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Daily Access to Local Foods for School Meals: Key Drivers

Katherine Ralston, Elizabeth Beaulieu, Jeffrey Hyman, Matthew Benson, and Michael Smith

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Abstract

Farm-to-school programs began in the 1990s and have been encouraged by the U.S. Department of Agriculture (USDA) through grant funding, technical assistance, and changes to school meal procurement regulations. In 2012, USDA's Farm to School Program was formally established to improve access to local foods in eligible schools. Today, more than 4 in 10 school districts report serving local foods or implementing other farm-to-school activities. To examine progress toward USDA's goal of daily availability of locally produced foods for all students and to identify potential targets for technical assistance, this report uses data from the 2013 Farm to School Census to measure the prevalence of school districts that serve local food daily and the characteristics of those districts.

Acknowledgments

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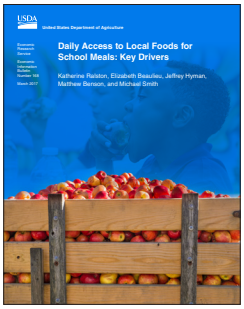
Contents

United States Department of Agriculture

A report summary from the Economic Research Service March 2017



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Daily Access to Local Foods for School Meals: Key Drivers

Katherine Ralston, Elizabeth Beaulieu, Jeffrey Hyman, Matthew Benson, and Michael Smith

What Is the Issue?

USDA's Farm to School Program was established in 2012 to improve access to local foods in eligible schools through grants and technical assistance. Farm-to-school programs bring locally or regionally produced foods into school cafeterias; provide hands-on learning activities such as school gardening, farm visits, and culinary classes; and integrate food-related education into the regular, standards-based classroom curriculum. Promotional activities and experiential learning also serve as an additional form of nutrition education to increase student awareness and interest in healthier foods. Frequent use of local foods in school meals has also been suggested as a way to expand the market for local agricultural producers.

What Did the Study Find?

This study is the first to focus on the prevalence of districts serving local food daily and the characteristics of those that do so more versus less frequently to identify potential targets for future technical assistance. While previous studies have examined the prevalence of farm-to-school activities, this study uses a "daily access" target, which provides a benchmark for assessing the depth of farm-to-school programs at different stages in their development.

The major findings in the study are:

- More than a third (35 percent) of all U.S. school districts reported serving local food in school meals during the 2011-12 school year.
- Nineteen percent of all school districts served at least one locally sourced food item daily. These districts, which tend to be larger, include 30 percent of all students.
- Locally produced milk—offered daily or more than weekly by 15.4 percent of school districts—and locally produced fruit, offered by 14.5 percent, were the local food categories served most frequently.
- The prevalence of serving local food daily differed significantly by region. Daily use of local food was least prevalent in the Southwest (8 percent of districts) and most prevalent in the Northeast (41 percent). After other factors that vary by region were accounted for, differences in the probability of serving local food daily were still statistically significant across regions.

- Holding other district characteristics constant, school districts with enrollment above 5,000, urban districts, and those districts in counties with higher density of farmers' markets were more likely to serve local foods daily, as were districts with higher per capita income, higher levels of college attendance, and those in States with more legislated policies supporting farm-to-school programs.
- Districts with the lowest probability of serving local food daily had enrollments at or below 5,000, were in rural counties with lower density of farmers' markets, or had lower per capita income, lower levels of college attendance, and fewer State-legislated farm-to-school policies.
- When the associations between school district characteristics and daily use of local food were modeled separately by region, we found that district size, locale type, and farmers' market density were associated with daily use of local food in almost all regions. However, per capita income, school spending per student, foodservice labor costs, and certification rates for free and reduced-price meals were not significantly associated with daily use of local food in most regions or differed in their effects by region.

How Was the Study Conducted?

In this study, researchers examined the association of daily access of locally produced foods with region, fruit and vegetable acreage, county-level per capita income, school district expenditures per student, foodservice labor cost per student, locale type (city, suburb, town, and rural), school district size (enrollment), percentage of students certified to receive free and reduced-price meals, and State-level educational attainment. Also in this study, researchers considered the role of State-legislated policies supporting farm-to-school programs and the density of farmers' markets as indicators of interest in local foods in the surrounding communities.

To identify characteristics of school districts that serve local food more frequently, an ordered probit model of the frequency of serving local foods was estimated using data from the 2013 Farm to School Census. Additional school district characteristics were merged from the National Center of Education Statistics' Common Core of Data (Public School District Universe Survey for the 2011-12 school year and School District Fiscal Survey for the 2010-11 school year) and State and county attributes from the USDA's Economic Research Service (ERS) Food Environment Atlas. The survey was distributed to all public school districts, including multisite charter districts, and included questions on farm-to-school activities in the 2011-12 school year as well as frequency and categories of local foods served in school meal programs.

Daily Access to Local Foods for School Meals: Key Drivers

Introduction

Farm-to-school programs (1) bring local or regionally produced foods into school cafeterias; (2) provide hands-on learning activities such as school gardening, farm visits, and culinary classes; and (3) integrate food-related education into the regular, standards-based classroom curriculum. Promotional activities and experiential learning can serve as a form of nutrition education to increase student awareness and interest in healthier foods (Slusser et al., 2007; Joshi et al., 2008; Gibson et al., 2014; Jones et al., 2015), while more frequent use of local foods in school meals can potentially expand the market for local agricultural producers (Izumi et al., 2010a; Holland et al., 2015).

Consistent with growing consumer interest in local foods, farm-to-school programs grew from California and Connecticut pilot programs in the 1990s to 5,254 participating school districts reported in the 2015 Farm to School Census (Conner et al., 2011; Feenstra and Ohmart, 2012; USDA FNS, 2016a). USDA involvement also began in the 1990s with a cooperative agreement funded by the USDA Agricultural Marketing Service (AMS) to help the New North Florida Cooperative market collard greens to local school districts (Feenstra and Ohmart, 2012). In 2008, USDA's Food and Nutrition Service (FNS) began providing guidance on procurement of local foods for school meals under new regulations allowing the use of geographic preference in procurement (USDA FNS, 2011).

USDA established the Farm to School Program within FNS in 2012 with a mandate from the 2010 Healthy, Hunger-Free Kids Act to provide grants and technical assistance to farm-to-school programs that improve access to local foods in schools. The program envisions that "one day every child who participates in nutrition assistance programs would have daily access to local foods (USDA FNS, 2016b)."

To develop baseline information on the prevalence of farm-to-school programs among school districts and to identify targets for further technical assistance, USDA carried out its inaugural Farm to School Census in 2013. Questions refer to participation in farm-to-school activities in school years 2011-12 and 2012-13, before the first USDA Farm to School Program had begun providing technical assistance, thus providing a useful baseline.

Previous studies have examined factors affecting farm-to-school participation in individual States or regions using a variety of different frameworks. Exploring the characteristics of Oklahoma school districts participating in farm-to-school programs, Vo and Holcomb (2011) found that districts that were larger, that spent a higher proportion of their budgets on produce, and that did not use a contracted distributor were more likely to participate in farm-to-school programs. Benson (2013) explored the interest level of extension agents and found that nearly three out of four extension agents surveyed in eight States (Alaska, Alabama, Hawaii, Louisiana, Ohio, Pennsylvania, Tennessee, and Washington) were interested in becoming involved in promoting farm-to-school programs.

Bagdonis and colleagues (2009) compared case studies of farm-to-school programs in Pennsylvania and described the role of champions inside and outside the school district who catalyzed and sustained the development of the programs. Izumi, Alaimo, and Hamm (2010) studied the motivations of school foodservice directors in Michigan to participate in farm-to-school programs; directors cited favorable reactions of students, lower prices, and the desire to support local agriculture as motivations to procure locally produced food. Conner and colleagues (2011) studied farm-to-school programs in Vermont and described a complex network of relationships between farmers, school districts, distributors, and policymakers at local, State, and national levels; Buckley and colleagues (2013) explore similar networks in Michigan, extending work by Izumi, Wright, and Hamm (2010b) on the importance of relationships with regional distributors.

The 2013 Farm to School Census is the first survey with a sufficient number of respondents to allow for the examination of determinants of participation in farm-to-school programs both nationally and regionally, as well as provide State-level estimates of participation totals. Further, the Farm to School Census included detailed questions regarding the *frequency* of local food use, making it possible to characterize progress toward the "daily access" target among varying farm-to-school programs.

This report examines the prevalence of districts serving local food daily and the characteristics of school districts that serve local food more frequently and less frequently. This information will be helpful in identifying potential targets for technical assistance to help those districts serving local foods less frequently or not at all.

Data Sources

This analysis is based on the 2013 Farm to School Census merged with data on school district characteristics from other sources described below. The 2013 Farm to School Census was distributed by email to all public school districts in the 50 States plus the District of Columbia. Charter schools were not included, except for multisite charter districts (an arrangement specific to Arizona and Texas) and charter schools in the District of Columbia. Seventy-five percent of districts responded, with 9,558 districts providing data. The questionnaire elicited information on participation in farm-to-school activities in school years 2011-12 and 2012-13. The variables used in this analysis are based on questions referring to the 2011-2012 school year (SY).

District characteristics including size (total enrollment); the share of students certified for free and reduced-price meals (F/RP); and locale type (city, suburb, town, rural, see table 1 for definitions) were merged to Farm to School Census responses using the Common Core of Data (CCD) Public School District Universe Survey file for SY 2011-12 collected by the National Center for Education Statistics (NCES). Fiscal data on school district expenditures and foodservice labor costs were merged from the NCES CCD School District Fiscal Survey file for SY 2010-11. State-level farm-to-school policies were merged to responses using data from the National Farm to School Network (2015).

Data on prevalence of farmers' markets at the county level (from the AMS farmers' market directory) were divided by population from the 2012 American Community Survey—as cited

in the ERS Food Environment Atlas—to derive the rate of farmers' markets per 10,000 population. Data on county-level average per capita income and the percent of adults in educational attainment categories (completed college or had some college, graduated high school, or did not complete high school) in States where districts were located were obtained from the ERS Food Environment Atlas (USDA ERS, 2016). Fruit and vegetable acreage within a 400-mile radius of the center of the school district was created using ArcGIS software by combining data from the USDA Cropland Data Layer for 2013 (USDA NASS, 2013) with data on school district boundaries from the U.S. Census Bureau (USCB, 2010).

Data were weighted based on the probability of response, using a model of response that included several district characteristics (see Appendix for details). Weights were calculated as the inverse of the predicted probability of response.

The Farm to School Census was repeated in 2015 to collect data on participation in farm-to-school activities in SY 2013-14 and SY 2014-15, but those data were not used in this report due to timing. While tabulated responses have been released for the 2015 Farm to School Census (USDA FNS, 2016a), the data for 2015 have not yet been weighted to adjust for nonresponse.

Most School Districts That Serve Local Food Serve It Daily

The Farm to School Census surveyed school districts to assess how frequently they served local foods in each of 12 categories: fruit, vegetables, milk, other dairy, meat, eggs, seafood, nuts and beans, grains, baked goods, herbs, and other foods. Response options were "never," "occasionally," "monthly," "more than monthly," "weekly," "more than weekly," and "daily." Only school districts that indicated they participated in any farm-to-school activities during SY 2011-12 were asked this question. Those districts that did not participate during SY 2011-12 were grouped with the "never" category.[1]

Of all U.S. school districts, 40 percent participated in at least one farm-to-school activity in SY 2011-12. Most of these, or 35 percent of all U.S. districts, served local foods at least occasionally. More than half of districts that served local foods at all (19 percent of all school districts) served local foods daily in at least one category (figure 1). Because larger school districts were more likely to offer local foods daily, school districts offering local food daily accounted for 30 percent of students. Of school districts offering local foods at least occasionally, responses were divided among "more than weekly but less than daily" (3 percent), "weekly" (3 percent), "more than monthly but less than weekly" (3 percent), "monthly" (1 percent), and "occasionally" (6 percent).

While 65 percent of school districts served no local food in SY 2011-12, many of these provided other farm-to-school activities during that year or started farm-to-school activities during SY 2012-13 (8 percent), or planned to start farm-to-school activities in the future (13 percent). More than 43 percent of districts, serving 25 percent of students, either had no plans to start farm-to-school activities or did not know if they had any farm-to-school activities.

Among food categories, locally produced milk was served daily or weekly by nearly 1 in every 7 U.S. school districts. Local fruits and vegetables were the next most frequent categories; 15 percent of all school districts served local fruit daily or more than weekly, and 12 percent served local vegetables daily or more than weekly (figure 2).

We examined the prevalence of daily local food use by region, based on FNS regional offices.[2] Prevalence of daily local food use was lowest in the Southwest (8 percent of school districts) and highest in the Northeast (41 percent, see figure 3). Regional variation may well reflect agricultural conditions in the area, such as the growing season. However, the high prevalence of local food use in the Northeast—with a shorter growing season—suggests that other factors are in play.

[1]School districts may source food locally but not consider such purchases a "farm-to-school" activity. Thus, the frequencies reported may represent a lower bound of actual local food use. This could be especially true for milk, which historically was produced for local consumption, although this pattern has shifted with increasing concentration in the dairy sector (MacDonald et al., 2007; MacDonald et al., 2016).

[2]Western (AK, AZ, CA, ID, HI, NV, OR, WA); Mountain Plains (CO, IA, KS, MO, MT, ND, NE, SD, UT, WY); Southwest (AR, LA, NM, OK, TX); Midwest (IL, IN, MI, MN, OH, WI); Southeast (AL, FL, GA, KY, MS, NC, SC, TN); Mid-Atlantic (DC, DE, MD, NJ, PA, VA, WV); and Northeast (CT, MA, ME, NH, NY, RI, VT).

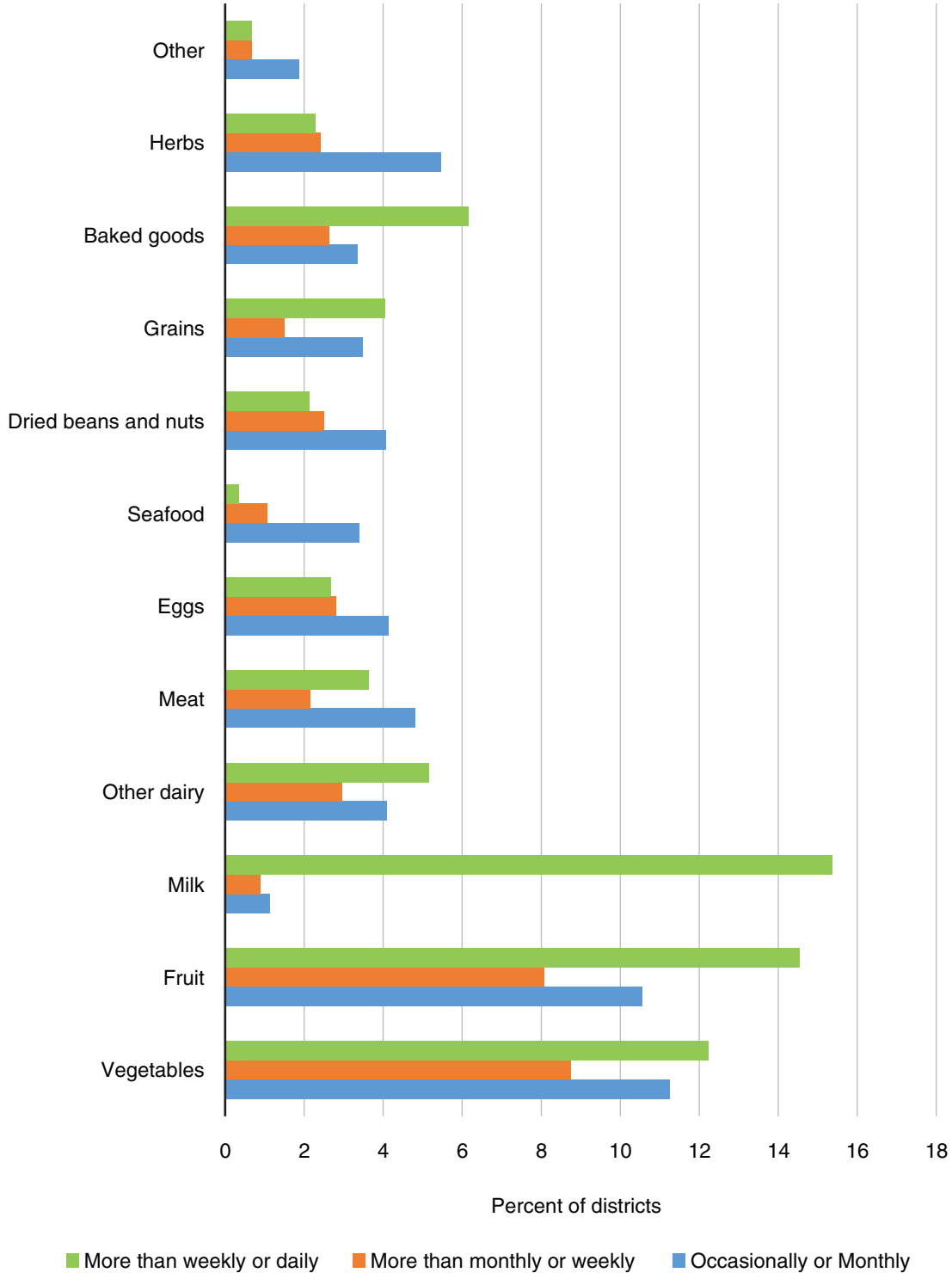
Figure 1

Frequency of local food use and farm-to-school programs, school year 2011-12

N=9,558. Statistics are weighted; see Appendix for explanation of weights.
Source: USDA, Economic Research Service calculations based on data from the 2013 Farm to School Census.

Figure 2

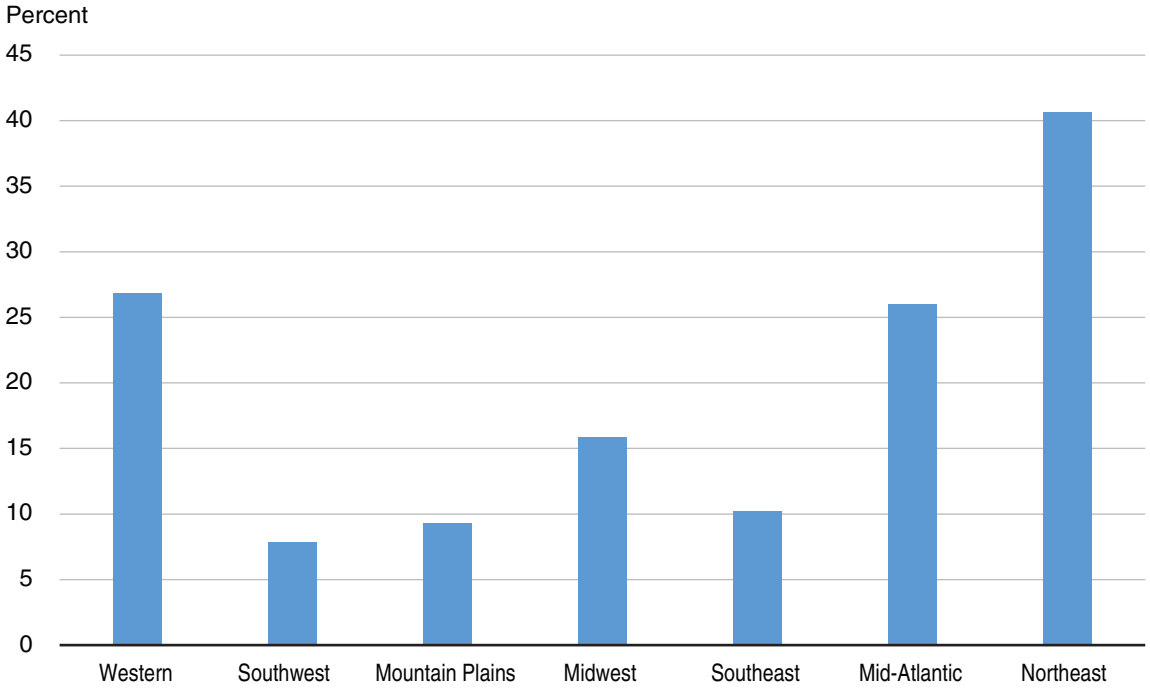
Locally sourced food categories served in school districts, by frequency, school year 2011-12



N=9,558. Statistics are weighted; see Appendix for explanation of weights.
Source: USDA, Economic Research Service calculations based on data from the 2013 Farm to School Census.

Figure 3

Share of school districts serving local food daily, by region, school year 2011-12



Statistics are weighted for nonresponse; see Appendix for explanation of weights.
Source: USDA, Economic Research Service calculations based on data from the 2013 Farm to School Census.

Modeling Local Foods Frequency

To examine the characteristics of school districts serving local food more frequently, we used the Farm to School Census data to fit an ordered probit model (see Appendix for details and diagnostic tests). This model measures the contribution of each characteristic to the probability that a district will be grouped in each of the seven frequency categories for serving any local food ranging from "never" to "daily." School district characteristics included (see table 1 for variable definitions with national and regional descriptive statistics):

- Region;
- Quartiles for fruit and vegetable acreage within a 400-mile radius of the school district, per student, plus a category for missing data;
- Quartiles for county-level per capita income;
- Categories for school district expenditures per student;
- Quartiles for school foodservice salary expenditures per student;
- School district size (5,000 students or less versus more than 5,000 students)
- School district locale type (rural, town, suburban, or city);
- Quartiles for percentage of students certified for free and reduced-price meals;
- Quartiles for county-level farmers' market density per 10,000 residents;
- Number of State-legislated farm-to-school policies (above and below the median); and
- State-level percentages of adults who attended any college.

We estimated models for the entire United States and for each region. We included data on fruit and vegetable acreage within a 400-mile radius of the school district to indicate the availability of local produce. While all food groups were represented among school districts serving local foods, school districts reported serving locally grown fruits and vegetables more frequently than any other food group other than milk. Difficulty obtaining locally grown fruits and vegetables was the most frequently cited problem among school districts (Ralston and Benson, 2015). Further, producers of crops supported by USDA programs—such as corn and peanuts—may have less incentive to develop market channels to supply local schools with food. We used data on fruit and vegetable acreage from the Cropland Data Layer for 2013. We combined the Cropland Data Layer with shapefiles for the school district boundaries from the U.S. Census Bureau (USCB, 2010) using ArcGIS software to derive fruit and vegetable acreage within a 400-mile radius of the center of the school district. School district boundary data for 2013 were not available at the time of the analysis; school districts created after 2010, as well as charter school districts for which shapefiles were not available, have missing data for fruit and vegetable acreage. We created a dummy variable to indicate missing data so that these observations would not be excluded from the analysis. We divided acreage by district enrollment (in 2012) to adjust for the size of the potential market for school food service and created quartiles for this variable. The highest quartile was excluded from the model as the reference category.

Table 1

Definitions and descriptive statistics for school district characteristics, U.S. and by region

	United States	Western	Mountain Plains	Southwest	Midwest	Southeast	Mid-Atlantic	Northeast
Sample size	9,569	1,296	1,740	1,426	2,247	897	802	1,160
Percent of districts		14	17	15	23	8	10	13
Variable	Percent of school districts with characteristic							
Fruit/vegetable acreage (per student within 400 miles)								
Quartile 1 (< 0.07)	21	5	10	63	3	55	25	11
Quartile 2 (0.07 – 0.26)	21	11	16	24	15	28	33	33
Quartile 3 (0.26 – 0.87)	21	16	22	6	35	12	20	23
Quartile 4 (> 0.87, omitted from model as reference group)	37	29	43	2	32	2	3	10
Fruit/vegetable acres missing	16	39	10	4	16	3	20	23
Income (county level per capita)								
Quartile 1 (< $39,200)	25	17	29	50	13	62	14	5
Quartile 2 ($39,200 -$44,400)	25	28	25	26	31	21	19	18
Quartile 3 ($44,400 – $51,700)	25	23	30	13	37	12	20	28
Quartile 4 (> $51,700, omitted from model as reference group)	25	32	17	11	20	6	47	50
School district budget (per student)								
Category 1 (< $10,000)	28	47	28	43	21	56	5	3
Category 2 ($10,000 - $12,000)	24	23	29	24	36	29	12	2
Category 3 ($12,000-$15,000)	21	13	23	17	29	12	33	16
Category 4 (> $15,000, omitted from model as reference group)	26	17	20	15	14	3	49	79
Food service labor cost (per student)								
Quartile 1 (< $118)	26	44	17	11	33	9	26	30
Quartile 2 ($118 – $154)	25	23	24	20	32	18	28	21
Quartile 3 ($154 - $193)	25	13	26	32	22	34	24	24
Quartile 4 (> $194, omitted from model as reference group)	25	20	32	37	12	38	22	25
Enrollment > 5,000	15	24	6	14	11	32	20	10
Enrollment ≤ 5,000 (omitted from model as reference group)	85	76	94	86	89	68	80	90

- continued

Table 1

Definitions and descriptive statistics for school district characteristics, U.S. and by region - continued

	United States	Western	Mountain Plains	Southwest	Midwest	Southeast	Mid-Atlantic	Northeast
Sample size	9,569	1,296	1,740	1,426	2,247	897	802	1,160
Percent of districts		14	17	15	23	8	10	13
Variable	Percent of school districts with characteristic							
Locale type								
Rural (Territory outside urbanized area, outside urban cluster)	52	44	72	63	48	52	31	45
Suburban (Territory outside principal city, inside urbanized area with population 50,000 or more)	22	21	5	9	26	15	48	39
Town (Territory inside urban cluster, at least 10 miles from urbanized area)	20	23	20	22	21	25	12	13
City (Territory inside principal city, inside urbanized area with population 100,000 or more, omitted from model as reference group)	6	13	3	6	5	8	9	3
Free and reduced-price meals (percent of students certified)								
Quartile 1 (<33%)	25	18	23	7	28	3	41	55
Quartile 2 (33-48%)	25	21	35	15	32	10	28	24
Quartile 3 (48 - 63%)	25	24	25	31	25	33	18	15
Quartile 4 (>63%, omitted from model as reference group)	25	38	17	48	14	53	13	6
Farmers' markets (county level density per 10,000 residents)								
Quartile 1 (< 0.9)	25	16	28	65	17	33	14	1
Quartile 2 (0.9 – 0.26)	25	30	9	17	33	25	52	14
Quartile 3 (0.26 – 0.55)	25	30	23	10	28	24	22	38
Quartile 4 (> 0.55, omitted from model as reference group)	25	24	39	8	22	18	12	47
Farm-to-school policies < 6 (State level, below median)	47	21	93	15	43	70	90	10
Farm to school policies ≥ 6 (State level, median or above, omitted from model as reference group)	53	79	7	85	57	30	10	90
Any college attendance (State level, percent some college or bachelor's degree)	61	64	64	57	62	56	60	64
No college attendance (State level, percent high school only or less than high school, omitted from model as reference group)	39	36	36	43	38	44	40	36

Sample size = 9,569. Descriptive statistics are weighted for nonresponse. See Appendix for details on weighting.

Source: USDA, Economic Research Service calculations based on data from the 2013 Farm to School Census.

Higher levels of education and income may be correlated with interest in local foods, at least in some parts of the country. Among studies of demographic characteristics associated with purchase of local food by consumers, Martinez and colleagues (2010) describe two national studies that found education and income were not statistically significant. But some State and regional studies found that local food purchases were more likely among consumers with higher income and education. We used county-level per capita income for 2012, as reported in the ERS Food Environment Atlas (USDA ERS 2016), to create income quartiles. The highest quartile was excluded from the model as the reference category. We used State-level percentages for adults with some college or completion of a bachelor's degree, also from the ERS Food Environment Atlas, as an indicator of education level.

School district size (enrollment) and financial position (expenditures per student and foodservice salary costs per student) may be associated with participation in farm-to-school programs and use of local foods for several reasons. Larger and/or more affluent districts are more likely to have the staff and skills needed for local procurement and onsite processing of local commodities. Districts with larger staff also may be better able to implement the training for local procurement offered by USDA and others. On the other hand, smaller school districts may be able to incorporate local foods more easily because of needing smaller quantities of local foods than a larger school district would. Size of district may also be related to whether the district has facilities to store and process fruits and vegetables onsite. We used data on enrollment from the Common Core of Data (CCD) Public School District Universe Survey for SY 2012-13. Previous research using school district size used cutoffs of < 1,000 for very small, 1,001 – 5,000 for small, 5,001 – 20,000 for medium, and > 20,000 for large. To address problems of multicollinearity, we combined the categories into Medium/Large (> 5,000) and Small/Very Small (≤ 5,000), the latter of which we omitted from the model as the reference category.

Whether a school district is located in a city, suburb, town, or rural area may also impact participation in farm-to-school programs and the frequency of local foods use in meals. Urban school districts often differ from rural districts both in interest in local food and capacity to procure it. The locale type codes assigned by the Common Core of Data to each school district reflect population density and proximity to larger population centers (defined in table 1). While large school districts are usually urban, small school districts are not always rural. In some States, school administration in suburbs and towns may be divided into small school districts. We excluded the dummy variable for urban as the reference category.

The model includes quartiles for the percentage of students certified for free and reduced-price (F/RP) meals served in the district.[3] Higher F/RP rates are often associated with lower income levels, although economic segregation in metropolitan areas can lead to high rates of F/RP certification despite high median incomes overall. Higher rates of F/RP certification can lead to higher meal participation levels and higher revenues; free meals are reimbursed by USDA at a higher rate than the revenue generated by students paying for a full-price meal. Higher revenues, in turn, could increase a school district's ability to manage the procurement of more frequent local food. On the other hand, lower rates of F/RP could provide stronger incentive for foodservice directors to innovate (with local sourcing) and attract paid meal participation. We used data matched from the CCD

[3]During SY 2011-12, three States participated in the Community Eligibility Provision (CEP), a new option to offer universal free meals; the option became available nationwide in SY 2014-15. District participation in the CEP was not considered in this study, but may be relevant for analysis of the 2015 Farm to School Census.

(aggregated from school level to the district level), with the highest F/RP quartile excluded from the model as the reference category.

Two variables serve as indicators for (1) consumer interest in local food and (2) higher likelihood of State-level encouragement and financial support. The density of farmers' markets per 10,000 residents at the county level (coded as quartiles) is one such indicator. The model uses farmers' market data from the 2013 Farmers' Market Directory, collected by USDA's Agricultural Marketing Service, and compiled by county in the ERS Food Environment Atlas (USDA ERS, 2016). We divided by county population for 2012 (also available from the Food Environment Atlas) and created quartiles, excluding the highest as the reference category.

The density of farmers' markets could also be associated with the frequency of local food use if school districts' purchases of food from farmers' markets are sufficient to encourage the growth of additional farmers' markets. This relationship would lead to biased estimates of the model, but because only 11 percent of school districts that served local food reported procuring local food from farmers markets' (Ralston and Benson, 2015), we judged this to be an unlikely problem.

The second indicator of community interest in farm-to-school programs is the number of State-level farm-to-school policies as of 2011, the reference year in the 2013 Farm to School Census. According to a database of policies in 2011 compiled by the National Farm to School Network (2015), 48 States (plus the District of Columbia) had at least 1 farm-to-school policy, and the number of individual policies varied from 1 to 16. State legislation in support of farm-to-school programs includes grant funding and additional reimbursement, as well as pilot programs and the establishment of State farm-to-school coordinators (table 2). We coded the number of policies as a dummy variable equal to 0 for districts in States below the median number of policies (6) and 1 for districts in States with 6 or more policies (omitted from the model as the reference category).

School district characteristics vary widely across regions. Comparing the two regions with the greatest difference in daily local food use, nearly half of school districts in the Northeast fall in the highest quartile of farmers' market density, while nearly two out of three districts in the Southwest fall in the bottom quartile nationally (table 1). Nine out of 10 school districts in the Northeast are in States with more than the national median of State-legislated farm-to-school policies, while a similar proportion of Southwestern school districts are in States below the median.

Table 2
State-level farm-to-school legislation, as implemented in 2011

Legislative element	Description	States with this policy in 2011
Farm-to-school program	Establishes a statewide farm-to-school program and provides support from local government agencies.	AK, AL, CA, CT, DC, DE, FL, GA, HI, IA, IL, IN, MD, ME, MI, NC, NM, NY, OK, OR, PA, SC, VT, WA, WI, WV, WY
Task force	Creates a task force, working group, or intra-agency council to implement and assess farm-to-school programs or directs State agencies to collect data and make recommendations.	AZ, CA, CO, DC, DE, HI, IA, LA, MA, ME, MO, MS, MT, NC, NH, NM, NY, OH, OK, OR, TX, VA, VT, WI, WV, WY
Pilot program	Establishes a temporary pilot program for farm-to-school activities in school districts.	AK, CA, CO, CT, DC, HI, MA, ME, VT, WA, WI
State funding	Authorizes additional funding to be set aside or appropriated for farm-to-school programs.	AK, CA, CO, CT, DC, IA, IL, ME, MN, MO, MT, NC, NM, NY, OK, OR, WA, WI, WV
Grants	Authorizes grants for implementation of farm-to-school programs.	CA, DC, IL, ME, MI, MN, MO, MT, NC, NM, NY, OK, OR, WA, WI, WV
Reimbursements	Allows schools to receive additional reimbursement money for serving local food in meals.	AK, CA, DC, MA, ME, MT, NC, NY, OR, PA
Local preference in State-procured agricultural products	Encourages State organizations, agencies, and schools to use local produce by allowing purchasing preferences for State-produced agricultural products.	AK, AL, CA, CO, CT, DC, FL, GA, HI, ID, IL, KY, MA, MD, MI, MT, NC, NM, NY, OR, TN, TX, WA
School gardens	Establishes or supports school garden programs.	AK, CA, DC, GA, HI, IA, MD, MO, NC, NJ, NV, NY, OR, WA
Farm-to-preschool	Establishes a statewide farm-to-preschool program and provides support from local government agencies.	AK, DC, OH, WV
State coordinator	Establishes position of statewide farm-to-school program coordinator.	AL, AZ, IA, MI, NC, OK, VT, WI
State directory	Directs State agencies to establish a website or list of participating schools and producers to facilitate local procurement.	AL, CT, GA, IL, MA, MD, ME, MI, MS, NY, OK, PA, TX, VA
Wellness policy	Encourages farm-to-school efforts as part of a broader wellness or food security policy.	CA, DC, FL, HI, MT, NC, NH, NJ, NM, NV, NY, OK, TN, TX, WA, WV
Promotion	Establishes a statewide promotion program or event that will promote local agriculture and foods to children.	CT, DC, DE, GA, HI, KS, KY, MD, ME, MN, NC, ND, NJ, NM, NY, VA
Targets underserved populations	Legislation targets underserved populations.	AL, CA, DC, ME, OR, WA, WI, WV
Resolution	Encourages or recommends farm-to-school programs or policies across the State, in State departments, or at the Federal level.	DE, GA, HI, KS, KY, MN, MS, MT, NC, ND, NE, NM, NV, OR, PA, TX, VT, WV
Other	May include provisions related to a broader economic policy (VT), goal setting (IL), a school construction project (MI), processing or distribution infrastructure projects (MT, VT), income tax credit incentives (RI), or another topic not covered in the above categories.	CA, CO, CT, HI, ID, IL, KY, LA, MA, ME, MI, MS, MT, NC, NH, NJ, NY, OH, OK, OR, RI, SC, TX, VT, WV

Source: National Farm to School Network, 2015.

School Location and Size Are Key Drivers of Local Food Frequency

We calculated marginal effects of each characteristic—the effect of a 1-unit difference on the probability of a district serving local food at a frequency in each of the seven categories—as follows. For discrete variables—all variables other than percent of adults who ever attended college—we used the model coefficients to calculate the probabilities, with all variables set to their average value except the variable of interest; we set that variable to 1 and then recalculated the probabilities with the variable set to 0, and calculated the difference in probabilities. For percent of adults with any college in the State where the district was located, we calculated the probabilities with the variable set to either the national or regional average value and with an additional 5 percentage points added. The estimating equation and diagnostic tests are described in the Appendix.

In the national model, all variables other than F/RP quartiles, foodservice labor cost quartiles, and the third quartile of per capita income had statistically significant associations with the frequency of local food use (table 3), although some associations were contrary to expectations, as discussed below.

All regions were statistically significantly different from the Southwest even after other characteristics were accounted for. School districts in the Northeast were 28 percentage points more likely than those in the Southwest (the reference region) to serve local foods daily after all other variables were held constant. This compares with the 33-percentage-point gap between daily local food use in the Northeast and Southwest without accounting for other factors.

Western school districts were 12 percentage points more likely to serve local foods daily, while Mid-Atlantic school districts were 17 percentage points more likely, and Southeastern school districts were 9 percentage points more likely to serve local foods daily. The marginal effects on the probability of never serving local food followed a similar pattern; Northeastern districts were 38 percentage points less likely to never serve local foods compared with Southwestern school districts (table 3).

Fruit and vegetable acreage per student within 400 miles was statistically significant, but not in the expected direction; districts in the lowest quartile were 5 percentage points more likely to serve local food daily than those in the highest quartile. Effects of county-level per capita income were consistent with other studies; districts in the lowest quartile of counties were 4 percentage points less likely to serve local food daily than those in the highest quartile. School district budget per student was statistically significant in an unexpected direction; districts in categories below the highest category were all roughly 3 percentage points more likely to serve local foods daily than those in the highest category.

Size and locale type showed the largest marginal effects on local food use after regional differences. Compared to districts with 5,000 enrollment or less, districts with more than 5,000 students were 10 percentage points more likely to serve local foods daily (table 3). School districts outside of urban areas were less likely to serve local food daily than those in cities (the reference category); rural school districts were 11 percentage points less likely, suburban districts 6 percentage points less likely, and districts in towns 7 percentage points less likely than districts in cities to serve local foods daily.

Table 3

Ordered probit model coefficients and marginal effects for determinants of frequency of local food use in school meals, school year 2011-12

Variable	Ordered probit coefficient		Marginal effect of serving local food in each frequency category Percentage point difference in probability						
			Never	<Monthly	Monthly	>Monthly	Weekly	>Weekly	Daily
Region									
Western	0.58	***	-19.5	2.3	0.6	1.3	1.6	1.8	12.0
Mountain Plains	0.14	*	-4.1	0.6	0.2	0.3	0.4	0.4	2.2
Midwest	0.38	***	-12.1	1.6	0.4	0.9	1.1	1.2	7.0
Southeast	0.45	***	-14.6	1.9	0.5	1.0	1.3	1.4	8.6
Mid-Atlantic	0.74	***	-25.9	2.6	0.7	1.5	2.0	2.3	16.8
Northeast	1.05	***	-38.3	2.7	0.8	1.8	2.4	3.0	27.5
Fruit/vegetable acreage									
Quartile 1	0.20	***	-7.3	0.6	0.2	0.4	0.5	0.6	4.9
Quartile 2	0.12	**	-4.5	0.4	0.1	0.3	0.3	0.4	3.0
Quartile 3	0.07	*	-2.7	0.3	0.1	0.2	0.2	0.2	1.8
Fruit/vegetable acreage missing	-0.12	**	4.0	-0.5	-0.1	-0.3	-0.3	-0.4	-2.5
Income									
Quartile 1	-0.17	***	6.2	-0.6	-0.2	-0.4	-0.5	-0.5	-4.1
Quartile 2	-0.09	**	3.5	-0.3	-0.1	-0.2	-0.3	-0.3	-2.3
Quartile 3	-0.04		1.5	-0.1	0.0	-0.1	-0.1	-0.1	-1.0
School district budget									
Quartile 1	0.13	***	-4.7	0.5	0.1	0.3	0.4	0.4	3.1
Quartile 2	0.11	***	-4.1	0.4	0.1	0.2	0.3	0.4	2.7
Quartile 3	0.13	***	-4.6	0.5	0.1	0.3	0.4	0.4	3.0
Foodservice labor cost									
Quartile 1	0.02		-0.8	0.1	0.0	0.0	0.1	0.1	0.5
Quartile 2	0.02		-0.8	0.1	0.0	0.0	0.1	0.1	0.5
Quartile 3	0.01		-0.5	0.0	0.0	0.0	0.0	0.0	0.3
Enrollment > 5,000	0.36	***	-13.6	1.0	0.3	0.7	0.9	1.1	9.7
Locale type									
Rural	-0.42	***	15.9	-1.2	-0.3	-0.8	-1.1	-1.3	-11.2
Suburban	-0.22	***	8.4	-0.5	-0.1	-0.4	-0.5	-0.6	-6.3
Town	-0.26	***	10.0	-0.6	-0.2	-0.4	-0.6	-0.8	-7.3

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Table 3

Ordered probit model coefficients and marginal effects for determinants of frequency of local food use in school meals, school year 2011-12 - continued

Variable	Ordered probit coefficient		Marginal effect of serving local food in each frequency category Percentage point difference in probability						
			Never	<Monthly	Monthly	>Monthly	Weekly	>Weekly	Daily
Free/reduced-price meals									
Quartile 1	0.04		-1.5	0.1	0.0	0.1	0.1	0.1	1.0
Quartile 2	-0.01		0.4	0.0	0.0	0.0	0.0	0.0	-0.3
Quartile 3	-0.04		1.3	-0.1	0.0	-0.1	-0.1	-0.1	-0.9
Farmers' markets									
Quartile 1	-0.27	***	9.8	-0.9	-0.2	-0.5	-0.7	-0.9	-6.6
Quartile 2	-0.27	***	10.0	-0.9	-0.2	-0.6	-0.7	-0.9	-6.7
Quartile 3	-0.10	***	4.0	-0.3	-0.1	-0.2	-0.3	-0.3	-2.8
Farm-to-school policies < 6	-0.09	***	3.4	-0.3	-0.1	-0.2	-0.3	-0.3	-2.2
Attended any college, percent	2.87	***	-5.4	0.4	0.1	0.3	0.4	0.5	3.7

N=9,558. * Statistically significant at the 0.10 level. ** Statistically significant at the 0.05 level. ***Statistically significant at the 0.01 level. Model is weighted; see Appendix for explanation of weights. For categorical variables, marginal effects are the difference in probability the frequency falls in a given range compared to the reference category. For educational attainment, the marginal effect is contribution of 5 additional percentage points of college attendance compared to the average. See Appendix for details on how coefficients are translated to the marginal effect of each variable.

Source: USDA, Economic Research Service estimates from the 2013 Farm to School Census.

Nearby Farmers' Markets, State Farm-to-School Policies, and Educational Attainment Also Matter

The density of farmers' markets was also an important indicator of interest in local food. School districts in counties with the two lowest quartiles of farmers' market density were 7 percentage points less likely to serve local foods daily than those in the highest quartile. While farmers' market density is also a potential indicator of the supply of local foods, only 11 percent of school districts reported buying food for school meal programs from farmers' markets in SY 2011-12 (Ralston and Benson, 2015).

School districts in States with fewer than six farm-to-school policies were 2 percentage points less likely to serve local food daily than those in States above the median, other characteristics held constant.

The share of adults who completed any college in the State where the district was located was a statistically significant factor. For every additional 5 percentage points in the proportion of adults age 25-65 who attended college or attained a bachelor's degree in the State, the probability of serving local foods daily was 4 percentage points higher, contrary to other studies of consumer interest in local foods showing a weak relationship with higher education (Martinez et al., 2010).

Regions Differ in the Role of School District Characteristics

We examined the effects of district characteristics separately in ordered probit models for each region to study how the effects differ geographically (see marginal effects on serving local food daily in table 4).

In regional models for the Mountain Plains, Midwest, and Northeast, fruit and vegetable acreage within 400 miles per student followed the national pattern of higher probability of daily local food use in the lowest or second lowest quartile compared to the highest, though effects were weaker. The Southwest and Southeast regions showed no statistically significant differences among groups, and the Mid-Atlantic model excluded these variables to address multicollinearity (see Appendix). Only the Western region displayed the expected pattern of lower daily food use among districts with fewer nearby fruit and vegetable acres per student.

County-level per capita income was statistically significant only in the Western and Mid-Atlantic regions. Western districts with per capita income in the lowest national quartile (< $39,200) were nearly 13 percentage points less likely to serve local food daily than those in the highest quartile (>$51,700). In the Mid-Atlantic region, districts in the second-lowest national quartile were 16 percentage points less likely to serve local food daily compared to those in the highest.

Associations with per-student school expenditures were in different directions across regions and in most cases in the opposite direction as associations with per capita income. While Midwestern districts in the lowest national quartile for school spending per pupil were almost 4 percentage points less likely to serve local foods daily than those in the highest national quartile, Western and Northeastern districts in the lowest national quartile were 13 and 20 percentage points more likely to do so, respectively. Similarly, associations with per-pupil foodservice labor costs were in contradictory directions across regions.

Total enrollment of the school district followed the national pattern and was a statistically significant determinant in most regions: in all regions except the Midwest and Northeast, districts with enrollment at 5,000 or less were significantly less likely to serve local foods daily compared to larger districts. Associations with locale type also followed the national pattern, with districts in rural areas significantly less likely to serve local food daily by over 21 percentage points in the Western region.

Associations with the level of certification for free and reduced-price meals, which were not significant in the national model, were significant in the Southeast and Southwest regions, but in different directions. Southwestern districts in the lowest national quartile (< 33 percent F/RP) were 5 percentage points *more likely* to serve local food daily compared to those in the highest national quartile (> 64 percent), but Southeastern districts in the lowest quartile were 4 percentage points less likely to do so.

County-level density of farmers' markets was statistically significant in all regions except the Mid-Atlantic and Mountain Plains, with districts in lower quartiles significantly less likely to serve local foods daily than those in the highest quartile.

In the Western, Mountain Plains, and Southwest regions, daily local food use was significantly lower in States with fewer than six State-legislated farm-to-school policies; in the Midwest, daily local

food use was significantly higher in States with fewer policies. In other regions, differences were not statistically significant.

Among districts in the West, Mountain Plains, Midwest, and Southwest, those with higher percentages of adults who attended any college were significantly more likely to serve local food daily, as in the national model. This effect was strongest in the Western region, where districts with 5 additional percentage points more college attendance were 7 percentage points more likely to serve local food daily.

In the Northeast, however, districts with higher levels of college attendance were less likely to serve local food daily. This result appears to be driven by two States, Vermont and Rhode Island. These States are comparatively small and homogeneous, with the highest rates of daily use of local foods in the region, but they both have rates of (any) college attendance that are low for the Northeast region, suggesting that other factors are driving interest in local food.

Table 4
Marginal effects of determinants on probability of daily local food use in school meals, by region, school year 2011-12

Variable	Western	Mountain Plains	Southwest[a]	Midwest	Southeast[b]	Mid-Atlantic[b]	Northeast
	Percentage point difference in probability						
Fruit/vegetable acreage							
Quartile 1	-6.5 *	4.2 *	4.0	8.2 ***			14.7
Quartile 2	-1.0	1.8	0.7	7.8			15.8 ***
Quartile 3	3.8	-0.7	-0.1	5.7 ***			5.1
Fruit/vegetable acreage missing	-6.7 **	-3.5 **	8.4 *	-4.9 ***			9.0
Income							
Quartile 1	-12.9 ***	0.0	-0.4	-2.5	-0.6	-10.0 *	-3.1
Quartile 2	-7.4 **	0.2	1.3	-1.9	2.4	-15.6 ***	-5.4
Quartile 3	-6.0	1.0	-0.1	-0.4	1.9	-6.6	4.3
School district budget							
Quartile 1	13.2 ***	0.3	1.6	-3.7 *	1.4	-7.3	20.2 **
Quartile 2	7.3 **	-0.1	3.6 **	-0.4	2.3	8.4 *	7.1
Quartile 3	9.8 **	-0.7	0.8	4.1 *	4.8	1.8	5.7
Foodservice labor cost							
Quartile 1	-4.8	3.9 *	-0.7	3.8 *	8.5 ***	-5.8	-5.6
Quartile 2	-0.1	-2.2	0.4	3.7 *	2.7	-2.7	-4.7
Quartile 3	-4.8	-2.2 *	0.8	2.3	0.9	-0.7	3.3
Enrollment > 5,000	13.7 ***	5.8 *	8.8 ***	3.6	4.7 **	13.9 ***	10.4
Locale type							
Rural	-21.3 ***	-8.3 **	-3.3	-12.5 ***	-5.9 **	-11.1	-16.8 *
Suburban	-8.7 *	-4.2	0.8	-9.7 **	-0.6	-5.4	-15.4 *
Town	-13.6 ***	-3.4	-0.8	-9.6 **	-4.2	-13.4 *	-21.0 **

- continued

Table 4

Marginal effects of determinants on probability of daily local food use in school meals, by region, school year 2011-12 - continued

Variable	Western	Mountain Plains	Southwest[a]	Midwest	Southeast[b]	Mid-Atlantic[b]	Northeast
	Percentage point difference in probability						
Free/reduced-price meals							
Quartile 1	-0.6	2.2	4.6 *	2.5	-4.5 *	-5.6	-2.2
Quartile 2	-4.3	2.2	-0.9	-2.1	-2.0	-0.5	-2.7
Quartile 3	-2.7	2.0	-1.6	-2.6	3.7 **	-2.7	-10.3
Farmers' markets							
Quartile 1	-21.7 ***	-0.6	-4.3 **	-7.6 ***	-8.1 ***	-5.9	11.5
Quartile 2	-19.9 ***	0.9	-2.8	-10.7 ***	-6.5 **	-6.0	-11.0 **
Quartile 3	-12.2 ***	1.1	-0.6	-4.0 *	-6.7 ***	-3.0	0.5
Farm-to-school policies < 6	-7.8 **	-13.2 ***	-4.5 ***	3.7 ***	-2.8	2.1	2.3
Attended any college, percent	7.1 **	1.7 **		6.2 ***	5.5 **	1.6	-5.8 *
Sample size	1,296	1,740	1,426	2,247	897	802	1,160

[a]College attendance omitted to address multicollinearity; see Appendix. [b]Fruit and vegetable acreage categories omitted to address multicollinearity; see Appendix.

* Statistically significant at the 0.10 level. ** Statistically significant at the 0.05 level. *** Statistically significant at the 0.01 level. For categorical variables, marginal effects are the difference in probability that local foods were served daily, compared to the reference category. For educational attainment, the marginal effect is the contribution of 5 additional percentage points of college attendance compared to the average. See Appendix for details on how coefficients are translated to the marginal effect of each variable.

Source: USDA, Economic Research Service estimates from the 2013 Farm to School Census.

Conclusion

Engagement of school districts in farm-to-school programs ranges from startup efforts such as periodic promotion of local foods in school meals to serving a wide variety of local foods daily. Promotional activities and experiential learning can serve as a form of nutrition education to increase student awareness and interest in healthier foods, while more frequent use of local foods in school meals can increase freshness of school foods as well as expand the market for local agricultural producers.

USDA's Farm to School Program distributes grants and technical assistance (such as webinars, best-practice videos, and in-person training) to increase the number of school districts serving local food and the frequency of local food use. The program's "daily access for all students" target is a clearly defined benchmark for assessment of the growth and depth of school district farm-to-school programs. The 2013 Farm to School Census provided data necessary to compare progress toward that target across school districts in different regions and with different characteristics.

Model results in this report provide insights into regional differences after accounting for other characteristics, while individual regional models show how other characteristics are statistically significant in some regions but not in others. Rural districts and districts with 5,000 students or less, especially those in the Southwest and Midwest, may benefit from additional technical assistance to increase participation in farm-to-school activities.

The example of the Northeast region, where growing seasons for fruits and vegetables are shorter due to the climate but local food use in school meals is high, illustrates the importance of factors other than the growing season. Overall, the results from the regional models suggest that while many factors are still statistically significant determinants (as in the U.S. model), factors specific to individual regions are also important to understanding which districts are more likely to serve local foods more frequently. Further, the contradictory directions of some associations across regions suggest that these associations may be confounded with other factors that the Farm to School Census was unable to capture, such as the presence of "champions" working at the local level to develop the relationships and networks that enable schools to source local food more frequently (Bagdonis et al., 2009; Buckley et al., 2013; Izumi, Wright and Hamm, 2010b; Conner et al., 2011). The results underscore the importance of customized technical assistance focused on the needs of school districts facing a particular set of circumstances.

While the detailed data of the Farm to School Census identify areas with lower participation as targets for assistance, the data also showcase areas of high participation that serve as success stories for other areas. Data from the 2015 Farm to School Census will be used to continue to assess progress toward the "daily access" target and identify school district characteristics related to trends in farm-to-school growth.

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Appendix: Technical Notes on Nonresponse, Weighting, and Estimation

We identified characteristics of districts less likely to respond using a model of nonresponse. The list frame for the Farm to School Census was created based on lists of school food authorities provided by State agencies for all 50 States and the District of Columbia. School district characteristics (district size category, rate of free and reduced-price meals, and region) were added by matching the districts to the 2013 Common Core of Data collected by the National Center for Education Statistics. Responses to the Farm to School Census were matched to the list frame to identify districts that responded.

An abridged survey was delivered to 100 nonrespondents 4 weeks after the original invitations for the Farm to School Census were sent. Rates of participation in farm-to-school activities were similar for nonrespondents and respondents overall, but not for some individual size categories. Table A1 gives the odds ratio results of the logit model for response.

Weights were developed by calculating the inverse probability of response from the response model using the propensity modeling methodology outlined by Carlson and Williams (2001).

Table A1
Logit model of response to the Farm to School Census, odds ratios of responding

Variable	Point estimate	95% Wald confidence limits		
Region				
West	0.989	0.844	1.158	
Mountain	1.378	1.185	1.603	***
Northeast	0.951	0.801	1.129	
Midwest	1.071	0.929	1.234	
Southeast	1.638	1.325	2.026	***
Mid-Atlantic	0.529	0.447	0.626	***
Enrollment				
Very small (≤ 1,000 students)	0.294	0.216	0.401	***
Small (1,001 – 5,000 students)	0.582	0.431	0.787	***
Medium (5,001 – 20,000 students)	0.701	0.510	0.963	**
Rural	1.304	1.176	1.445	***
Farm-to-school policies (number, State level)	0.979	0.964	0.995	**
Percent Democrat (congressional district level)	1.000	0.998	1.002	
Free and reduced-price meals (percent of students certified)	1.055	0.930	1.197	

N=12,799. ** Statistically significant at the 0.05 level. *** Statistically significant at the 0.01 level. Effects of size categories are relative to reference category, large (≥ 20,000 students).
Source: USDA, Economic Research Service estimates from the 2013 Farm to School Census, together with the listframe of public school district school food authorities developed for the Farm to School Census.

The Ordered Probit Model Estimation

The ordered probit model expresses the probability that the Frequency variable (FREQ) takes a given value as a function of several district characteristics. The potential responses—in this case, "never," "occasionally but less than monthly," "monthly," "more than monthly but less than weekly," "weekly," "more than weekly but less than daily," and "daily"—are coded as values ranging from 0 for "never" to 6 for "daily." These responses are categories that have an ordered relationship to one another.

An ordered probit model assumes that the "true" frequency of serving local food is a latent variable that we do not observe. For example, a school district might have served local food a certain number of times per month or per year, while our survey captured only the ordered categories. For school district *i*, the true, unobserved, *FREQ** can be expressed as a linear combination of effects of characteristics plus a random term e:

$$FREQ_i^* = x'\beta + e_i$$

where *x* is a vector of dummy variables for regions and other characteristics (in quartiles or categories) and percent college attendance:

DW = 1 for Western region, 0 otherwise

DMP = 1 for Mountain Plains region, 0 otherwise

DMW = 1 for Midwest region, 0 otherwise

DSE = 1 for Southeast region, 0 otherwise

DMA = 1 for Mid-Atlantic region, 0 otherwise

DNE = 1 for Northeast region, 0 otherwise

DFVAQ1 = 1 for fruit and vegetable acreage within 400 miles, quartile 1, 0 otherwise

DFVAQ2 = 1 for fruit and vegetable acreage within 400 miles, quartile 2, 0 otherwise

DFVAQ3 = 1 for fruit and vegetable acreage within 400 miles, quartile 3, 0 otherwise

DFVAMISS = 1 for fruit and vegetable acreage within 400 miles missing, 0 otherwise

DPCIQ1 = 1 for county per capita income, quartile 1, 0 otherwise

DPCIQ2 = 1 for county per capita income, quartile 2, 0 otherwise

DPCIQ3 = 1 for county per capita income, quartile 3, 0 otherwise

DPSDBC1 = 1 for per-student district budget, category 1, 0 otherwise

DPSDBC2= 1 for per-student district budget, category 2, 0 otherwise

DPSDBC3 = 1 for per-student district budget, category 3, 0 otherwise

DPSFSLCQ1 = 1 for per-student foodservice labor costs, quartile 1, 0 otherwise

DPSFSLCQ2 = 1 for per-student foodservice labor costs, quartile 2, 0 otherwise

DPSFSLCQ3 = 1 for per-student foodservice labor costs, quartile 3, 0 otherwise

DEGT5000 = 1 for enrollment greater than 5,000, 0 otherwise

DRURAL = 1 for rural, 0 otherwise

DSUBURB = 1 for suburban, 0 otherwise

DTOWN = 1 for town, 0 otherwise

DFRPQ1 = 1 for free and reduced-price meal certification rate, quartile 1, 0 otherwise

DFRPQ2 = 1 for free and reduced-price meal certification rate, quartile 2, 0 otherwise

DFRPQ3 = 1 for free and reduced-price meal certification rate, quartile 3, 0 otherwise

DFMDQ1 = 1 in counties with farmers' market density per 10,000 residents, quartile 1, 0 otherwise

DFMDQ2 = 1 in counties with farmers' market density per 10,000 residents, quartile 2, 0 otherwise

DFMDQ3 = 1 in counties with farmers' market density per 10,000 residents, quartile 3, 0 otherwise

DPLTM = 1 in States with less than median number (6) of legislated policies supporting farm-to-school programs, 0 otherwise

PCANYCOLL = percent of adults in State with any college attendance.

The equation for *FREQ**, the unobservable true frequency, can be expanded as:

β_1 (Intercept) +

$\beta_2 D_W + \beta_3 D_{MP} + \beta_4 D_{MW} + \beta_5 D_{SE} + \beta_6 D_{MA} + \beta_7 D_{NE} +$

$\beta_8 D_{FVAQ1} + \beta_9 D_{FVAQ2} + \beta_{10} D_{FVAQ3} + \beta_{11} D_{FVAMISS} +$

$\beta_{12} D_{PCIQ1} + \beta_{13} D_{PCIQ2} + \beta_{14} D_{PCIQ3} +$

$\beta_{15} D_{PSDBC1} + \beta_{16} D_{PSDBC2} + \beta_{17} D_{PSDBC3} +$

$\beta_{18} D_{PSFSLCQ1} + \beta_{19} D_{PSFSLCQ2} + \beta_{20} D_{PSFSLCQ3} +$

$\beta_{21} D_{ELT5000} +$

$\beta_{22} D_{RURAL} + \beta_{23} D_{SUBURB} + \beta_{24} D_{TOWN} +$

$\beta_{25} D_{FRPQ1} + \beta_{26} D_{FRPQ2} + \beta_{27} D_{FRPQ3} +$

$\beta_{28} D_{FMDQ1} + \beta_{29} D_{FMDQ2} + \beta_{30} D_{FMDQ3} +$

$\beta_{31} D_{PLTM} +$

$\beta_{32} PCANYCOLL.$

If the random term e_i is distributed normally, the probability that $FREQ_i^*$ falls in one of the seven ordered categories j, is the probability that $x'\beta + e_i$ falls within thresholds, μ_{j-1} and μ_j:

$$Prob\ (FREQ_i = j) = Prob\ (\mu_{j-1} < FREQ_i^* \leq \mu_j) = \Phi\ (\mu_j - x'\beta) - \Phi\ (\mu_{j-1} - x'\beta),$$

where Φ is the standard normal cumulative distribution function. We used SAS 9.3 to estimate the thresholds μ_j, for j=1…7, and coefficients β_1- β_{32} under maximum-likelihood estimation.

The estimated coefficients of the ordered probit model are not the marginal effects of each variable on the probability of observing a given frequency response, however. For the groups of categorical variables (e.g., region, income quartiles, etc.), we calculated the marginal effect of each variable as the difference in probabilities of a given response under a value of 0 for the variable (e.g., *DRURAL*) and under a value of 1 for the variable, with other variables in the group (e.g., *DSUBURB*, *DTOWN*) set to 0 (since they must be 0 if *DRURAL* is 1), and other variables set to their average levels. For percent college attendance, we calculated the marginal effect as the difference in probabilities for each frequency response under the average level versus a level 5 percentage points higher.

Model Specification

We tested each group of variables for its contribution to model fit using a likelihood ratio test. In order to include the regional differences in the associations with other school district characteristics, we used an interaction model in which each region is interacted with each of the other school district characteristics. The test of each group of related dummy variables (region, fruit/vegetable acreage quartiles, per capita income quartiles, etc.) compares the likelihood of the full model with all variables to the likelihood of a restricted model with coefficients on tested variables constrained to 0. The test statistic, -2 (log L_1- log L_0), is distributed as chi-squared with degrees of freedom equal to the number of restrictions in the test.

For example, to test the contribution of the income variables to model fit, log L_0 would be the log-likelihood for the full model with all variables and interactions included, and log L_1 would be the log-likelihood of the model with coefficients for the income variables and regional interactions with the income variables restricted to 0. The number of restrictions for this test is 21 (3 dummy variables plus 6 regional interactions times 3 dummy variables). The chi-squared critical value for alpha = 0.05 at 21 degrees of freedom is 11.6, and the hypothesis that the coefficients for income and income interactions are 0 is rejected. The complete set of nested hypothesis tests is presented in table A.2 and shows that all groups of variables considered were significant contributors to model fit.

Several of the variables raised concerns of potential multicollinearity. We estimated the interaction model using ordinary least squares to obtain condition index values; values above 10 indicate weak multicollinearity, and values over 100 indicate severe multicollinearity (Belsley et al., 2004). The OLS model with all interactions exhibited a severe degree of multicollinearity (condition index = 1,541). We addressed this problem by estimating a national model with no interactions and separate models for each region, resulting in condition index values ranging from 5 to 18. For the Southwest, Southeast, and Mid-Atlantic regions, we omitted variables after diagnosing the source of multicollinearity to further reduce condition index values to 9, 8, and 7, respectively.

Table A2
Nested model test results

Test	Chi-squared statistic	Restrictions	p-value	
All variables other than region	955.74	175	<.0001	***
All regional interactions	367.7	150	<.0001	***
Region	744.87	156	<.0001	***
Fruit/vegetable acreage	89.02	28	<.0001	***
Income	32.04	21	0.058	*
School district budget	58.24	21	<.0001	***
Foodservice labor cost	38.99	21	0.0098	***
Enrollment > 5,000	40.83	7	<.0001	***
Locale type	65.48	21	<.0001	***
Free and reduced-price meals	40.37	21	0.0067	***
Farmers' markets	102.62	21	<.0001	***
Farm-to-school policies < 6	31.45	7	<.0001	***
Attended any college, percent	62.93	7	<.0001	***

N=9,558. *Statistically significant at the 0.1 level. ***Statistically significant at the 0.01 level.
Source: USDA, Economic Research Service estimates from the 2013 Farm to School Census.

Table A3

Probit coefficient results for regional models of local food frequency in school meals, SY 2011-12

Variable	Western	Mountain Plains	Southwest[a]	Midwest	Southeast[b]	Mid-Atlantic[b]	Northeast
	Percentage point difference in probability						
Fruit/vegetable acreage							
Quartile 1	-0.21 *	0.24 *	0.41	0.34 ***			0.39
Quartile 2	-0.03	0.11	0.09	0.33			0.42 ***
Quartile 3	0.11	-0.05	-0.01	0.25 ***			0.14
Fruit/vegetable acreage missing	-0.22 **	-0.29 **	0.68 *	-0.29 ***			0.24
Income							
Quartile 1	-0.43 ***	-0.001	-0.03	-0.11	-0.04	-0.31 *	-0.08
Quartile 2	-0.23 **	0.02	0.10	-0.09	0.15	-0.53 ***	-0.14
Quartile 3	-0.18	0.07	-0.01	-0.02	0.12	-0.20	0.11
School district budget							
Quartile 1	0.46 ***	0.02	0.16	-0.19 *	0.11	-0.27	0.51 **
Quartile 2	0.27 **	-0.01	0.31 **	-0.02	0.17	0.25 *	0.18
Quartile 3	0.35 **	-0.05	0.09	0.17 *	0.32	0.06	0.15
Foodservice labor cost							
Quartile 1	-0.15	0.21 *	-0.06	0.18 *	0.48 ***	-0.19	-0.14
Quartile 2	0.003	-0.15	0.03	0.18 *	0.19	-0.08	-0.12
Quartile 3	-0.15	-0.16 *	0.07	0.11	0.07	-0.02	0.08
Enrollment > 5,000	0.41 ***	0.32 *	0.56 ***	0.15	0.29 **	0.41 ***	0.26
Locale type							
Rural	-0.65 ***	-0.46 **	-0.27	-0.48 ***	-0.36 **	-0.34	-0.42 *
Suburban	-0.24 *	-0.20	0.05	-0.35 **	-0.03	-0.16	-0.39 *
Town	-0.38 ***	-0.16	-0.05	-0.35 **	-0.23	-0.42 *	-0.53 **
Free/reduced-price meals							
Quartile 1	-0.02	0.16	0.30 *	0.10	-0.46 *	-0.18	-0.06
Quartile 2	-0.14	0.16	-0.07	-0.10	-0.16	-0.02	-0.07
Quartile 3	-0.08	0.15	-0.15	-0.12	0.23 **	-0.08	-0.27
Farmers' market density							
Quartile 1	-0.68 ***	-0.04	-0.32 **	-0.31 ***	-0.47 ***	-0.18	0.29
Quartile 2	-0.61 ***	0.06	-0.19	-0.47 ***	-0.35 **	-0.18	-0.29 **
Quartile 3	-0.35 ***	0.07	-0.03	-0.15 *	-0.37 ***	-0.09	0.01
Farm-to-school policies < 6	-0.26 **	-0.63 ***	-0.51 ***	0.17 ***	-0.18	0.07	0.06
Attended any college, percent	4.27 **	2.15 **		4.93 ***	6.03 **	0.98	-3.07 *
Sample size	1,296	1,740	1,426	2,247	897	802	1,160

[a]College attendance omitted to address multicollinearity; see Appendix. [b]Fruit and vegetable acreage categories omitted to address multicollinearity; see Appendix. * Statistically significant at the 0.10 level. ** Statistically significant at the 0.05 level. *** Statistically significant at the 0.01 level. For categorical variables, marginal effects are the difference in probability that local foods were served daily, compared to the reference category. For educational attainment, the marginal effect is the contribution of 5 additional percentage points of college attendance compared to the average. See Appendix for details on how coefficients are translated to the marginal effect of each variable.

Source: USDA, Economic Research Service estimates from the 2013 Farm to School Census.