Local Foods: Estimating Capacity

David Timmons
Community Development and Applied Economics
University of Vermont
Burlington, Vermont
dtimmons@resecon.umass.edu

Qingbin Wang
Community Development and Applied Economics
University of Vermont
Burlington, Vermont
qwang@uvm.edu

Dan Lass
Resource Economics
University of Massachusetts
Amherst, Massachusetts
dan.lass@resecon.umass.edu

Many parts of the United States have seen a surge in local food interest during the past decade, as reflected in part by the rapid growth of farmers' markets, community supported agriculture (CSA) farms and other food purchasing directly from farmers. According to U.S. agricultural census data, real direct sales, in 2002 dollars, increased 23% between 1997 and 2002, to over $812 million (USDA, 2004). Such direct agricultural sales are the most obvious indicator of local food production and use. Hundreds of initiatives and projects promoting local food have been implemented around the country, including farm-to-school programs, local restaurant fare, and local harvest dinners. The name "localvore" has been adopted by the strongest proponents of local food, who actively seek to base their diets on local production.

On the consumer side, interest in local foods has been stoked by popular literature like Barbara Kingsolver's Animal, Vegetable, Miracle (2007), which described her family's year-long experiment in growing and eating local foods in Virginia. In Eat Here, Halweil (2004) both related how traditional food supply systems went global, and made a multi-faceted case for relocalization. Pirog et al (2001) calculated the travel distance of selected Iowa food products, and arrived at the often-quoted figure of 1,546 miles of travel from "conventional" sources and only 44.6 miles for local Iowa sources. Carbon emissions were estimated at 8.3 million pounds per year in the conventional system, and 0.5 million pounds per year for the best of several more local distribution options. Lyson (2004) emphasized "civic agriculture" as a critical component of rural economies and rural societies in general. A number of studies (Greenberg Quinlan Rosner Research Inc., 2002; Wilkins, Bowdish, & Sobal, 2002) have also looked at consumer knowledge of and interest in local food.

The USDA and many state departments of agriculture are actively promoting local food, and extension professionals have become more involved in local food issues. In Vermont, for example, the "Buy Local, it's just that simple" campaign encourages consumers to shift 10% of their food purchases to local providers, and estimates the potential economic impact of doing so to be $100 million. In Massachusetts, the "Be a Local Hero Campaign" has gained national attention for its approach to promoting local food products. The growing demand for local food is expected to provide opportunities for many farmers to improve their profitability through local markets, and will likely increase needs for information and assistance from extension professionals.

Despite the growing interest in local foods, there is little information available to measure how much food might be local in any given place. Without such information, it is difficult to assess what opportunities exist, to set goals, or to measure change. Feenstra (1997) noted that "… more studies that ask questions about regional food self-reliance are needed... A first step will be to identify meaningful indicators and measurement methods." This paper proposes a two-part method for estimating local food capacity:

- calculating local production and consumption for aggregated categories of food products, to determine overall local capacity, then
- conducting more detailed assessments of local production of specific, locally significant foods.

An example of using this method is then provided, based on data from Massachusetts and Vermont, two leading local food states, as measured by direct agricultural sales: Massachusetts has the greatest per-farm direct sales and Vermont has the highest per capita direct sales among the fifty states (USDA, 2004).

Maximum Percentage of Local Food

While the USDA's Census of Agriculture collects a great deal of data at the county level, such data do not directly indicate how much of a region's food supply might be local. An exact calculation of a region's local food use would require data on regional food production and consumption, as well as data on food exports and imports from the region. But because regional food import and export data are not generally available, one feasible approach is to simply compare local production to local consumption. This results in an upper bound estimate, or the maximum percentage of food that could be local if all local needs were met from local sources before any food were exported. Since an unknown amount of cross transportation normally occurs (for example, apples may be both imported *and* exported from a region), the production/consumption ratio only reveals a hypothetical maximum amount of local food, or how much local food might be obtainable in the future based on current production. Yet this maximum local food percentage is likely the best available indicator of the current and potential scale of local food production.

From Census of Agriculture data, a local food maximum can be calculated for a county, a group of counties, a state, a region, or the nation. This paper presents examples from two states (Vermont and Massachusetts) as well as overall maxima for all fifty states.

Calculating National Benchmark of Food Consumption

To evaluate the maximum percentage of local food, we must first know how much food is consumed in each area or region. The challenge is to express local consumption in units that can be directly compared to local production. Many different measures have been used for both food production (raw weight, farmgate value) and food consumption (processed weight, retail value, food away from home value), and the units of measure are often not comparable. While dietary intake data can be used to compare consumption to production of specific food items, such information is difficult to generalize to the entire food supply. Food use includes a wide variety of products that may be difficult to track, as well as intermediate commodities used as animal feed, and some food waste. Establishing a benchmark of food consumption based on national production, as described below, is used to avoid most of these problems and allow a maximum local food percentage to be calculated.

Table 1 shows this national benchmark, calculated as per capita farmgate production value. Data are from the quintennial USDA Census of Agriculture, representing the most comprehensive information on national agricultural production. Since the Census tracks all agricultural production in the United States, after we make corrections for imports and exports, the national production figures can be used as a proxy for food consumption. At the national level all production (net of imports and exports) is consumed (or wasted, which is also part of the food system).

Table 1. U.S. Total Food Benchmark

USDA Category (2002 Census of Agriculture)	2002 Market Value (1000 $)	Net Exports	Adjusted Market Value (1000 $)	U.S. 2002 per Capita Production ($)
1. grains, oilseeds, dry beans, and dry peas	$39,957,698	21%	$31,442,659	$109.04
2. vegetables, melons, and potatoes	12,785,898	-3%	13,191,098	45.74
3. fruits, tree nuts, and berries	13,770,603	-25%	17,273,959	59.90
4. other crops and hay	7,929,618	0%*	7,929,618	27.50
5. poultry and eggs	23,972,333	11%	21,253,203	73.70
6. beef, pork, and other meat	58,057,906	-1%	58,527,966	202.96
7. milk and other dairy products	20,281,166	-2%	20,703,329	71.79
8. aquaculture	1,132,524	0%*	1,132,524	3.93
9. other animals and other animal products	721,738	0%*	721,738	2.50
TOTAL U.S.	$178,609,484		$172,176,094	$597.07

*no adjustment made to this category
Source: USDA 2004

The Census aggregates agricultural production into 16 categories. Five categories that primarily represent non-food are excluded from this analysis and three red meat categories are combined into one, to facilitate the import-export adjustment (discussed below). Thus, nine food-product categories are used in the analysis, as shown in Table 1.

Note that the categories used do not perfectly measure products used in the U.S. food system. The excluded "nursery, greenhouse, floriculture, and sod" category, for example, does include greenhouse vegetables. But vegetables account for only 4.9% of the space under glass (USDA, 2004), and value of greenhouse vegetable crops is not provided in the Census, so the category is excluded. Thus, the categories used represent the best available measure of U.S. food production, though small amounts of food-related products are excluded and small amounts of non-food are likely included. The Census of Agriculture does not include seafood (other than aquaculture) or other food from wild sources, so these foods are excluded from the analysis. While private gardens also provide some local food, their contribution is excluded in the calculation due to lack of data.

The total production values reported in the second column of Table 1 are then adjusted for imports and exports, using food disappearance data from the USDA's Economic Research Service (USDA Economic Research Service, 2002). The adjusted figures reflect production that would be needed to supply all national consumption, and thus, can be used as consumption estimates. Note that Census of Agriculture production categories and measures do not perfectly match any available data on national food imports and exports. Thus, the import-export adjustment can be considered only an approximation, but still represents an improvement in the accuracy of the national consumption benchmark.

Table 1 summarizes the calculation of the U.S. per-capita consumption benchmark, based on import-export adjusted U.S. production, and expressed in the desirable unit of farmgate dollars per capita. Using this method, all intermediate and final food products are counted: animal feeds, food consumed both at home and away from home, etc.

Local production can then be expressed as a percentage of the $597.07 per capita production and consumption figure for the United States as a whole. This method assumes that diets are similar across the United States. Also, since production and consumption are measured in dollars, more valuable foods like meats influence totals more than their caloric values might suggest.

Comparing Local Production and Consumption

Having calculated the U.S. per capita food consumption benchmark, the next steps are to calculate local (county or state) per capita production as a percentage of that benchmark, and then to obtain a local food maximum. Local production data also come from the Census of Agriculture, and the USDA categories are again rearranged slightly as described above for the benchmark.

Results for Vermont local food are shown in Table 2. Production exceeds consumption for several categories, notably dairy. Because the state produces far more dairy than the state's residents could consume, most of the dairy production must necessarily be exported, not used locally. Thus the maximum local food contribution in each category is the smaller of U.S. per capita production (consumption) or state per capita production. In Vermont, the possible dairy contribution to local food is capped at the state consumption level, as shown in Table 2. Category values are then summed, and divided by the U.S. per capita production (representing consumption) to arrive at a local food maximum. In Vermont, for example:

$$\frac{\text{\$225.77 per capita food value produced and useable locally}}{\text{\$597.07 U.S. per capita food production (consumption)}}$$

$$= 37.8\% \text{ maximum local food}$$

Table 2. Vermont Local Food Totals

	Production per Capita		Maximum Local Food	
USDA category (2002 Census of Agriculture)	US ($2002)	VT ($2002)	VT ($2002)	VT (%)
1. grains, oilseeds, dry beans, and dry peas	$109.04	$4.49	$4.49	4.1%
2. vegetables, melons, and potatoes	45.74	16.45	16.45	36.0%
3. fruits, tree nuts, and berries	59.90	15.03	15.03	25.1%
4. other crops and hay	27.50	**39.30**	**27.50**	100.0%
5. poultry and eggs	73.70	9.53	9.53	12.9%
6. beef, pork, and other meat	202.96	76.32	76.32	37.6%
7. milk and other dairy products	71.79	**555.38**	**71.79**	100.0%
8. aquaculture	3.93	2.15	2.15	54.7%
9. other animals and other animal products	2.50	**3.13**	**2.50**	100.0%
TOTAL	$597.07	$721.77	$225.77	37.8%

Source: USDA (2004)

This local food measure reflects the relationship between volume of production and population, as well as diversity of production. Since diets include many foods, local food consumption can be higher when production diversity matches diet diversity. With Vermont's dairy concentration, local food is constrained more by lack of production diversity than by total production. A state for which the per capita production matched or exceeded U.S. production (consumption) in every category would have a local food maximum of 100%, though in 2002, there were no such states (see Table 4).

The case of Massachusetts is somewhat different, as shown in Table 3. While Massachusetts production is not as concentrated in one sector as Vermont's, it also has a much larger population in relation to the size of its agricultural base. Thus Massachusetts local food appears to be more constrained by total production than by lack of diversity. However, as shown below, a more detailed analysis indicates some production diversity issues in Massachusetts as well.

Table 3. Massachusetts Local Food Totals

USDA category (2002 Census of Agriculture)	Production per Capita: US 2002 ($)	Production per Capita: MA 2002 ($)	Maximum Local Food: MA ($)	Maximum Local Food: MA (%)
1. grains, oilseeds, dry beans, and dry peas	$109.04	$0.21	$0.21	0.2%
2. vegetables, melons, and potatoes	45.74	5.96	5.96	13.0%
3. fruits, tree nuts, and berries	59.90	8.64	8.64	14.4%
4. other crops and hay	27.50	1.75	1.75	6.3%
5. poultry and eggs	73.70	1.88	1.88	2.6%
6. beef, pork, and other meat	202.96	1.67	1.67	0.8%
7. milk and other dairy products	71.79	9.26	9.26	12.9%
8. aquaculture	3.93	1.47	1.47	37.6%
9. other animals and other animal products	2.50	3.05	2.50	100.0%
TOTAL	$597.07	$33.88	$33.34	5.6%

Source: USDA 2004

Table 4 shows local food maximum percentages for all fifty states. Note that raising food locally is only a first step; a lack of processing facilities can also constrain local food consumption. Yet a maximum figure can be based on production alone. For some crops, seasonality is also important, and is not reflected in these calculations (e.g. fruit production and consumption may appear to be balanced, but fruit may actually be in surplus in some seasons and in deficit in others).

Table 4. Local Food Maximum Percentages for All U.S. States

State	Maximum Local Food Percentage	State	Maximum Local Food Percentage
Alabama	37.4%	Montana	72.8%
Alaska	3.7%	Nebraska	87.6%
Arizona	38.2%	Nevada	29.3%
Arkansas	73.2%	New Hampshire	5.8%
California	51.1%	New Jersey	7.2%
Colorado	78.0%	New Mexico	71.8%
Connecticut	8.8%	New York	22.4%
Delaware	41.6%	North Carolina	64.4%
Florida	33.8%	North Dakota	82.9%
Georgia	39.3%	Ohio	50.5%
Hawaii	34.5%	Oklahoma	79.1%
Idaho	81.4%	Oregon	73.5%
Illinois	44.3%	Pennsylvania	39.7%
Indiana	70.2%	Rhode Island	2.6%
Iowa	83.1%	South Carolina	29.5%
Kansas	70.1%	South Dakota	82.8%
Kentucky	71.9%	Tennessee	45.0%
Louisiana	42.8%	Texas	64.3%
Maine	39.4%	Utah	61.2%
Maryland	27.5%	Vermont	37.8%
Massachusetts	4.0%	Virginia	40.1%
Michigan	51.4%	Washington	75.3%
Minnesota	90.0%	West Virginia	30.6%
Mississippi	58.0%	Wisconsin	81.2%
Missouri	79.9%	Wyoming	58.0%

Local Food Detailed Calculations

The advantages of the aggregated method described above are in being able to calculate a local food maximum for all food, including all intermediate (animal feed) products required, and in being able to generate comparable statistics for every state and county in the United States. But there are also several disadvantages. Food production is highly aggregated into only nine categories. To some extent this allows for substitution: either turkey or chicken could contribute to local poultry, for example. Yet substitution has limits, and aggregation may mask important production information within categories. The above method also depends on having U.S. national data to calculate the consumption benchmark. These data are only available every five years through the Census of Agriculture. Local food analysis can benefit from timelier and more detailed data.

Having generated local food totals with the method above, another useful local food analysis technique is to directly compare pounds of various foods produced to pounds consumed. This again provides a local maximum for a particular commodity. Production data in pounds are more readily available than the farmgate values obtained from the Census of Agriculture, and may come from regional USDA National Agricultural Statistics Services (NASS) offices, or local trade groups. Production can also be calculated from acres in production and typical yields per acre. Some of these data are available annually. U.S. consumption data are available from the USDA Economic Research Service (ERS).

Returning to the case of Massachusetts, we see from Table 3 that for the fruit category Massachusetts has a local maximum of 14.4%. Knowing that Massachusetts is physically capable of growing many varieties of fruit, and that fruit production was historically important there, we may wish to know more about current fruit production. Table 5 shows selected Massachusetts fruit production and consumption data (note that this does not include all fruits produced or consumed in the Commonwealth).

One issue in using annual agricultural data is that yields of many crops vary significantly from year to year. And production values depend on both yields and market prices. Thus there is much “noise” in annual production data, and techniques to generate representative data may be needed. In Table 5, Massachusetts production data were based on the number of acres in production (from the 2002 Census of Agriculture), multiplied by average yields from NASS for 2002-2005. In some cases where Massachusetts yield data were not available, data from nearby states were used.

Consumption data in Table 5 are based on data from the USDA ERS. For specific fresh fruit products, the data available extended from 1970-2003 or 1981-2003. Annual data that were available over time were used to forecast per capita consumption for 2006. Forecasts were developed using time-series methods, again smoothing some of the random disturbances that affect annual estimates.

In the more detailed analysis shown in Table 5, we see that Massachusetts' performance in the fruit category is somewhat inflated by a large surplus of cranberries. Unless Massachusetts residents consume more cranberries than the national average, Massachusetts' 14.4% total in the fruit category (from Table 3) is likely overstated. But Massachusetts is at least self sufficient in cranberries, and possibly in blueberries. Current apple production appears capable of meeting about 35% of local needs. While this is less than total self-sufficiency, it still represents a large and viable apple industry. This could be assessed for potential expansion. Pears and raspberries show a similar status. Peaches and strawberries currently contribute less to local consumption, again raising questions for additional research.

Given the fruits and production/consumption patterns shown in Table 3, seasonality is currently not important in Massachusetts, though seasonality might be significant in other times and places. A state that produced 100% of its grape consumption, for example, might still not meet grape demand in the off season (when grapes would likely be imported), so production would have to be discounted by a seasonal availability factor.

Table 5. Production and Consumption of Selected Fruits in Massachusetts

	Estimated Total Consumption[a] (1,000 lbs.)	Estimated Total Production[b] (1,000 lbs.)	Surplus (Deficit) (1,000 lbs.)	Maximum Local Fruits in MA
Apples	116,022	39,863	(76,159)	34%
Blueberries	2,999	3,043	44	100%
Cranberries	740	156,677	155,934	100%
Peaches	33,643	2,603	(31,040)	8%
Pears	20,351	4,027	(16,323)	20%
Raspberries	2,999	1,019	(1,980)	34%
Strawberries	35,941	1,041	(34,900)	3%

[a] Estimated total consumption was calculated using U.S. per capita consumption estimates available from the USDA Economic Research Service.
[b] Estimates of total MA production are available from the USDA National Agricultural Statistics Service.

Other Local Food Indicators

While the calculations described above likely represent the most accurate statistics that can be generated for local food from widely available data, a number of other indicators may also be used. The Census of Agriculture tracks direct sales through farmstands, farmers' markets, etc. Direct sales indicate the extent and importance of a direct-sale farm economy, and by extension, the extent of consumer interest in buying products from local farmers. Locally, many farmers' markets also maintain their own statistics on sales of agricultural products, and the USDA periodically conducts national farmers' market surveys (USDA, 2002). Less formal research on local food can also be conducted. The UK's Soil Association, for example, asked consumers to record how much of the organic produce and meat for sale in their groceries was sourced domestically. They then compiled and publicized statistics for different grocery chains across the UK (Green & Smithson, 2005). Many such local sources also provide annual data, while indicators based on the USDA Census of Agriculture can only be obtained every five years.

Conclusions

Though it may never be possible to gauge exactly how much food consumed in any particular place is grown there, the measures and methods described in this article represent reasonable estimates. They are also low-cost indicators that can, in most cases, be compiled from existing publicly available data. Such information can help to develop local food programs, and help Extension professionals to guide farmer and consumer groups. Specific uses of local food data include:

- establishing baselines for how much of what kinds of foods are local in a given area,
- monitoring changes over time,
- setting realistic goals for local food production and consumption,
- raising relevant questions for additional research, and
- evaluating, comparing, and contrasting the success and efficiency of alternative local food promotion programs.

The growing consumer interest in local foods represents new opportunities for farmers and brings about new demand for information and assistance from extension professionals. Attention to quantitative indicators of local food production and consumption can be an important component of developing successful local food programs. The local food indicators and estimation methods presented in this article are expected to be a useful reference for extension professionals and farmer groups that are interested in local food issues.

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Abstract

While local food is enjoying new interest in much of the country, data revealing the extent of local food production and consumption are typically lacking. This lack of data has made it difficult to set local food goals and assess progress toward such goals. This paper describes two methods for quantifying local food consumption and presents estimation results using national and state data. The local food indicators presented in this article can be easily estimated with publicly available data, and represent low cost indicators of local food use.