals in school as well.

Despite the perceived disadvantages of high-risk districts like Fennville, these districts have the opportunity to apply for and receive a variety of government grants. Fennville is currently receiving a grant as part of a pilot program in Michigan, which equates to an additional reimbursement of $0.10 per meal from the state for every meal served with a local fruit or vegetable. Approximately $21,000 of the school's annual $250,000 budget is used for local food procurement (8.4% vs. goal of 20% by 2020, which was delayed by the COVID-19 pandemic).

Siedis explained that a significant challenge to procuring food ingredients from local farmers is that they do not always want to sell to schools because they find selling their whole crop at one time to a food processor more convenient. Examples of local producers that Siedis would like to incorporate in their cafeteria's offering are a local coffee roaster, who can provide

caffeinated beverages at their high school, and a local resident who produces fresh apple cider, which could be served at the cafeterias of their elementary school.

Fennville Public Schools serve at least one local ingredient or produce every day, even though the selection tends to be influenced by seasonality. When school food cannot be sourced locally, Fennville prefers to buy from American producers and distributors. For instance, it is counter-intuitive that peaches from Michigan might get canned in China before they are returned to Michigan, and this is what Siedis tries to avoid. Milk is also sourced locally, and its purchase costs an additional $100,000, on top of Fennville's $250,000 budget.

Fennville Public Schools also receive a grant from the USDA to allocate commodity money towards unprocessed fruits and vegetables. Siedis noted that Fennville serves fresh vegetables daily, such as celery sticks, baby carrots, salads and grape tomatoes, but most other fruits and vegetables were previously frozen. Potato-based items including mashed potatoes and hash browns are typically the most popular option on Fennville's lunch menu. Everything is baked or air-fried.

In order to entice students to try new foods and shift from the preferred meat and potatoes, Siedis conducts taste testing using new and healthy foods that families in the district may not be able to afford, such as blueberries, papayas, and mangos. The school's kitchen uses a smoker to slow roast salmon and meat, which makes students curious about the food being prepared. The district also roasts vegetables, including onions, baby carrots, parsnips, radishes, using a similar method.

Fennville does not have a formal gardening program, which presents a challenge in the level of student involvement. However, the district has built a three-level hydroponic wall that grows herbs, sunflowers, lettuces, radishes and beans. Third grade students take trips to the local high school, where they plant basil seeds along the building walls. Once the plants are ready, students harvest the basil to make pesto, which is later used for cooking pesto pizzas. Siedis has also organized a trip for fourth grade students to go into the woods, identify trees to tap, and learn the process of collecting and processing syrup. Since the program has started, students have tapped eight trees for 90 gallons of sap, which made three gallons of maple syrup. Fennville's Food Service Department then hosted a pancake breakfast with the students' maple syrup. Students were proud and excited to explain the syrup-making process. Despite not having formalized gardening programs, Fennville has involved and integrated kids into the growing process of different ingredients and produce, and has educated its students on the importance of the local landscape. This hands-on education and learning style for horticulture and agriculture drives increased interest and support for local foods. The district also aims to leverage grants to build a greenhouse in order to grow and use more local food in school lunches.

Grants have also provided Fennville with the funds necessary for kitchen upgrades. Prior to Siedis' arrival, the kitchen was built to feed 500 kids, even though there were 700 at the time. Three combination ovens have been purchased and incorporated within Fennville's kitchen system. While this renovation was costly ($70,000, with an additional $10,000 being dedicated

to new tables on the patio for students to sit for lunch), the ovens have changed the nature of Fennville's lunch capabilities. Approximately 25% of meals are now cooked from scratch, with 45% being "speed scratch" meals, meaning they create items out of byproducts, some that (meals that have already been processed). Furthermore, the staff participates in 16-hour training programs annually, and the state also provides Food Service 101 and a refresher for any kitchen staff member who is interested.

Richfield Public Schools, Richfield (MN)

Richfield Public Schools is a district of Minnesota that stands out for its commitment to increase plant-based meal options and expand its offering of culturally-diverse meals. Approximately 70% of the children in the district live in poverty, and the district has a 72% minority enrollment. The push for change within the school food systems is driven by student involvement. Students have advocated for the signing of the Forward Food Pledge, a program created by the Humane Society of the United States, to encourage food providers in K–12 schools to commit to increasing the percentage of plant-based food offerings in their schools. Currently, 10% of lunch entrees are non-meat items, which will be expanded to 20% within the next three years. The push for the integration of more plant-based options is also reflected in students' eating patterns. Plant-based meal options are increasing in popularity, and waste levels are not higher for non-meat meals than for meat-heavy options. The school district has a student-led "green team" that has input on school menu changes. For instance, when the Director of Food and Nutrition Services wants to introduce meat analogs, these students are asked to try them first and propose how they would like to see them cooked or integrated into recipes. While meat analogs are quite expensive, the school district can afford them thanks to the savings gained from other plant-based dishes, which are usually less expensive than meat-based meals.

While school meals are oftentimes made through speed scratch cooking, and staffing remains a significant issue, it is essential that the district be creative in its approach to increasing the consumption of plant-based meals. In the lunch line where meal options are displayed, plant-based foods are always the first option, while the least healthy options are moved to the end of the line. This strategy can help lower the number of unhealthy items that end up on a student's plate. Also, kitchen staff typically try to pair options that children like with plant-based meals. For instance, staff will sometimes prepare a black bean bowl with a small bag of nachos, leading many children to select this vegetarian meal option because they want the nachos that go with it. Finally, because a grilled lunch option is always included on the menu, the district always makes sure to include a vegetarian option as well. For example, a veggie patty can be included in lieu of a beef patty. By including a vegetarian option, schools are able to give students an additional plant-based entrée option every day, without the requirement of additional labor or ingredients.

Unfortunately, even though the equipment for full scratch cooking is available in the kitchen, the district is often unable to take advantage of their upgrades due to staff shortages. Labor shortages are a huge limitation of menu development, as are federal regulations that require high protein content for meals, making it difficult to develop and serve vegetarian alternatives.

School District of Beloit, Beloit (WI)

The School District of Beloit in the State of Wisconsin, under the leadership of their Food and Nutrition Director, Dawn Smith, stands out for its commitment to serving minimally processed foods. More than 70% of students live below the poverty line, and the district is a Community Eligibility Provision School District, meaning that all students receive their meals for free.

All schools (except for the high school) receive an annual Fresh Fruit and Vegetable grant of $200,000 per school, which leads to a higher meals reimbursement rate on average ($2.46 per breakfast and $4.32 per lunch). Under this program, children receive at least one cup of fresh fruit per meal and two portions of vegetables for lunch. For vegan or vegetarian students, they can choose up to 5 types of vegetables, of which one is potatoes for calcium. While only 5% of the entrees offered are vegan, the district is committed to accommodating all dietary needs of students. The low rate of plant-based meal options reflects the student demographics as Smith mentions that many students are Hispanic and frequently consume meat at home.

Smith noted that because most students generally consume a lot of meat at home, many do not see a meal as complete without animal protein. On top of the grants, the schools participate in the Seamless Summer Option program, meaning that students are fed throughout school breaks. Smith also highlighted how for many students, the meals served at school are the only ones that they receive throughout the day. She is committed to making sure that no child goes hungry and has been integrating additional measures to guarantee access at all times.

To ensure that all students are properly fed, the district has purchased two food trucks that drive to schools and other public areas in the district to serve food to students and community members in less accessible areas. Additionally, the district has started offering soup to students in the afternoon in order for children that are still hungry to receive a warm meal before departing from school. This offering has been received very well by the children and has become popular.

Recently, the district purchased Fork Farm Hydroponic Gardens for six schools. The gardens are used to teach students about the benefits of gardening and to integrate self-grown vegetables into the menus. Sourcing fresh vegetables directly from farmers has posed a large challenge due to the size of the district; most farms cannot provide large quantities of food on a consistent basis. The requirement for farmers to be Good Agricultural Practices (GAP) certified before being allowed to deliver produce to schools also presents a hurdle. The process to become certified requires farms to be audited for the implementation of sound food safety practices. This

certification proves that the produce has a reduced risk of microbial contamination and aims to make sure these foods are safe to eat. Many farmers are not certified, meaning that they cannot supply schools. Furthermore, the certification process is complicated, long, and expensive.

The district does not use any canned or frozen fruits and vegetables, and serves most foods in the most minimally processed form, so students learn about the foods while eating them. In its initial stages, this strategy led to quite some pushback from the food supplier, parents, and students. The district also lacked the facilities to process the foods effectively.

To overcome these challenges, the district integrated student taste tasting into their weekly routine to see whether students liked the proposed food options. Taste testing has increased the acceptance of certain ingredients and meals, and has also given students ownership over their meal options. As Smith worked for Aramark before starting her position at the School District of Beloit (Beloit, WI), she was able to use her connections to effectively communicate the needs of the district to the food service provider and request ingredients that fit the needs and wants of students.

Lastly, federal grants help the district update its kitchens and canteens to be more efficient and user-friendly for students. The updates cost approximately $500,000 per kitchen. Despite the large upfront investment cost, the upgrades have significantly improved the efficiency and reliability of food services. To save money on labor costs, the district outsourced the chopping of the vegetables to fruits to a nearby facility that will process and bag the products for the district in the way they are required. Additionally, through utilizing outsourced labor, students can experience fruits and vegetables in greater quantities and variations.

PART 3 - Conclusions and Recommendations

1. Discussion of Recommendations

As a result of the observations, literature review, interview process, and hard data analysis during the research process, a set of recommendations has been formed. Since the client had indicated that the report might be used to address sustainable school meals with school district representatives and policy makers across the United States, the recommendations were divided into two sections accordingly.

Overall, the research collected suggests that fostering interdepartmental collaboration to strengthen the connections between education and school meals is key in incorporating sustainable food menus within school districts.

These recommendations can help children develop healthier eating habits, make school meals more environmentally sustainable, and address the equity issues embedded in the food production system.

2. Recommendations to school districts

Including food education in the schools' curriculum

The educational opportunities that can be incorporated into school districts are endless. Using food systems as an educational tool will not only increase student health and well-being, academic achievement, and community involvement, but it will lead to additional long-term positive behavioral habits. Raising sustainable food awareness when students are young will create healthy eating habits that will hopefully be carried over through adulthood. During COVID-19, virtual cooking workshops were offered within certain school districts across the country, possibly to assist parents and students in cooking more frequent, healthier meals at home. Extracurricular activities, such as virtual cooking classes, which involve sustainable food education, are great teaching tools that can impact not only the students, but their families as well. In addition to cooking classes, school garden programs are highly effective in educating students about healthy food meals. School gardens offer students hands-on learning opportunities, which has been proven to excite students to participate more in class and allow active, hands-on learning. During the interviews, school gardening programs were also used as a way to increase the consumption of fruits and vegetables, decrease the amount of kitchen food waste, and connect students to their communities.

Recognizing that not all schools have the capacity or physical space for school gardens, another option is to incorporate field trips to local farms and distribution centers, which allow school districts to establish strong relationships with their local farms and vendors. Nutritionists at Lexington Public Schools (Lexington, MA) believe that telling the students the story of their

local food systems has been a big change in the way children consume foods. For example, Lexington Public Schools has a local fish program where they incorporate learning about local food systems by using QR codes to educate students about the fishing vessel, the area where fish were caught, the type of fish, and the fishermen (Silva, personal communication, 2021). The incorporation of new technology can further contribute to the program as it increases the chances of participation.

Operation strategies

One way to increase children's selection of plant-based options was suggested by Michael Manning, Director of Food and Nutrition from Richfield Public Schools (Richfield, MN). In his school district, plant-based meal options are always placed as the first option on the line in cafeterias, while the least healthy options are placed at the end. This seems to have an impact on children preferring the plant-based meal option. Additionally, pairing items that children are usually attracted to with plant-based meals encourages children to select the plant-based meal option. For instance, by offering a small bag of nachos with a plant-based meal, children are most likely to select the plant-based meal option over the meat-based meal option.

Schools can also introduce plant-based / vegetarian meals through programs such as theme days. According to Kevin Silva, the Food Service Director at Lexington Public Schools (Lexington, MA), *Meatless Mondays* are a great way to introduce children to a more plant-based diet (personal communication, 2021). In addition to creating designated days for meatless meal options, providing students with regular taste tests in the cafeterias is a great incentive to help increase consumption of plant-based options. Taste tests should be made available to all students, staff, and parents. In the School District of Beloit (Beloit, WI), the integration of taste testing has led to more effective meal preparation and a higher acceptance rate from students.

Another option is incorporating Do It Yourself (DIY) options into the school menu. Richard Mallard, Director of Child Nutrition at the Eanes Independent School District (Austin, TX), said that kids tend to eat more fruits and veggies when you let them pick what they want (personal communication, 2021). For example, children will not choose a whole cup of celery because they may only want one stick of celery, but when they have the choice, they may choose celery, carrots, tomatoes, or other vegetable options. (Mallard, personal communication, 2021).

The results from the salad bar pilot program in the Davis Joint Unified School District (Davis, CA), conducted by the University of California, Davis' Sustainable Agriculture Research and Education Program, showed that students selected an average of 3–3.5 servings of fruit and vegetables at each salad bar meal, in contrast to an average of less than one serving at the hot meal (Brillinger et al., 2003).

Staff training

Mandatory retraining of food procurement and kitchen staff is another recommendation that should be implemented across all school districts. Research shows that many school districts simply do not know what local produce is available and consider establishing relationships with local vendors and farms difficult, time-consuming, and costly. School districts should invest in annual training programs for food procurement and kitchen staff to better incorporate seasonal local ingredients into the school menu.

To avoid costs for retraining and to educate existing staff, school districts should consider hiring individuals that have extensive culinary knowledge, specifically in vegetable preparation, resulting in less food waste— "it goes a long way with kids to make food look good and taste good" (Mallard, personal communication, 2021). The process of retraining staff can be inefficient and costly, but re-educating the workforce or bringing in new talent will significantly accelerate the process in the sustainable food transition process.

Centralized kitchen

Centralized kitchen facilities are a great investment idea that school districts across the country should seriously consider incorporating within their meal programs. Centralized kitchens would solve many difficult problems that schools face today, such as the lack of trained staff and concerns with high operational costs associated with local food procurement; most importantly, centralized kitchens would allow schools to procure ingredients in bulk rather than purchasing in small quantities. Bulk purchasing allows school districts to utilize the economies of scale to lower costs, reduce packaging waste across the supply chain, and also benefits local farms and integrate the community. A centralized kitchen facility would also significantly reduce both labor costs and maintenance costs for individual schools and make management more efficient, with specialized teams completing tasks from price negotiation with farmers to designing meals for students. Furthermore, the overall utility expenses across school districts would significantly be reduced since the majority of energy usage is concentrated in one location. Though there might be a high upfront cost with facility construction and purchasing of cooking and storage equipment, the overall savings from operations will, in the long run, become financially beneficial to the school district.

3. Recommendations to policy makers

Transitioning to plant-based food

The implementation of federal legislation to enforce plant-based meals as the default option in school is a necessary step towards a more sustainable food culture in the education system. Schools will have the option to select meals with added meat/dairy upon request. A

study shows that even if meat and dairy options are available, changing the default makes consumers much more likely to choose a plant-based meal option (DefaultVeg, n.d.). Another strategy to go plant-based includes the government providing extensive levels of support to its agri-food sector. In 2020, the USDA provided the agri-business with $37.2 billion in subsidies, which constituted 36% of net farm income (Taxpayers For Common Sense, 2020). If some of these funds were directed towards plant-based products, plant-based food manufacturers would be incentivized to enter into the highly-regulated and demanding school lunch market. The growing demand for more sustainable, healthy meal options by schools and students would also make the business case for suppliers to develop tastier and more appealing plant-based products.

Removing the dairy milk mandate is also an important component for school menus to be more sustainable. At the present time, the NSLP is required by law to offer milk to children, which not only limits the food options for students but also disadvantages students with any degree of lactose intolerance.

Policy enforcement

Creating a policy mandate regarding the utilization of food entitlement dollars is a highly recommended action by the federal government. The USDA DoD-Fresh allows schools to use USDA Foods entitlement dollars to buy fresh produce. It should be mandated that a certain percentage of the funds given must be used in the procurement of locally grown ingredients/produce. Additionally, the USDA has increased subsidies towards local food purchasing, which should incentivize schools to take advantage of programs such as this one. Schools usually have to buy from Co-ops and go through an extensive bidding process which most cannot financially support (Mallard, personal communication 2021). Policymakers should make these standards less strict, so not only big vendors can act as food suppliers (Mallard, personal communication, 2021). It would be highly beneficial for both school districts and local farms if there were more collaboration between the state education department and the state agriculture department.

Investing in local food hubs

Local food hubs can have an immediate impact on local farms across the country and the ability for schools to create sustainable lunch menus. Increased investment should be made in the establishment of local food hubs across the country. Not only does purchasing produce directly from local farmers eliminate third-party costs and logistics concerns, local food hubs also provide small farms a platform to sell their produce and maximize profit. Due to variation in seasonality and varying demands from school districts, single farms may struggle to meet the continuous high-volume demand for fresh produce. Local food hubs would minimize food procurement concerns because volume would be met through the collection of produce from

multiple farms. As mentioned above, the USDA estimates that over 80% of food hubs are focused on increasing opportunities for local farms and increasing the reliability of Farm to School food procurement (Neal, 2017).

Additionally, food hubs have the ability to address issues regarding equity in current food systems. Food hubs can both supply underserved populations with greater variety in meal options and increase the economic development of farmers that may have faced marginalization in the past, specifically the BIPOC producers. Food hubs reduce the burden on small local farms to meet high volume demands, while also reducing the burden on schools to source local produce from multiple sources efficiently. As discovered while interviewing school districts from across the country, developing and maintaining close relationships with local farms is a significant time commitment that not all school districts can afford. Establishing local food hubs would both help well-funded school districts and under-funded districts that might not have the resources and management resources needed to source food locally. Lastly, beyond the social benefits of sourcing food locally, local food hubs have the ability to significantly increase the profits of small farms.

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