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The Chicago Local Food System: An Economic Assessment

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1. Introduction

This project is initiated by Openlands, a metropolitan land conservation organization, and is a joint collaboration of Fresh Taste, the Chicago Metropolitan Agency for Planning, and the Center for Economic Analysis at Michigan State University. It is motivated by three needs. The first is to develop cost-effective, credible and replicable economic measures of Chicago's local food system, defined for the purposes of this study as 38 contiguous counties around the Chicago Metropolitan Statistical Area, and henceforth referred to as the Study Region. The second is to understand the economic implications of production and consumption patterns of the region's local foods and the potential impacts of changes in the local food system. Third is to identify policy prescriptions necessary to help the local food system evolve. The specific project objectives include:

1. Estimate the economic baseline values of local foods for the Study Region;
2. Estimate the economic impacts of a hypothetical increase, 10 percent and 25 percent of the baseline identified in objective one, in production/consumer purchases of locally-sourced foods within the Study Region, and assuming the following:
    a. There exists unmet consumer demand at current prices;
    b. Farm-producer expenditures vary between conventional and conservation practices;
3. Determine the necessary changes in land use, within the Study Region, should local food production in the region increase by 10 percent and 25 percent of the baseline identified in objective one. This assumes the following:
    a. There exists unmet consumer demand at current prices; and
    b. Farm-producer expenditures vary between conventional and conservation practices.

This report is laid out in the following fashion. In the *Background* section, we provide a discussion on local food systems in the context of relevant economic considerations such as definitions and measurements. This leads up to a discussion of the primary way in which local food systems have been broadly measured, via input-output modeling. In the *Data* section, we discuss our sources of data and frame the Study Region. This is followed by the *Methods and Procedures* section in which we discuss the specific input-output modeling techniques used to establish the baseline measures. We then discuss the process for establishing a basket of goods to be considered in the assessment and considerations for land use which includes potential shifts in production. The *Analysis* section includes the empirical models used to determine baseline estimations and the impacts from simulated shifts in production or exporting of local foods. This section also includes a presentation and discussion of the empirical results. We conclude the report in the *Summary and Conclusion* section with a summary of the outcomes followed by policy implications and areas for further study.

2. Background

Local food systems have been thoroughly examined over the past two decades, though there remain a number of unresolved challenges that impact the framework, results, and policy implications of studies focused on such systems. This examination of the Study Region is not an exception, as the two major hurdles encountered include defining the local food system and the method(s) employed to measure it. The main issue is the interconnectedness between the local food definition and the specific method for measuring the system. The choice of how one defines local food impacts the methods by which local foods can be measured. Conversely, the method one adopts for measuring local foods impacts how local foods are defined (McFadden, Conner, et al., 2016; Miller, Mann, et al., 2015).

The most recent attempts to measure local food systems have approached this issue from one of two general frameworks: 1) methods that allow for flexible definitions; and 2) definitions of local food that are driven by specific modeling methods. For example, if the local food system is specifically defined by the unique goods offered in a region's farmers markets and consumed in the selected geographic region, then data must be collected that accurately reflect the unique basket of goods and region that provides it (Henneberry, Whitacre, & Agustini, 2009; Hunt, 2007; Schmit, Jablonski, and Mansury, 2013). However, these types of data are labor and cost intensive to collect and, as a result, are not widely available for all geographies and time. Alternatively, methods-driven definitions may include features of local food systems that are outside the scope and interest of a particular study but are considerably less costly to implement. For example, regional Input-Output (IO) models may include fresh and processed local foods as well as a range of consumers (e.g., households, government, and non-governmental organizations) within a single measure. While IO models provide a comprehensive assessment of the size of the local food system, they are not effective at delineating the different means of access to local food, e.g., various forms of direct sales.

What follows in this background section is a brief discussion about the challenges of measuring local food systems—namely defining what a local food system is; some of the pitfalls that need to be addressed when considering the local food "systems" approach; and recent efforts to overcome these particular obstacles.

2.1 Economic Framework for Local Food Systems

Establishing a definition for what makes up a local food system has planning, social, geographic, economic, and political ramifications. For example, defining a local food system based on particular social perceptions may restrict the geography or the type of products included. This, in turn, restricts the kind of measurement and tools used to gauge the local food system. The imposed geographic and economic restrictions could also have policy and planning implications.

Alternatively, imposing a restrictive definition based on a particular measurement method can affect what gets classified as (and as not) local foods, and this will inevitably impact the social consequences of the system.

In 2008, the US Congress adopted a definition of local food based strictly on geography – “less than 400 miles from its origin or within the state which it was produced” (Martinez, et al., 2010).[1] However, consumers have varying definitions as to what they perceive to be local food that depend on attributes beyond geography (Darby, et al., 2008; Hand and Martinez 2010, Onozaka, Nurse, and McFadden 2010). Perceptions of local food may be further complicated by the good itself, e.g., citrus fruit vs. grains, or by who is producing the good, e.g., small vs corporate producers. While geography is relevant, this 2008 definition did not resolve the underlying issues, and there remains no consensus as to what a definition of local food should encompass (Martinez, Hand, et al., 2010). With different stakeholders placing different attributes to what they consider to be local food, the relationship may be represented in the following diagram. Those that place geography as the key attribute of local food would see the space under geography as that which represents local food. Those seeking product performance attributes may see a different space from those seeking their ideal production or marketing process for the foods they eat. Each concept has shared space with other concepts, but limiting the analysis to one or another concept may overlook other attributes consumers assign to local foods. Rather than pick the definition, one can look toward an envelope that encompasses all attributes tied to local foods.

One consideration, given the more recent economic literature, may be that restricting local food measures to a one-size-fits-all definition is inappropriate. It may be that definitions need to include food characteristics and be region specific, i.e., driven by the relevant characteristics of a particular region that makes up the local food system. For example, consumers’ perception of what makes up local is largely clouded by the attributes they assign to local foods (Martinez, Hand, et al., 2010). Along with gauging attributes that consumers place on local foods, Onozaka, Nurse, and McFadden (2010) delineate the regional context consumers place on local foods from that of regional foods. They used a national, web-based survey of consumers, where consumers identified “local foods” as those largely produced within 50 miles or within the county of purchase. They further identified “regional foods” as those that were produced within up to 300 miles from place of purchase or those produced in the state.

[1] In the administration of federal agricultural programs, the USDA defines local as that which is purchased for final consumption within 400 miles and within the state of its source.

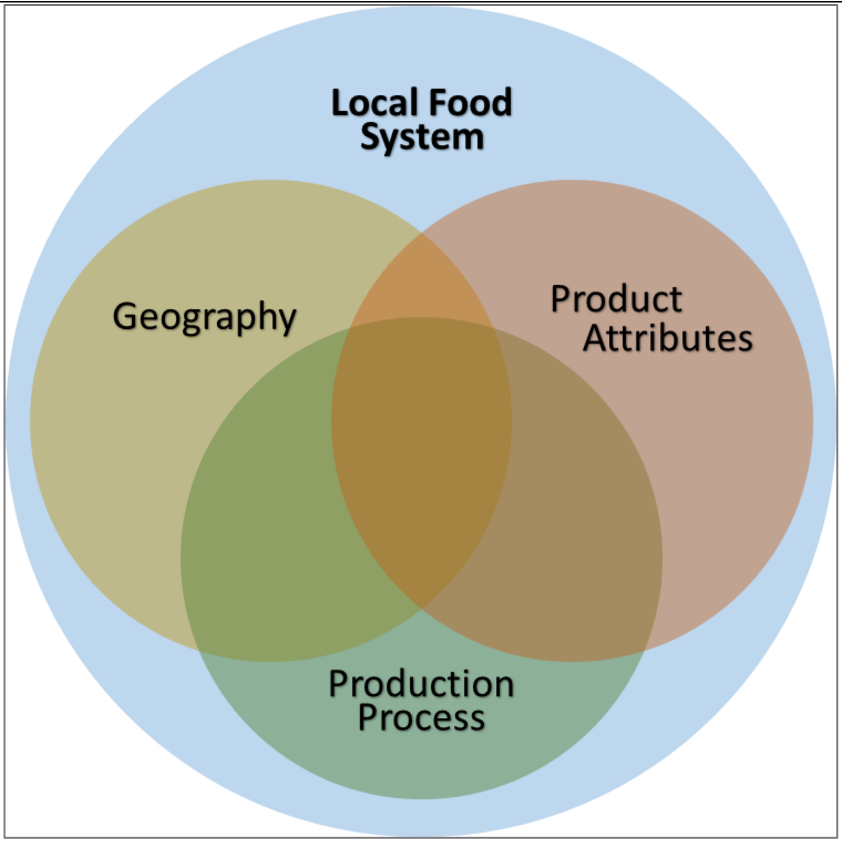

Figure 2.1-1: Conceptual Space of Local Foods

Three important economic considerations that can impact definitions and are relevant for developing measures of local food include: 1) available physical resources including climate and soils that affect the ability of a region to self-supply; 2) the extent to which minimally-processed and processed foods are considered part of the local food system, and how this will define the size of the value chain; and 3) the regional policies in place that support (or detract from) the local food system (Martinez, Hand, et al., 2010; McFadden, Conner, et al., 2016; Miller, Mann, et al., 2015) . First, Swenson (2010) recognized that expanding a local food system requires that some existing practices be abandoned. While this presents a challenging economic situation to model related to opportunity costs, (discussed in more detail below) it also introduced another important question: what are regions realistically capable of producing and supporting in the first place? In other words, some regions are better suited to produce particular goods compared to others, and this means that depending on the region, the selections, and potentially per-capita volume, of locally produced goods will likely differ and be impacted by season, environment, and other resource considerations. Classic examples are banana and citrus fruit consumption in the Midwest. Combined, these fruits account, on average, for about half of all fruit consumption, but citrus fruits are primarily produced in four states, Arizona, California, Florida, and Texas, while bananas are primarily imported from tropical regions (Lin, Buzby, et al., 2016;USDA Economic Research

Service 2014, 2015). Therefore, the makeup of local fruit available in southern states like Florida or Texas would look very different from those in Midwestern states, like Illinois or Michigan.

Second, Low, Adalja, et al., (2015) emphasized the growing importance of local intermediaries (e.g., local wholesalers and food manufacturers) in the local food value chain. While much of the early local food literature restricted the focus on fresh food from farmers markets (Brown and Miller, 2008), Low, Adalja, et al., (2015) pointed to the increase in revenue experienced by local producers who also traded with local intermediaries. Their findings highlighted the potential contribution to a local economy that intermediaries can provide, thus justifying expanding the definition of local foods to include value-added products that may span beyond the traditional farmer's markets venues. Similar findings have also been reported by subsequent studies (McFadden, Conner, et al., 2016; Miller, Mann, et al., 2015).

Third, a new report from the USDA Agricultural Marketing Service (AMS) highlight some local, regional, and state policies that may aid in the growth local foods systems. These may include investment in repurposed public lands to produce food, addressing obstacles to food system innovations, challenges to meeting food safety guidelines, or branding campaigns (McFadden, Conner, et al., 2016). In this, "local" may afford a higher margin value proposition for growers that enable them to profitably operate on disjointed and small plots of land. Such urban and peri-urban, small-plot operations have real socio-economic implications toward building workforce experience of disadvantaged populations, and generate economic opportunities in disadvantaged regions. While such potential impacts are beyond the scope of this report, they are relevant to the broader policy discussion.

2.1.1 Economic Measurement Philosophies

Expansion of local food systems represents an import substitution assertion, where imported foods are supplanted with locally-sourced foods. This has significant implications to those involved in the local food markets, but also to the broader economy. From an economic perspective, importing foods from outside the region represents an outflow of wealth from local residents. This is sometime referred to by the "leaky bucket" metaphor. That is, a $1 apple imported means that someone outside the community has increased their earnings by $1. When they spend from those earnings, it is likely to impact their community. Alternatively, if that $1 apple was sourced locally, then that dollar is retained in the local economy to be spent on other goods and services, thereby, plugging the leak in the bucket. Conceptually speaking, one would expect that retaining more dollars by self-supplying the goods consumers demand generates wealth in the local economy. In other words, the economic goal is to retain local consumers' dollars in the local economy as long as possible. As simple as this concept appears, it overlooks real-world issues around regional competitive and comparative advantage. If other regions can produce apples at a lower cost than local producers can, then import substitution may result in a decline in the local standard of living, and consumers end up paying more for the same amount of goods.

Additionally, agglomeration effects can impact grower and processor efficiency if commodity producers co-locate with other similar producers. Agglomeration effects take many forms including the transference of knowledge through a mobile workforce, networks and technical consultants. Extension educators at US land-grant universities may specialize in certain commodities, but be grounded by the geographic space they can cover. Such shared resources are most efficient when co-located, implying that specialization can increase the overall economic health of a region. However, specialization may run counter to the diverse demands of local food systems, where a broad spectrum of goods must be co-generated within a defined region.

The economic implications of local food from an economic development perspective are quite complex. As an extreme example, we should recognize that some commodities like oranges will not be competitively produced in the Midwest in the foreseeable future, while other local products with a cost disadvantage can be competitive if the correct consumer value proposition for paying more for local attributes is reached. Some commodities that do not currently compete may be competitive under modern production techniques. Alternatively, products with a regional comparative advantage may fit right at home in the Midwest and require little intervention to make them a part of the regional flavor and the regional food system.

Regardless, measuring a local food system would include incorporating the three economic considerations into a cohesive framework, where impacts are based on net effects of changes in consumer purchases. Following Hughes et al. (2008) direct effects should recognize foregone purchases in the pursuit of local foods. In particular, when consumers purchase more fresh tomatoes from farmer’s markets but do not increase their overall consumption of tomatoes, then fewer tomatoes will be purchased from conventional channels (Jablonski, Schmit et al. 2016). While the increase in purchases at farmer’s markets has a positive impact on the local economy, there would be a corresponding negative impact on the broader economy due to reduced purchases at the grocer. In other words, the net effects and the channels that these net purchases take to consumers is what must be captured when measuring local food systems.

2.2 Local Foods from an Input-Output Model Perspective

Many studies have attempted to quantify the size of local food systems but may fall short of desired expectations (Martinez, Hand, et al., 2010; McFadden, Conner, et al., 2016). Such efforts generally target specific transactions with known association with local food production. These may include direct to consumer sales reported by farms or sales at farmers’ markets. Such specific transactions may overlook a much larger component of local food systems. According to Low, Adalja, et al. (2015), non-direct to consumer channels may make up a substantially larger share of local food purchases. Accordingly, they and other researchers argue that local food has to go mainstream to have a viable impact on consumer eating habits (King, Gómez, and DiGiacomo 2010, King et al. 2010; Low, Adalja, et al., 2015). The data underlying IO models may be the most comprehensive and cost effective alternative to counting receipts from intermediate sales of local foods, as the data provides a comprehensive accounting of all transactions underlying an economy.

The use of IO models to address economic questions about local foods systems have been applied in a variety of frameworks, from specific definition of local foods, e.g., farmer's markets, to very broadly defined, e.g., all locally-produced goods that are consumed locally (Henneberry, Whitacre, and Agustini 2009, Hughes et al., 2008; McBratney et al., 2005; Miller et al. 2015, Schmit, Jablonski, and Mansury, 2013, Stickel and Deller, 2014, Watson et al., 2015). The primary benefit of IO modeling is that it allows for a range of geographies (municipal/MSA, county, state or a regional mix) while also making considerations for the net economic effect of the system in question. Further, IO models can be restricted to what a defined region is capable of producing and include considerations for broader definitions such as the inclusion of intermediaries into the value chain. In short, IO models provide a means to a holistic economic approach to measuring local food systems.

Two recent examples that provide this holistic approach are Miller et al., (2015) and Watson et al., (2015). Miller et al. established a method of tracing transactions throughout the local economy, from farm to consumer, using a regionally specified IO model for establishing baseline estimates of the size of the local food system. Watson et al. used a regional IO model to estimate the contribution of the local food system to the local economy. Both approaches have relevancy, as Miller et al. establish the direct value of transactions tied to local foods, while Watson et al. estimates take into account secondary transactions tied to the supply of local foods.

3. Data

Several data sources were developed and used in this analysis. First, IMPLAN Pro 3.1 (IMPLAN Group LLC 2015) and the regional data provided by IMPLAN, LLC, was the primary source of analytical data for modeling the 38-county local food baselines and for undertaking the local foods contribution analysis. County-level IMPLAN data sets were purchased for Illinois, Indiana, Michigan and Wisconsin for 2013. IMPLAN employs the Bureau of Economic Analysis Benchmark Input-Output accounts, which are updated and regionalized to the corresponding modeling region using regional data provided by the Bureau of Economic Analysis, the USDA, US Census Bureau and others.

Second, the IMPLAN data was vetted with other data sources. For example, the U.S. Census, Population Division provided annual estimates of county populations, while the Department of Commerce's County Business Patterns (U.S. Department of Commerce 2015) provides counts of establishments by county, but provides very limited indication of the size of operations in terms of payroll or employment. Economic Census data were limited to metropolitan divisions and lacked industry granularity. So this was not included in the data set.

Third, many USDA sources of information were referenced. For a visual assessment of production activity, the USDA Cropscape raster data file was used (USDA National Agricultural Statistics Service Cropland Data Layer 2016). This raster data map was collected for the 38-county region with spatial granularity of just under ¼ of an acre. The Cropscape data file has limitations in that it is a raster (or image) file with fields identified through infrared satellite sensing. Hence, it is representative, but not an accounting-accurate survey of the crop landscape. The USDA Economic Research Service provides an online mapping tool and database called the Food Environment Atlas (USDA Economic Research Service 2015), which houses a wealth of geographic information at the state or county level regarding food access, production, health as well as other topics. For this project, food retail establishments were collected by county. In addition, the USDA ERS Food Availability (Per-capita) Data System (USDA Economic Research Service 2015) was used in conjunction with updated USDA reports to determine aggregate demand for food commodities, adjusted for losses.

The USDA Census of Agriculture County Profiles data (USDA 2012) were also utilized in this project. These reports provide county-wide estimates of sales by broad commodity classes, valued at the farm-gate. The reports, like the underlying data, can be restrictive in that the National Agricultural Statistics Service often suppresses county-level data if revealing that data may identify individual operations. Such data suppressions were most acute for specialty crops, where few growers may operate. This impacts vegetable, fruit and berry estimates at the county level.

Acres planted to commodities were derived from the USDA, Farm Service Agency (FSA). Crop Acreage Date (Farm Service Agency 2016) may be more comprehensive than Ag Census statistics. However, there are limitations. The Crop Acreage Data is collected from producers participating in certain USDA programs, such as direct and county-cyclical payment programs and the Average Crop Revenue Election (ACRE) programs. Other programs may apply, but participation in such programs requires reporting on acre usage for eligibility in certain programs, where the data is used in the administration of program benefits. Because reporting is only by participating producers, the statistics may not be as comprehensive as the five-year Ag Census. The omissions may lead to biased estimates, as smaller producers may perceive that the time-cost and regulatory costs of enrolling in such programs exceed the expected benefits. For larger producers, the time costs can be spread over more acres, where the number of acres directly corresponds with expected benefits.

In addition, other data sources were used and specifically cited throughout this document, as described in the text. All data sources used have shortcomings, but collecting and comparing several data sets can improve one's overall assessment of the food production environment in the

Study Region. While more labor intensive, we believe this strategy provides a more holistic view of the local food system in question. At the same time, we also recognize the data limitations.

3.1 Study Region

The Study Region is comprised of 38 counties making up an extended region around the Chicago Metropolitan area and spans Illinois, Indiana, Michigan and Wisconsin (**Figure 3.1-1**).[2] As such, the region entails both the urban areas that make up the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area that comprises 14 counties in three metropolitan divisions and the surrounding rural landscape. The rural landscape is largely viewed as the agricultural production region, but this should not be taken as the sole source of agricultural production. Using high-resolution satellite images, Taylor and Lovell (2012) mapped food production in central Chicago, finding widespread distributions of community, school and private gardens along with urban farms throughout Cook County, IL. While not isolating commercial production, their findings suggest that the opportunity to host urban agriculture is widespread, where the density of planted gardens increases with distance from the city center.

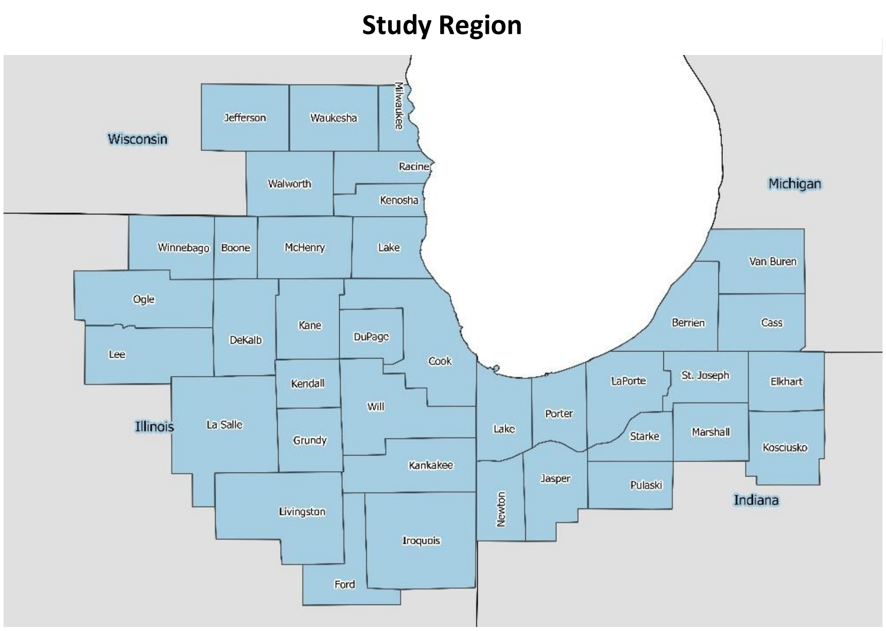

Figure 3.1-1. Modeling Region

Eight of the counties are densely populated and make up the core Chicago-Aurora-Juliet Division, while six counties comprise the other divisions of the Chicago Metropolitan Statistical Area. The remaining 24 counties make up the periphery and are steeped in agricultural production. The

[2] While the specific geographic definition (i.e., the 38 counties) of the relevant region is somewhat ad-hoc, it is necessary to clearly define the geographic area to establish economic estimates. In general terms, there is no definitive definition of what constitutes a local market within the local foods literature, and, therefore, possible that neighboring counties to the Study Region also contribute to its local food system.

central business district for the Chicago CBSA is in Cook County, IL, and agricultural production is expected to be denser the farther away one moves from the central business district. Each county posits a unique spectrum of agricultural production and processes, and exchanges goods with consumers and other producers within and outside of the Study Region. At its widest, the Study Region spans about 300 miles, but all points are within about 160 miles of the central city in Cook County. The 14 counties that make up the Chicago CBSA is home to 9,928,312 residents, and the population of the 38-county region making up the Study Region is estimated at just over 13 million persons (U.S. Census Bureau 2015). To get a perspective on total food-related expenditures in the region, the USDA estimates that the average 2014 per-capita at-home and away from home food expenditures is $4,576 (also based on 2014 prices). This suggests that residents in the Study Region are expected to spend more than $60 billion on food in 2016.

4. Methods and Procedures

4.1 Estimating the Baseline Local Food System Values

IO approaches to measuring local foods tend to be more comprehensive in their assessments because the underlying structure of the models represents a complete accounting for the transactions that take place in the production of goods and services for final consumption. However, IO models have limitations as they are not particularly effective at identifying specific transactions or commodities, but rather group commodities and services into broad categories and aggregate transactions that occur over the course of a year. For example, corn grown by a small local producer and intended for consumption in the local foods market cannot be isolated from corn grown by a large producer and marketed through conventional channels. Additionally, seasonal constraints cannot be accounted for within the single annual metrics underlying IO models. As the ambition of self-sufficiency in local foods is hindered by consumer demand for foods in the offseason, IO models are not able to resolve such growing-season restrictions in supply. Finally, regional IO models are estimates based on a national survey of producers for documenting purchases and sales. This means that the production description of inputs may not reflect unique local characteristics, though estimates of what inputs and purchases are supplied locally are estimated with local measures of product and service availability.

The transactions matrix is of particular interest to regional analysis as it represents transactions between sectors in the process of generating goods and services for final consumption. To understand its importance, consider the representative input-output, transactions table in Table 4.1-1. This representative input-output table has *N*=3 sectors representing different industries of the regional economy (for example, manufacturing, trade, services). Rows and columns are additive in that the sum of each cell across the row provides gross output and the sum of each cell along a column provides gross payments. For example, the row-sum of intermediate transactions and final demand provides gross expenditures and the column-sum of intermediate transactions and gross income (value added) provides gross payments. The system represents a double-entry social accounting system where gross expenditures should equal gross payments (generally termed output).

		Intermediate Purchases			Consumption	Exports	Output
		1	2	3			
Intermediate Sales	1	z_{11}	z_{12}	z_{13}	c_1	x_1	q_1
	2	z_{21}	z_{22}	z_{23}	c_2	x_2	q_2
	3	z_{31}	z_{32}	z_{33}	c_3	x_3	q_3
Income		y_1	y_2	y_3		x_4	Y
Imports		m_1	m_2	m_3	m_4		m
Outlays		q_1	q_2	q_3	C	X	Q

Table 4.1-1: Representative Input-Output Table

We use the following example from Miller, Mann, et al., (2015) to illustrate the computational framework for estimating the size of the Study Region's local food system. In this example, the intent is to measure the total economic value of local food where "local food" is defined as food that is grown in the region and that remains within the region for consumption. This definition is much broader than what is generally conveyed by proponents of local food systems (Martinez et al., 2010), and includes foods distributed through conventional channels. This means that food is considered local as long as it remains in the region moving from farm to plate, regardless of whether it is marketed as local. Using Table 4.1-1, let industry 1 represent apple production and includes all the regional farm-food production for apples, industry 2 represents manufacturing and includes the production of applesauce, and industry 3 represents all trade sectors including transportation, wholesale and retail transactions. The idea in this example is to quantify the total value of local foods as measured by transactions for all apples that are grown in the region and remain in the region through to consumption as fresh apples and processed applesauce.

The total output of local apples, measured in sales, is equal to "total output" minus "exports." Local consumption of locally supplied apples is captured by c_1 while industry purchases of apples are captured by the intermediate purchases z_{11}, z_{12} and z_{13}. Apple producer purchases from other apple producers is captured by z_{11}, and includes one-to-one transactions with other growers to meet contractual deliveries as well as the purchase of custom services like pest management and harvesting. While some researchers may be tempted to exclude own-industry transactions to avoid double counting (Canning, 2013), omitting such also discounts services and the exchanges among growers that are relevant to an overall assessment of the contribution of agriculture to the local economy.

Processed local foods follow a channel to consumers through manufacturers' purchases, depicted by z_{12}. For our example, consider applesauce as the sole representation of local processed foods. Food processors purchase apples along with other inputs like packaging, energy, sugars, cinnamon and other ingredients to make applesauce. They combine these purchases with labor income in hopes of generating value-added in excess of the costs of ingredients, processing and marketing activities. It is important to recognize that fresh apple inputs should claim a share of this value-added generated from processing. Estimating the value-added of food manufacturing attributed to the local apple value chain can be accomplished in two steps: 1) estimating apples' share of the value-added in food manufacturing; and 2) estimating the share of food manufacturing that remains local. For Industry 2, apple input's share of value-added can be calculated as z_{12} divided by the sum of intermediate inputs z_{12}, z_{22}, z_{32}, and intermediate imports M_2. Multiplying this with the value-added term, y_2, provides apples' share of the food manufacturing value-added. The share of the food manufacturing value-added that remains in the region is calculated as the sum of z_{21}, z_{22}, z_{23}, and $c_2$and then divided by q_2, the gross output of industry 2. Finally, multiplying this by apples' share of the food manufacturing value-added provides an estimate of the value chain of local apples through processing.

Finally, we can recognize local food's role in trade channels represented by the row and column labeled Industry 3. Note that the trade sector records the margins earned by this sector rather than how much the trade sector purchases for resale (Isard et al., 1998: pp. 47-48). Margins are analogous to markups that retailers and wholesalers charge, and transportation and warehousing fees. For example, z_{13} measures the margins earned by transport sectors in shipping and those earned by wholesale and retailers in handling apples. Margins earned for handling imported apples are captured by M_3. Therefore, local apples' share of trade margins are captured by the margins earned from handling fresh, local apples and from handling processed apples (i.e., applesauce in the example). The first is simply the value of the entry z_{13} while the second is apples' share of z_{23}. Local apples' share of manufacturing trade margins can be calculated as the share of Industry 2 output derived from local apple inputs. That is, the value of apple inputs and apples' share of value-added calculated in the prior step and divided by q_2, the manufacturing gross output. Multiplying this by total margins earned from manufacturing, z_{23}, and adding apple margins, z_{13}, gives the value of trade activities of the local apple sector.

These calculations are summarized in the following equations,

$$Local\ Direct\ Sales = z_{11} + z_{12} + c_1 \qquad (4.1\text{-}1)$$

$$Local\ Processed\ VA = \left(\frac{z_{12}}{\sum_{i=1}^{3} z_{i2} + M_2} y_2\right)\left(\frac{q_2 - x_2}{q_2}\right) \qquad (4.1\text{-}2)$$

$$Local\ Trade = z_{13} + \left(\frac{z_{12} + Local\ Processed\ VA}{q_2}\right) z_{23}, \qquad (4.1\text{-}3)$$

where the sum of *Local Direct Sales*, *Local Processed VA* (value-added), and *Local Trade* gives the total value of the local food system as exemplified in this simplified example. In practice, there will be many segments of the local food industry, but the same approach can be expanded and applied to any system.

4.2 Accounting for Secondary Transactions

Watson, et al. (2015) used an import substitution framework for estimating the macro-economic impact of changes in local food purchases. The approach is based on a standard regional IO table as shown in Table 4.1-1, where changes in local spending give rise to changes in economic leakages and accounts for all direct and indirect transactions in the provision of local foods. However, the approach does not consider the mechanisms leading to the baseline estimate of a local food system or any changes from this baseline. These are assumed as given.[3]

Instead, attributing economic value to an existing industry requires a different impact modeling assessment than what is generally considered in the literature (Watson, Cooke, et al. 2015, Watson, Kay, et al. 2015). Economic impact studies that use standard multiplier analysis are best used to assess the economic impact of introducing new industry or economic activity to a region. Such studies are generally undertaken before the new activities are introduced. Alternatively, estimating the economic contribution of existing and embedded industries should take into account how those industries influence the channels of production in the local economy. Watson, et al. (2015) develops a framework for undertaking such a study within the guise of local food based on an import-substitution framework described in Cooke and Watson (2011).

Standard impact modeling is largely silent on measuring the economic attributes of import substitution. This may be due, in part, to the historical focus on exports as a mode of regional economic growth. Import substitution occurs when locally-sourced production is expended to supply local demand in lieu of imports (Deller and Goetz, 2009). From a regional perspective, this is consistent with the local foods movement, which seeks to expand local consumption of locally sourced foods in place of that provided by the global food system.[4]

Standard impact models take the current structure of the economy as a given, and ask how much will this economy need to produce to generate some predetermined level of output in any given industry or set of industries. A key assumption underlying these models, in the context of local food systems, is that the share of purchases that come from outside the region remains constant. However, from an import substitution framework, this assumption breaks down. Cooke and Watson (2011) show that as a region becomes more self-reliant, economic impacts due to changes in production become larger. By reducing the transaction leakages out of the region, a greater proportion of the transactions remain in the local region to recirculate to generate additional expenditures (Little and Doeksen, 1968).

[3] We use Miller et al. (2015) to derive baseline values of local food and Watson et al. (2015) to derive impacts from changes in that baseline.

[4] It may also be that this particular point drives some of the differences in views between proponents of local food systems and neoclassic economics (Donald, et al., 2010).

Cooke and Watson start with a restatement of the transactions table shown in Table 4.1-1 as technical coefficients. For each industry row in the transactions table, technical coefficients can be calculated as the ratio of transactions, Z_{ij} , to the corresponding row total, Q_i, as:

$$q_i - a_{i1}q_i - a_{i2}q_i - a_{i3}q_i - a_{ic}c_i = x_i, \tag{4.2-1}$$

where $a_{ij} = \frac{z_{ij}}{q_j}$ are the direct input or direct requirement coefficients. Rewriting equation 1 in matrix form for all sectors *i* provides,

$$\mathbf{Q} - \mathbf{AQ} = (\mathbf{I} - \mathbf{A})\mathbf{Q} = \mathbf{X}. \tag{4.2-2}$$

The **A** matrix is an $(N + 1) \times (N + 1)$ matrix of all direct requirement coefficients a_{ij}, while the matrix **I** is an identically sized identity matrix. The direct requirement coefficients describe the transactions among industries in the production of final goods and services. The **A** matrix holds a particular interesting interpretation as the elements a_{ij} represent the proportion of output by industry *j* that is made up from input by industry *i*, for numbered entries and by purchases of labor and capital from households for entries subscripted with *c*.

Solving equation 2 for Q provides:

$$\mathbf{Q} = (\mathbf{1} - \mathbf{A})^{-1}\mathbf{X}. \tag{4.2-3}$$

The matrix $(\mathbf{I} - \mathbf{A})^{-1}$ is often substituted with **L** and denotes the Leontief inverse, named after Wassily Leontief, the 20th century economist who derived the mathematics underlying economic multiplier analysis. The column sum of the **L** matrix provides the multiplier effect of a change in the corresponding industry output. It indicates the change in direct and secondary transactions necessary to supply an additional unit of the corresponding industry output.

Conventional multiplier analysis assumes that the **A** matrix, and hence, the **L** matrix is fixed and derives the total economic impact as:

$$\Delta\mathbf{Q} = \mathbf{L} \cdot \Delta\mathbf{X}, \tag{4.2-4}$$

where the Greek symbol delta (Δ) preceding **Q** and **X** denote "change in." In other words, a change in the vector of export demands **X** will generate a change in **Q** by a multiple of **L**, thus the term multiplier analysis. However, if industries and consumers change their purchasing behaviors, the **A** matrix will change causing a change in the **L** matrix and the resulting multipliers. Hence, all secondary transactions associated with a given level of output will also change accordingly.

Economic contribution analysis differs from conventional economic impact analysis. Conventional impact assessments assume that an increase in final demand causes purchases within the region scale up proportionately. The **A** matrix remains constant in the Leontief inverse. Economic contribution analysis allows us to simultaneously recognize changes in total output produced in the region and corresponding changes in the underlying transactions, allowing disproportionate changes in total economic activity.

Equation 4.2-4 describes how an impact in any one sector or combination of sectors will impact all other sectors of the economy. Watson, Kay, et al., (2015), applied a simple modification (Waters, Weber, et al., 1999) to separate out the sector impacts by export base and import substitution components. In their article, Watson, Kay, et al., (2015) posits that the export base, or base output, is all the direct and secondary transactions necessary to produce a given level of output for export. To that extent, the export base may be less than, greater than or equal to the value of exports. Sectors with larger base output are expected to have a larger contribution to the overall region's economy.

Starting with equation 3, Watson, Kay, et al., (2015) make a simple modification by replacing the N-vector of exports with an $N \times N$ diagonal matrix of the export vector.[5] In doing so, the vector solution of equation 3 becomes an $N \times N$ solution represented as:

$$\widehat{\mathbf{Q}} = \mathbf{L} \cdot \widehat{\mathbf{X}}, \qquad (4.2\text{-}5)$$

where the hat symbol ($\widehat{\ }$) denotes a matrix representation of the underlying vector. The diagonal values of the $N \times N$ matrix $\widehat{\mathbf{Q}}$ are the direct effects of output $\widehat{\mathbf{X}}$.[6] Reading down the columns of $\widehat{\mathbf{Q}}$ provides the indirect and induced effects of the corresponding output in $\widehat{\mathbf{X}}$. When compared to total sector output, $\mathbf{Q}$, the sector direct and indirect effects provide a measure of the extent that output reverberates throughout the local economy to generate larger, economy-wide impacts.

Watson, Kay, et al. (2015) show that equation 4.2-5 allows output to be broken out into that which contributes to local consumption (import substitution) and that which supports exports (export base). By comparing the export base output to import substation output, one can assess the extent to which the sector contributes to local consumption versus revenues through export sales. A simple ratio is used.

Next, the analysis turns to estimating the impact of a change in local demand. Starting with Cooke and Watson (2011), the framework starts by specifying the **L** matrix as a function of the technical requirements matrix, **A**:

$$\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}. \qquad (4.2\text{-}6)$$

When the transactions table changes, the Leontief inverse will also change. In the context of local processors purchasing more from local suppliers and fewer imports, one or more of the **A** matrix

[5] This produces an $N \times N$ matrix of zeros accept along the diagonal where diagonal values are set to corresponding values of the vector elements in **X.**

[6] Technically, it is the direct effect plus the own indirect effects, where the own-indirect effects are industry purchases to themselves.

coefficients, a_{ij}, will increase, reflecting a greater share of inputs being supplied locally. We state without proof, that the change in all elements of the Leontief matrix will be non-negative, that is, they will not become smaller (Miller and Blair 2009, pp. 569). This implies that the change in multipliers will be non-negative with an increase in local uses. The outcome is intuitive in that retaining more economic activity locally, by reducing reliance on imported goods, will lead to larger secondary effects for a given level of economic activity. In the input-output literature, this is referred to as economic deepening (Cooke and Watson 2011).

When undertaking economic impact assessments of import substitution, it is important to recognize that directing current production to local uses has an implicit cost of not directing that output to exports (Conner, Knudson et al. 2008, Swenson 2009). It is easy for a researcher to model the economic impacts of local food sales from a farmers market and overlook that, by selling through the farmers market, the grower did not sell the same produce through other channels. To the grower, the net benefit is the price earned by selling at the direct to consumer price less the price they would have earned selling through conventional wholesale channels.[7] In a similar vein, when modeling the economic impact of local foods, the impacts should be net of the export value of the local sales.

The export impacts of a change in output can be calculated as:

$$\Delta\mathbf{Q}^{\boldsymbol{E}} = \mathbf{L}^{\mathbf{0}} \cdot \Delta\mathbf{F}^{\boldsymbol{E}}, \tag{4.2-7}$$

where, $\mathbf{L}^{\mathbf{0}}$ is the baseline Leontief inverse, $\Delta\mathbf{F}^{\boldsymbol{E}}$ is the value of direct sales (in this case change in export sales), and $\Delta\mathbf{Q}^{\boldsymbol{E}}$ is the vector of the total change in output required for generating $\Delta\mathbf{F}$ final sales, including direct and secondary effects. Equation 4.2-7 is the standard export-oriented economic impact assessment where the Leontief matrix reflects fixed local expenditure patterns. Alternatively, increasing local demand shifts the underlying relationships that underlie the Leontief inverse. The impact of an increase in local demand, holding exports constant, can be estimated as:

$$\Delta\mathbf{Q}^{\boldsymbol{L}} = \mathbf{L}^{\mathbf{1}} \cdot \Delta\mathbf{F}^{\boldsymbol{L}}, \tag{4.2-8}$$

where $\mathbf{L}^{\mathbf{1}}$ is the modified Leontief inverse reflecting a greater share of industry and consumer purchases of food imports being supplied by local producers, $\Delta\mathbf{F}^{\boldsymbol{L}}$ is the change in the value of output to local consumption and $\Delta\mathbf{Q}^{\boldsymbol{L}}$ is the vector of total change in output required for generating $\Delta\mathbf{F}^{\boldsymbol{L}}$ in output.

[7] One should also subtract out the costs of getting the produce to the farmers market and time-costs of manning the store front.

To estimate the net impact of increasing local uses by reducing exports can be found by equation 4.2-7 and equation 4.2-8. Assume there is no change in agri-cultural output and that an increase in local consumption is afforded by an equal decrease in exports:

$$\Delta\mathbf{F}^{\boldsymbol{L}} = -\Delta\mathbf{F}^{\boldsymbol{E}} \tag{4.2-9}$$

The net effects are calculated as combined impacts, or as:

$$\mathbf{NE} = \Delta\mathbf{Q}^{\boldsymbol{L}} + \Delta\mathbf{Q}^{\boldsymbol{E}} = \mathbf{L}^{\mathbf{1}} \cdot \Delta\mathbf{F}^{\boldsymbol{L}} + \mathbf{L}^{\mathbf{0}} \cdot \Delta\mathbf{F}^{\boldsymbol{E}} \tag{4.2-10}$$

Substituting equation 9 for $\Delta\mathbf{F}^{\boldsymbol{E}}$ in equation 10 and simplifying provides:

$$\mathbf{NE} = (\mathbf{L}^{\mathbf{1}} - \mathbf{L}^{\mathbf{0}}) \cdot \Delta\mathbf{F}^{\boldsymbol{L}} \tag{4.2-11}$$

The net effect diverting production from export sales to local uses, is the net change in the multipliers times the value of goods diverted to local use.

4.3 Establishing the Basket of Goods

A "basket of goods" that is representative of what is currently produced for the Study Region's local food system was constructed using a multi-tiered strategy that included the incorporation of USDA data on production and consumption, as well as regional stakeholder input. USDA data are from the March 2016 report from Lin, et al., and include information from: (1) Food Availability; (2) Loss-Adjusted Food Availability; (3) Food Availability Data System; (4) Federal dietary intake surveys; (5) Food Intakes Converted to Retail Commodities Databases; and (6) National Health and Nutrition Examination Survey. We only report on the most recent of these data, 2006-7. This basket of goods is important for identifying what the region provides to the local food system in terms of consumer goods as well as to aid in estimating the respective changes in land use necessary to increase the supply of locally produced foods. It is also noteworthy that considerations were made for the diversity of agriculture in regards to changes in land use. For example, land used for corn and soybean production may not be suitable for blueberry production, and increases in production from apple orchards may need to cluster around existing apple production to enable necessary economies of scale.

Our first step to establish the basket of goods was to identify the typical amounts of annual US consumption of fruit and vegetables. The USDA, ERS reports that US consumers, on average, eat about 246 pounds of fruit (fresh and processed), 275 pounds of vegetables (fresh and process), and 94 pounds of grains (mostly processed) annually (Lin, et al., 2016). Values for the most common of these are presented in Table 4.3-2, as well as their relative shares of the total food item consumed (i.e., fruit, vegetable, or grain). Since the consumption data are based on national-level surveys and estimations, it is important to point out that some level of regional variation is likely to occur that is not captured in the table below. Additionally, some food items are not produced in the region due to environmental inputs. For example, just over 50 percent of fruits consumed annually (bananas, orange, other citrus, and tropical) are not produced in the Study Region.

Food item	Pounds per year	% of categorical consumption
Total fruit	*246.2*	-
Apples (total)*	52.4	21.3%
Bananas	24.1	9.8%
Berries	10.1	4.1%
Grapes	17.7	7.2%
Melons	18.4	7.5%
Oranges (total)*	83.4	33.9%
Other citrus	11.3	4.6%
Stone fruit	8.6	3.5%
Tropical fruit	11.6	4.7%
Other	8.5	3.5%
Total vegetables	*274.9*	-
Broccoli and cauliflower	8.4	3.1%
Carrots	7.4	2.7%
Celery	3.7	1.3%
Cucumbers	3.7	1.3%
Lettuce	16.1	5.8%
Onions	10.4	3.8%
Other brassica	5.6	2.0%
Other leafy	0.8	0.3%
Green peas	6.6	2.4%
Peppers	5.5	2.0%
Potatoes	75.7	27.5%
Snap beans	5.6	2.0%
Sweet corn	18.1	6.6%
Tomatoes	85.7	31.2%
Other	21.5	7.8%
Grains	*94.2*	-
Corn	9.8	10.4%
Wheat	68.7	72.9%

Table 4.3-2. Mean US Fruit & Vegetable Consumption

** Includes juice and non-juice*

Source: Lin, et al., (2016); Converted from daily grams to pounds per year.

Table 4.3-3 compares regional production with regional demand of the key basket of goods. Data for Table 4.3-3 include the USDA Farm Service Agency (FSA) Crop Acreage Data for 2015 (column 2 - planted acres) and weighted average yield from USDA NASS (column 3 - Ave. yield lbs./ac) to examine what the region produces annually. Column 4, per-capita availability, measures the per-capita availability of local production per person and is comparable to per-capita consumption (re-stated in column 5 from Table 4.3-2). The region's total fruit yield (17.0 lbs. per-capita), total vegetable yield (41.2 lbs. per-capita), and total grain yields (1,760 lbs. per-capita), represent about 6.9 percent, 15.0 percent, and 1869.0 percent of the regions total consumption respectively.[8] However, it is important to point out that this does not imply that all the fruit, vegetables, and grains produced in the region are consumed in the region. For example, the vast majority of the region's grain is likely exported outside the region and potentially used for non-food consumption. Another example is the region's cucumber production, which is also likely directed to export markets. Rather than measure what is supplied locally for consumption, per-capita availability represents a baseline comparison of the region's current production levels relative to the estimated total fruit and vegetable consumption.

Food Item	Planted Acres	Ave. Yield (lbs./ac)	Per-capita avail. (lbs.)	Consumption (lbs.)	Proportion[a]
Total Fruit [b]			*17.0*	*246.2*	*6.9%*
Apples	5481	21,492	9.1	52.4	17.4%
Blueberries[c]	2246	4830	0.8	1.9	44.3%
Cherries[c]	2868	5313	1.2	1.6	13.9%
Grapes	7274	9408	5.3	17.7	29.9%
Peaches[c]	1003	7148	0.6	6.7	6.5%
Total Vegetables			*41.2*	*274.9*	*15.0%*
Asparagus[c]	1552	2120	0.3	1.6	15.9%
Beans[d]	4525	5300	1.9	5.6	33.0%
Cabbage[c]	2069	26,859	4.3	7.9	54.5%
Sweet Corn[e]	3322	8811	2.3	18.1	12.5%
Cucumbers	4617	19,200	6.9	3.7	187.7%
Peas	7277	3860	2.2	6.6	32.8%
Potatoes	6019	34,067	15.9	75.7	21.0%
Radishes[c]	3023	6750	1.6	0.5	316.4%
Squash[c]	1329	21,200	2.2	4.4	49.6%
Tomatoes	2880	16,813	3.8	85.7	4.4%
Grains			*1760.2*	*94.2*	*1869.0%*
Corn	3,945,128	5467	1725.4	9.8	17,662.6%
Wheat	105,805	4110	34.8	68.7	50.7%

Table 4.3-3. Representative Basket of Goods

Note: food items presented represent about 93% of total fruits and vegetables produced in region.
a. Hypothetical value; considers if all production went to local consumption, shows what % is met.
b. About 65% of fruit consumed cannot be produced in the region, e.g., oranges and bananas.
c. Based on USDA ERS food availability data and may not accurately reflect actual consumption.
d. String beans are used for annual consumption data.
e. Does not include corn grain for human consumption.
Source: Lin, et al., (2016); USDA, ERS (2014); USDA, FSA (2016); USDA, NASS (2016)

[8] These values represent about 93% of planted acres in fruits and vegetables, and we used 12.9 million as the estimated regional population.

In the last step of the establishment of the basket of goods, we incorporated regional stakeholder feedback to verify which goods should be included as part of the expansion assessment. There are two important practical considerations that emerged from this process that will also impact potential regional policies going forward. First, anecdotal evidence from individual stakeholders provided support for the approach used to construct the basket of goods. The data in Table 4.3-3 (especially the hypothetical "Proportions" values in column 6) helps verify potential local food gaps for specific commodities. For example, there is a high demand for locally produced tomatoes (Andrew Lutsey, Co-founder and CEO of Local Foods, personal communications, February 23, 2016), but the region's current capacity can only meet 4.4 percent of total consumption, if all that was produced was also made available for local consumption (Lin, et al., 2016; USDA, ERS, 2014; USDA, FSA, 2016; USDA, NASS, 2016). Another example is cucumbers, where demand for locally produced cucumbers is steady but not necessarily adversely affected by short supply (Irv Cernauskas, Owner-operator of Fresh Picks, Personal Communications, April 29, 2016). This may also be reflected by the current capacity. Discussions with local stakeholders provided a level of granularity that is otherwise missed in the consumption and production data above. For example, consumers are demanding locally produced goods that are largely off the radar for statistical reporting agencies. Mushrooms are an excellent example, where demand for locally sourced mushrooms exist, but no data exist that tracks the volume or value of mushroom production (Andrew Lutsey, Co-founder and CEO of Local Foods, personal communications, February 23, 2016). Another example, are different varieties of lettuce which some producers have moved from California to the Study Region to produce, but production is sporadic (Irv Cernauskas, Owner-operator of Fresh Picks, Personal Communications, April 29, 2016). While these examples cannot be effectively accounted for in the basket of goods, it will highlight important considerations for future research.

4.4 Measuring Land Use Change and Capacity

In this section, we discuss the approach for measuring the shifts in land use as they relate to increasing local food production. We begin by aligning the basket of goods to IMPLAN sectors and allocate acres to specific commodity classes that are more delineated than that of the IMPLAN model. That is, the IMPLAN vegetable and melons output, for example, is broken out into acres of the respective commodities that make up the IMPLAN category. This allows us to determine the change in acres of production by commodity for a given change in vegetable and melon output, based on average yields per acre and assuming all respective commodities change proportionately. We follow this by reviewing the present state of land use in the region and consider what is being produced and how production of particular goods may cluster in sub-regions within the Study Region.

An important question regarding changes in local food production that was raised by Swenson (2010) and highlighted above in *2.1 Economic Framework for Local Food Systems*: does a particular region have the ability to meet the desired production capacity in terms of local foods? Revisiting Table 4.3-3, we can see that if all that was produced in the region stayed in the region, conceivably about 7 percent total fruit consumption, 15 percent of total vegetable consumption, and 100 percent total grain consumption could be met.[9] However, as also pointed out in section *2.1* and in *4.3*, the relative proportions of different foods produced must also be considered. For example, the region produces more of some commodities than local consumers can consume. For instance, if all the production of corn (17,663% of total local consumption), radishes (316%), and cucumbers (188%) were made available locally, this would dramatically exceed the average per-person consumption of that commodity. On the other hand, wheat (51%), peaches (7%), and tomatoes (4%) would only account for a small proportion of the total consumption, again if all that were produced in the region remained local.

Another relevant consideration in thinking about changes in production is the allocation of land for production, as each commodity produced requires different quantities of land for a given unit of output. Here, the established basket of goods and the current production activities related to each good provides some examples. To produce one pound of apples per-capita in the Study Region, about 605 acres are needed (i.e., 13 mill people/21,492 lbs. per acre = 605 acres). To produce one pound per-capita in the region of blueberries, about 2,692 acres are needed. While this consideration is relevant, it is also important to point out that not all land is well suited for all types of food production. For example, land used to produce corn may not be well suited to produce blueberries (at least not without costly adjustments), and vice versa. The established basket of goods gives some guidance in terms of opportunities for changes in production, information and support services necessary when reallocating suitable land for specific production.

4.4.1 Present State of Agricultural Land Use

With the aid of the next series of figures, the distribution of crop production in the Study Region is discussed in greater detail. The motivation of this discussion is to provide relevant considerations as to where increases in particular crop production may likely need to occur due to the presence of other similar crops, and to identify potential opportunities to shift current land use. The presence of similar crops is relevant in the context of providing potential cost savings by sharing of resources in a given area (economics of scale), as well as assumptions regarding suitable land for particular crop production. For example, consider blueberry production. For the purpose of production shifts,

[9] Recall that this accounts for about 93% of all non-animal food production; therefore, the percentages for total fruit and vegetable production are slightly higher, likely 7.4% and 16.0% respectively.

we assume it is more likely that land suitable for blueberry production is close to where other blueberry production already occurs. This same assumption is applied to other crops.

Figure 4.4.1-1 shows the complete spectrum of the USDA Cropland Data Layer (CDL) for 2014, indicating developed areas in grey and the combination of farmed and non-farmed lands through a spectrum of colors (USDA National Agricultural Statistics Service Cropland Data Layer 2016). The USDA Cropscape (Han et al. 2014) application isolates some 83 crop/use categories and provides significant granularity for isolating regions where key commodities are being produced. However, estimates of crop acres based on the CDL are subject to several limitations. First, the spatial granularity for identifying plots of land is limited to just under ¼ of an acre. Therefore, small plots of crops measuring less than a quarter acre square may not be identified in the CDL. Additionally, the cropland measures are derived from satellite imagery, and have some precision shortcomings in determining both the size and the specific crop on the fields. In some cases, very small plots may be misidentified. Finally, CDL estimates of total acres rely on pixel counting and are largely suspected of under-estimating total acreage of any one commodity. Hence, aggregated acre-planting estimates are largely unreliable. Regardless, the CDL is a valuable resource for assessing sub-regions within the larger Study Region where similar and/or identical commodities are being produced, and gauging the broad extent of land usage dedicated to commodity production.

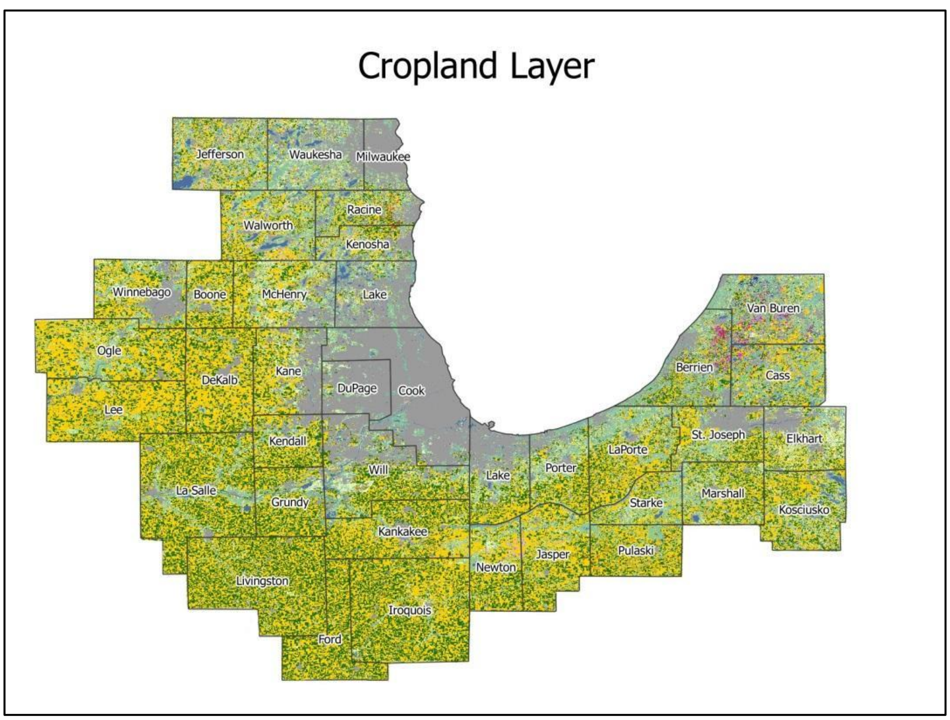

Figure 4.4.1-1: USDA Cropland Data Layer

Table 4.4.1-2 shows the estimated number of acres by commodity/land use category, sorted by most acres to least acres. Evident is the prominence of corn and soybean acres, both of which are common in a corn rotation. Non-farm acres, including forests, wetlands and developed space make up a sizable share of total acres. While it may be tempting to think of these as potential land resources for local food production, we should recognize that such fields might be protected or serve economic needs that dictate their current uses.

Value	Category	Pixel Count	Acreage	Value	Category	Pixel Count	Acreage
1	Corn	18,830,167	4,187,728	207	Asparagus	2,347	522
5	Soybeans	12,873,321	2,862,958	27	Rye	2,332	519
141	Deciduous Forest	6,094,978	1,355,491	76	Walnuts	2,318	516
176	Grass/Pasture	5,744,674	1,277,585	56	Hops	1,815	404
122	Developed/Low Intensity	5,585,455	1,242,175	229	Pumpkins	1,452	323
121	Developed/Open Space	3,771,345	838,727	245	Celery	1,197	266
123	Developed/Medium Intensity	2,400,589	533,878	226	Dbl Crop Oats/Corn	1,153	256
190	Woody Wetlands	1,790,429	398,182	4	Sorghum	1,126	250
124	Developed/High Intensity	1,076,953	239,509	220	Plums	1,101	245
111	Open Water	985,371	219,141	219	Greens	1,041	232
36	Alfalfa	616,387	137,081	77	Pears	1,034	230
195	Herbaceous Wetlands	457,979	101,852	49	Onions	906	202
24	Winter Wheat	422,423	93,945	54	Tomatoes	624	139
131	Barren	154,716	34,408	221	Strawberries	550	122
13	Pop or Orn Corn	125,280	27,862	58	Clover/Wildflowers	377	84
37	Other Hay/Non Alfalfa	114,637	25,495	14	Mint	362	81
69	Grapes	91,858	20,429	23	Spring Wheat	316	70
152	Shrubland	70,539	15,688	205	Triticale	302	67
68	Apples	69,235	15,398	21	Barley	281	63
66	Cherries	52,714	11,723	249	Gourds	230	51
143	Mixed Forest	51,743	11,507	39	Buckwheat	222	49
57	Herbs	47,687	10,605	6	Sunflowers	220	49
12	Sweet Corn	43,906	9,765	254	Dbl Crop Barley/Soybeans	209	47
142	Evergreen Forest	42,676	9,491	241	Dbl Crop Corn/Soybeans	131	29
61	Fallow/Idle Cropland	28,241	6,281	224	Vetch	103	23
242	Blueberries	28,084	6,246	60	Switchgrass	94	21
53	Peas	23,049	5,126	29	Millet	53	12
28	Oats	21,572	4,798	41	Sugarbeets	51	11
59	Sod/Grass Seed	20,946	4,658	223	Apricots	31	7
43	Potatoes	19,081	4,244	240	Dbl Crop Soybeans/Oats	14	3
225	Dbl Crop WinWht/Corn	11,389	2,533	250	Cranberries	12	3
243	Cabbage	9,919	2,206	11	Tobacco	3	1
42	Dry Beans	7,680	1,708	206	Carrots	3	1
50	Cucumbers	6,976	1,551	247	Turnips	3	1
26	Dbl Crop WinWht/Soybeans	6,358	1,414	74	Pecans	2	0
48	Watermelons	5,903	1,313	214	Broccoli	2	0
67	Peaches	5,334	1,186	236	Dbl Crop WinWht/Sorghum	2	0
216	Peppers	5,136	1,142	31	Canola	1	0
70	Christmas Trees	3,609	803	92	Aquaculture	1	0
44	Other Crops	3,599	800	227	Lettuce	1	0
222	Squash	3553	790.2	237	Dbl Crop Barley/Corn	1	0

Table 4.4.1-2: USDA 2014 Cropland Data Acre Estimates

To better understand the dispersal of commodity production, the next graphs break out maps into specific commodity types. Figure 4.4.1-3 shows land use for oats, corn, wheat and soybeans and all rotations that entail some combination of these. As evident, most farm acres are represented in these crops. We might further notice that these row crop acres bump up against the developed acres represented by the grey regions. This may be significant once considering the grower opportunities to enter local foods value chains, as acres currently producing agricultural output may be more pertinent to local foods consideration.

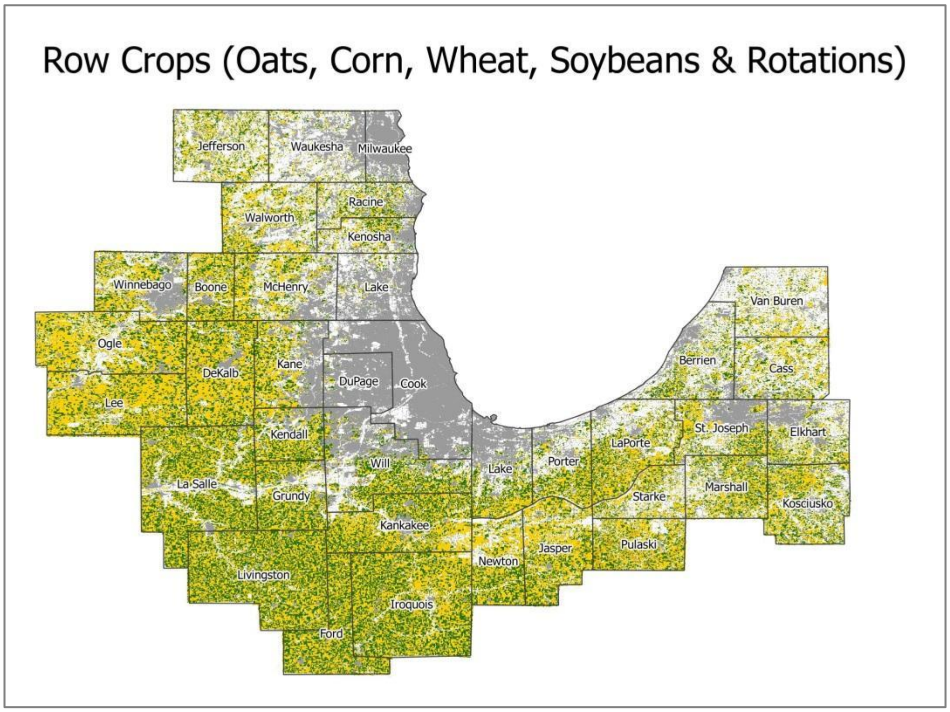

Figure 4.4.1-3: USDA Cropland Data Layer of Oats, Corn, Wheat, Soybeans and all associated rotations

Figure 4.4.1-4 shows only vegetable categories of the USDA CDL and contrasts significantly from Figure 4.4.1-3 in that few points of color exist. However, careful inspection shows that areas of relatively intense vegetable production exist in the 38-County region. In particular, Kankakee County in Illinois hosts specific regions of intense potato production and a scattering of pepper production. Potato production also clusters in Pulaski and Marshall Counties in Indiana, while cucumbers are common around Starke County. That is, there appears to be a feature in the agricultural landscape that appears to favor regions of specialization in vegetable production. Other clusters also appear. Pea production distribution is systematically located around La Salle and Lee Counties in Illinois and Walworth County Wisconsin, while acres in Cabbage and Dry Beans cluster in Kenosha and Racine Counties Wisconsin.

A couple of reasons may explain these clusters. First climatic and soil conditions may be primed for specific commodities in specific regions. This may go a long way toward explaining the clusters of peppers, tomatoes and peas in Southwestern Michigan. Second, regional synergies in production, processing and marketing may encourage clustering. Here, built human and physical capital can contribute to regional expertise in key commodities that, in turn, generate regional comparative advantage in those commodities. By clustering equipment, storage, grading and processing, costs can be spread over more acres and inputs and technical expertise can be better specialized, reducing grower costs. Comparative advantage relates to lower consumer prices, greater producer profitability, and greater regional vitality. As a counter example, it appears that diverse pockets of vegetable production exist in Kosciusko and Elkhart Counties Indiana, where a broad mix of vegetable crops are scattered about the landscape. Finally, it may be instrumental to note that the three Michigan Counties appear to have the largest amount of diversity in vegetable production, most likely taking advantage of the combined benefits of scale in acres devoted to vegetable crops and micro-climatic conditions that make this an ideal region for growing vegetables.

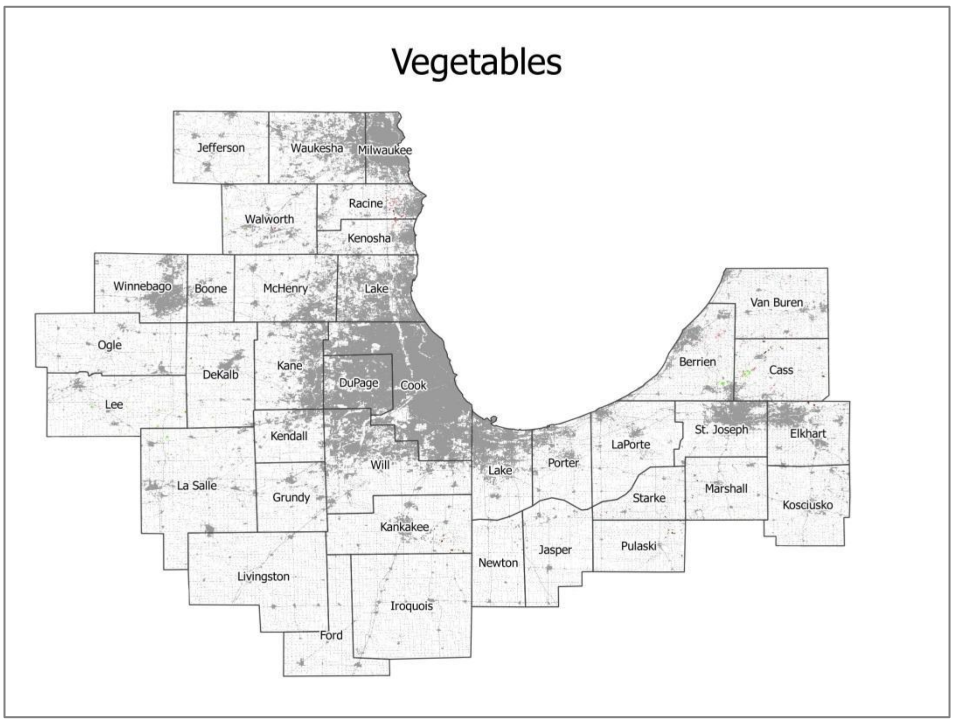

Figure 4.4.1-4: USDA Cropland Data Layer of assorted vegetables

The last crop category to consider is that made up of grapes, berries and cranberries, and tree fruit and nuts. In general, most of the grape, berry and tree fruit production appears to be clustered in the three counties making up Southwest Michigan. Here, apple, peach, grape, walnut, cherry and blueberry production share space with other crops reviewed earlier. However, even within this confined space, there appears to be distinct regions of specialization. Though difficult to discern in Figure 4.4.1-5, there exist distinct bands of significant commodity clusters that indicate some degree of regional specializations. All Michigan counties have scatterings of each of these commodities, but also distinct regions of specialization. Van Buren has areas almost exclusive to blueberry production, and regions of mixed apple and cherry orchards. Berrien County has a large region of near exclusive grape production, while Cass County has mixtures with pockets of clusters throughout.

Outside of Southwest Michigan, few clusters seem apparent. The exceptions are Waukesha and Jefferson Counties in Wisconsin which have sporadic areas of apple production. Also, grape production appears to be widely distributed West of the eastern border of Cook County, Illinois, while to the East, widespread blueberry production occurs. Walnut production tends to correspond with areas of grape production.

The absence of uniform distribution of commodity production in the Study Region suggests that economic and potential physiological forces give rise to clustering of agricultural production. This specialization underpins the conventional U.S. agri-food system and has created efficiencies that contributed to the U.S. exhibiting the lowest expenditure shares on food (Mahapatra 2014). It is also faulted for generating inequality (Allen 2010), environmental degradation (Feenstra 1997), and the loss of social cohesion (Hinrichs 2003).

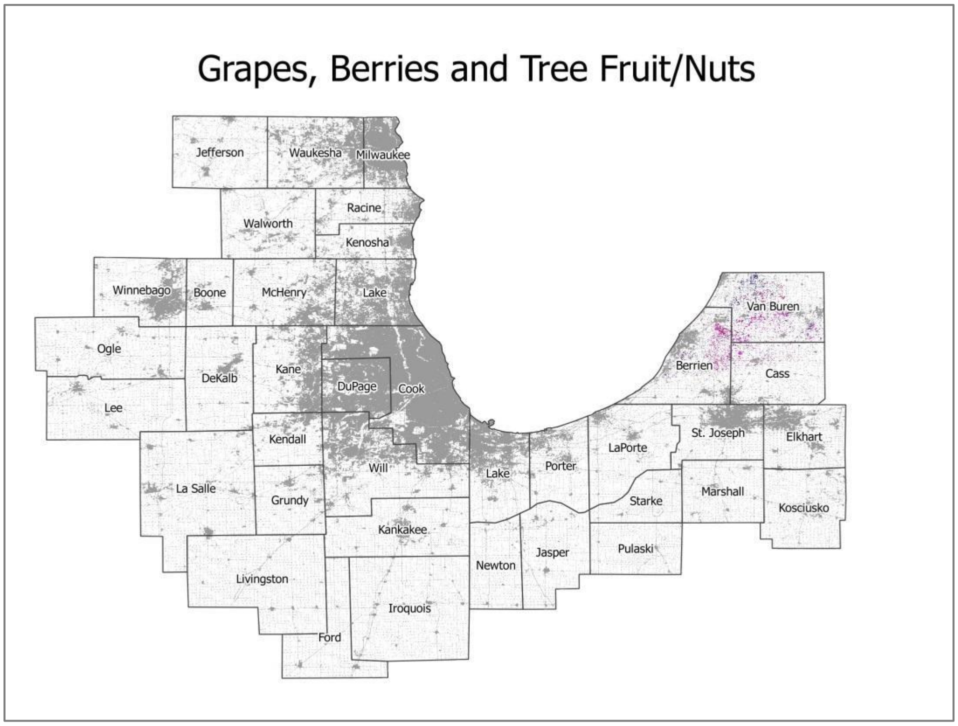

Figure 4.4.1-5: USDA Cropland Data Layer of Grapes, Berries and Cranberries, and Tree Fruit and Nuts

As the next two maps show, there exist land resources in the Study Region that may be allocated to agricultural uses. However, we urge caution when interpreting these. Figure 4.4.1-6 shows plots of land that are currently not developed and not used in farm production. At first sight, the green areas in Figure 4.4.1-6 may appear as opportunities to enroll acres in local food production.

However, as evident, much of this land follows water features and make up wetlands that are protected under Section 404 of the federal Clean Water Act, and applicable state laws. Other plots may entail state, county and municipal parks, private land under conservation easements, and private forests. That is, the opportunity costs of converting non-farm and non-developed plots to agriculture is not necessarily zero, but such plots serve economic and social benefits that may hinder their conversion to agricultural uses.

Alternatively, Figure 4.4.1-7 shows farmland that is currently in pasture or in various fallow states. The use of fallow land may be restricted due to NRCS restrictions under the Conservation Reserve Program. Pastureland may posit economic returns to owners for ranch and livestock operations. Hence, recruiting them for crop production necessarily preempts their use for livestock operation. In mass, this will adversely impact local and conventional livestock operations. The green-highlighted region in Figure 4.4.1-7 indicates grass or pasturelands, while a small count of fallow or idled cropland is shown in olive. Aside from Starke County, Indiana and parts of Michigan, fallow acres appear to cluster around developed acres giving some opportunities for local food expansion and neighborhood-level agriculture. However, each location must be vetted against zoning laws and other ownership and neighborhood interests.

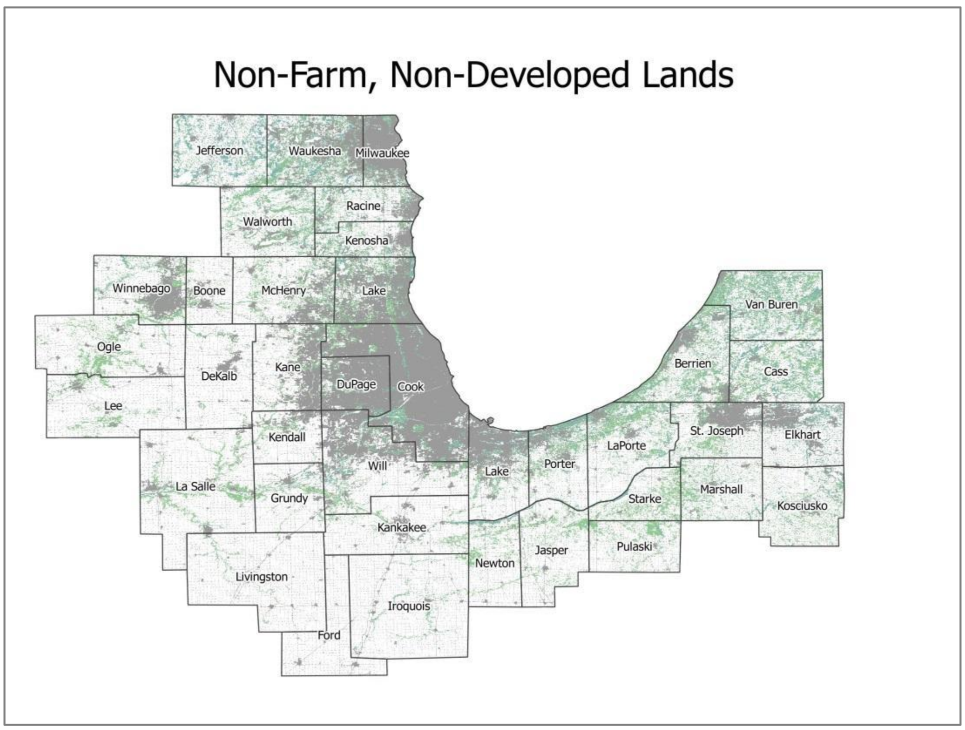

Figure 4.4.1-6: USDA Cropland Data Layer of non-farmed and Non-Developed Lands

In light of the findings using the CDL, it is tempting to ask, “how can a local food system gain a stronger foothold in the marketplace?” These issues may be addressed by taking advantage of the spatial distribution of production throughout the Study Region. Local food systems by necessity are systems of diverse agricultural production. This is not to suggest that specialization cannot take place, but rather the scale of specialization is likely to be much smaller than in today's conventional food system. Because the "local" in local food is constrained by geography, it necessitates that local food must come from some defined radius from the point of consumption. Smaller scales of operations engender niche marketing opportunities and are often required for commanding higher prices necessary to compete against large-scale processors and handlers that compete on low cost value propositions (Martinez, Hand et al. 2010).

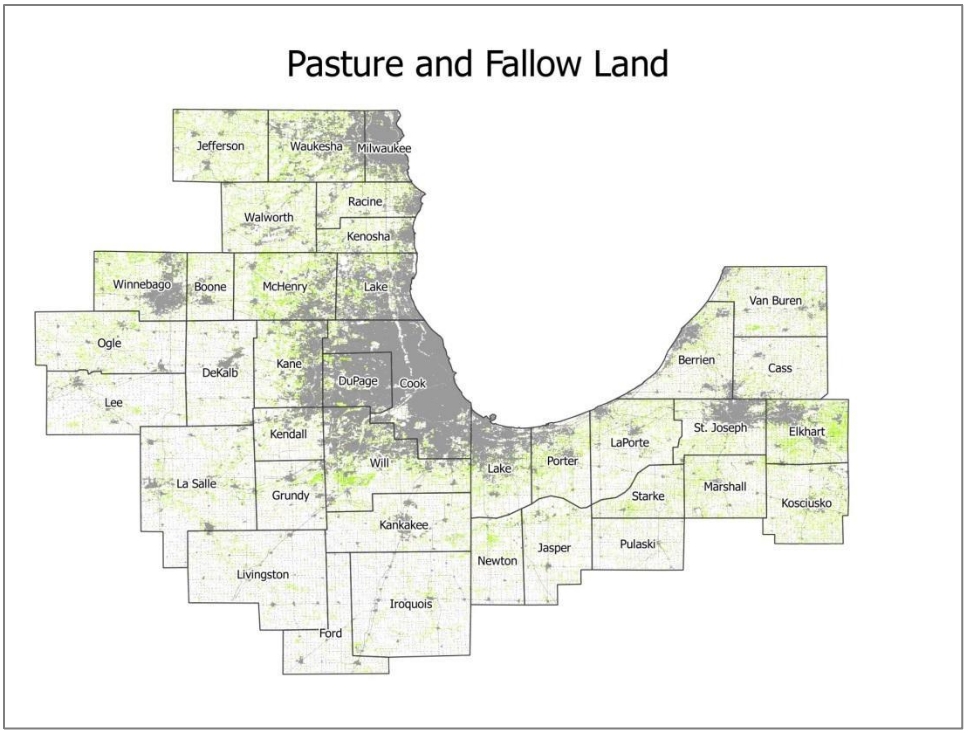

Figure 4.4.1-7: USDA Cropland Data Layer of low-intensity use Farmland

Local food systems also tend to favor fresh produce over processed foods, where, along ideological grounds, local food is an escape from the conventional food system that is seen as regulated by corporations. It is also a venue to healthy eating, where American consumers are increasingly realizing shortcomings in both personal habits and increasing processor use of non-natural ingredients. From practical grounds, modern food processing is a high-volume, low-margin industry that relies heavily on economies of scale in operations. Local food largely bypasses the processor stage with greater emphasis on home preparation. This is not to suggest there is little room for processing and value-added activities in local food systems, but rather that such efforts tend toward higher-end, or artisan flavors that command higher prices to offset losses in economies of scale.

While shifting land resources to local food systems is a viable option, there are limitations. The most accessible shift would entail directing higher proportions of the regional outputs from lands currently in commodity production to the local foods market. Shifting agricultural land uses can leverage existing channels to consumers including farmers markets, but large-scale shifts will require building out intermediary channels that can provide direct-to-consumer, intermediated sales through conventional and specialized retail channels, restaurants, and through food services.

4.4.2 Modeling Methods for Production Shifts

The discussion in section 4.4, thus far, has identified two key considerations for thinking about changes in production to meet local demands: (1) which goods to produce, and (2) where to produce these goods. However, given the review of the data and prior literature, an effective method for identifying the changes in production of the basket of goods (either by volume or by proportion) has not emerged. One issue highlighted by Miller, Mann, et al., (2015) is that decision makers are often uncertain as to the current status of their local food systems, e.g., economic value of a local food system or the proportion of local food available for local consumption. On the other hand, this discussion has revealed three potential strategies that may be employed to increase the availability of local foods, and include:

1. Diversion – Divert export sales to local purchases
2. Land Use – Shift from export-oriented grains to local food-oriented fruits, vegetables,and grains
3. Production Expansion – Expand output of all crop output

Further, these strategies, which are modeled and also explained in greater detail in section *5.6*, may provide benchmarks such that some combination of each is appropriate. The first strategy does not impact land use, and instead relies on altering the marketing of current production from export sectors to local uses. The second and, to an extent, third strategies do impact land use. The second strategy requires a shift from grain production to local fruit and vegetable production and has the greatest impact on land use. The third strategy may alter land use, but only that land not used in current agriculture production (e.g., fallow or otherwise protected lands). Additionally, the third strategy can also include potential changes in technology allowing for increases in per-acre yields and may include controlled environment agriculture.

The shifts in land use are calculated as the number of acres required to support a given change in local production, where changes in local production are driven by local food objectives. Changes in land use are estimated based on the basket of goods that make up each of the IMPLAN agri-crop sectors modeled. Changes in total output volume is assumed proportional to sales. The basket of goods allocates the change in output by IMPLAN sector to the corresponding, commodities that make up that sector. Similarly, changes in acre by commodity are assumed proportional to the yields per acre of the corresponding commodity and its share of the food basket.

Empirically, the individual fruits, vegetables, and grains have to be aggregated when entered into the IMPLAN categories (fruit farming, vegetable and melon farming, and grain farming)). We assume that inputs and resulting IMPLAN outputs are proportionally distributed across; therefore, these results are only reported in aggregated form (section 5.6). Conceivably, the aggregated output could be redistributed across the individual commodity groups (e.g., apples, blueberries, etc.) as conceptualized in Figure 4.4.2-1. However, IMPLAN does not capture the level of granularity to make this possible. For example, each commodity requires different types and quantities of inputs. Therefore, the results reported in section 5.6 are aggregated impacts from the fruit and vegetable industry combined.

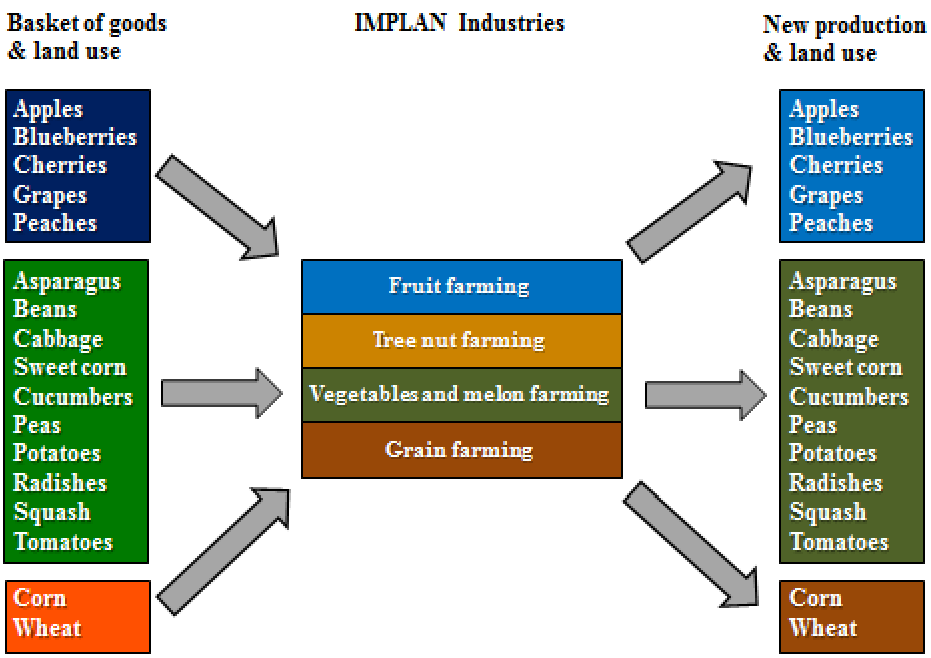

Figure 4.4.2-1. Conceptualization of local food production inputs and outputs.

5. Analysis

As the modeling region entails a significant urban center, availability of land appropriate for specialized agricultural production (e.g., fruits and vegetables) may be a limiting factor to increasing the size of the current local food system. Despite this potential limitation to acres, Chicago is host to a significant number of consumers, where interest in purchasing foods from local providers is growing. Figure 5-1 shows population densities by county, where the average number of inhabitants per square mile can range from a low of just under 26 in Iroquois County, IL to a high of 5,545 in Cook County, IL. With the exception of Milwaukee and Waukesha Counties, that make up the Milwaukee metropolitan area, population densities tend to decline as one moves away from the central Chicago Cook County.

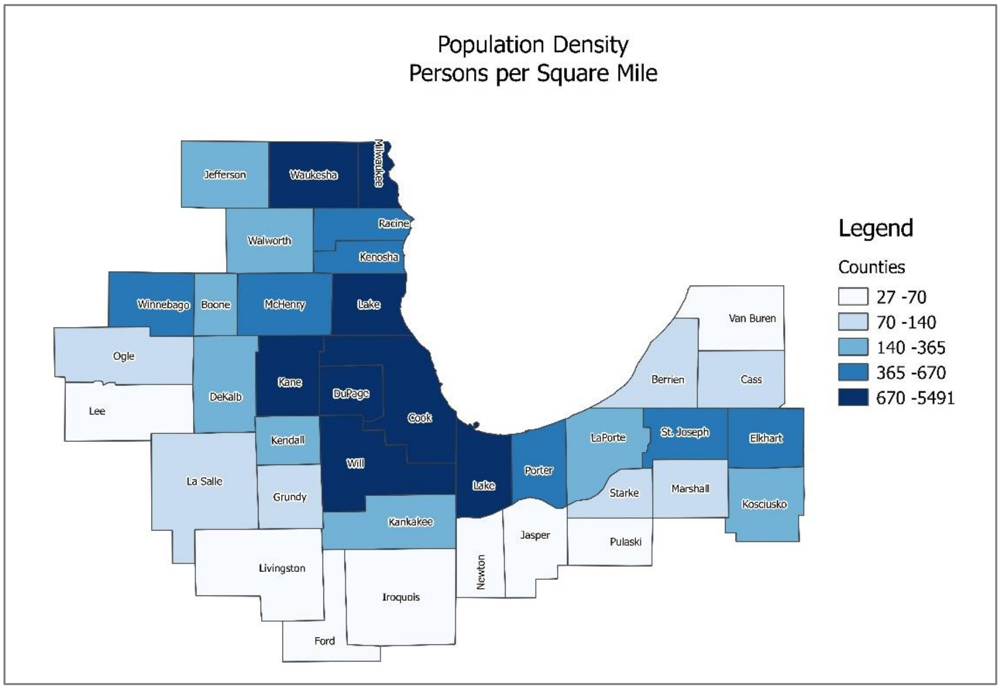

Figure 5-1 Population per Square Mile

In the proceeding subsections, we consider additional factors and characteristics impacting potential supply and demand that also drive the economics of the local foods system. We then determine the baseline estimations, followed by the impacts from changes in local food production.

5.1 Characteristics of Local Food Producers

Characteristics of local food producers are important considerations in matching local food definitions to measurement efforts. These characteristics also have implications on policies intended to ramp up local food production and consumption (Martinez, et al., 2010). Farm sizes and participation in the local foods system by farm size has significant implications. For example, national estimates in 2008 indicate that small farms (gross sales < $50,000) accounted for 81 percent of farms supplying local food markets (includes direct to consumer and intermediated channels), medium sized farms (gross sales of $50,000-$250,000) accounted for 14 percent, and large farms (gross sales > $250,000) accounted for 5 percent (Low and Vogel, 2011).[10] However, large farms accounted for about 6 times the total sales value of small farms and about 4 times of medium farms. These observations are also consistent with the 2012 US Census of Agriculture data (USDA 2012). One policy implication is that strategies that broadly target producers may mostly impact the small producers and, while significantly increasing their participation, may not greatly impact total production volume. Specifically targeting large producers to increase participation could have a greater impact on the total volume of food entering the local food market than targeting small producers. While smaller producers may be more open to participating in local food systems, encouraging a large number of smaller producers to participate in the local food system is likely to have a smaller impact than encouraging a few larger producers. At the same time, the idea of increasing the participation of large or corporate farms may be antithetical to some proponents of local food systems (Darby, et al., 2008).

Farm location relative to local food demand hot spots (urban centers or peri-urban local food hubs) also has implications. Historically, agricultural property surrounding urban centers tends to command higher prices and rents than those parcels distant from the urban center (Chicoine 1981; this is discussed further in section 5.3). Higher land prices tend to reduce the overall size of operating farms. This has been recognized in the literature (Vandermeulen, et al., 2009) and shown graphically in Figure 5.1-1, where the average farm size tends to be larger in rural counties. Smaller farms on the urban fringe cannot take advantage of economies of scale and are squeezed by higher land rents. This requires them to seek higher production margins through value added activities or seek niche market opportunities that will give them returns in excess of those earned by large commercial producers (Vandermeulen et al. 2006). Urban farms have also found favor with urban planners. As urban sprawl absorbs bordering farmland that is developed for residential housing, there is little chance that it will ever be reverted back for agriculture production (Nickerson et al., 2007). Farms help to maintain open space landscapes and many states have farm conservation programs directed at maintaining these open spaces. These considerations may provide ammunition for arguments in favor of including urban farming into the local food conversation as they may retain open space in and around the city and provide additional production resources (McFadden, Conner, et al., 2016).

[10] MacDonald, Korb, and Hoppe, (2013) also point out that farm size is diverging in that large farms are absorbing more medium sized operations which increases the average farm size. At the same time, the number of small producers is also increasing. The trend is moving toward two types of farms, large producers and small producers, with very few producers in between.

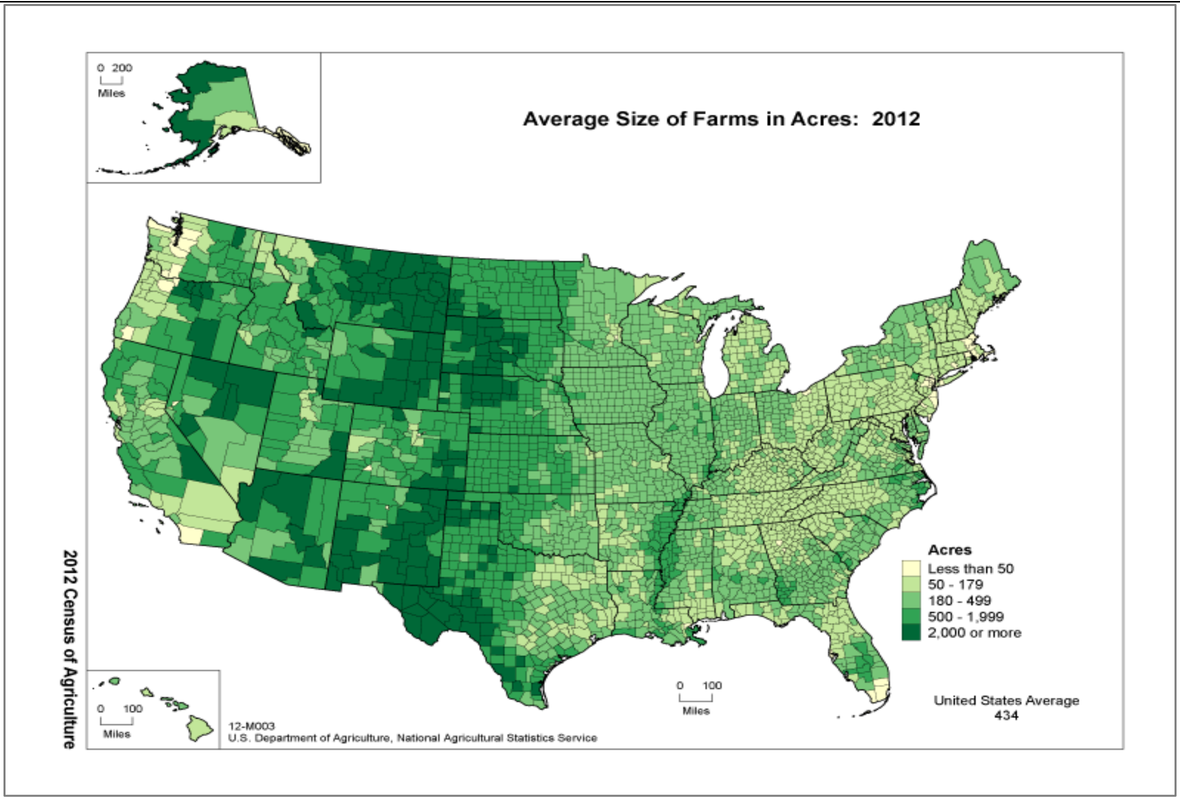

Figure 5.1-1. Distribution of average farm size by county across the US, 2012
Source: 2012 US Census of Agriculture

In the context of local foods, it may be that smaller producers who are closer to the local food hotspots (given the data in Figure 5.1-1) are also the more likely to participate in local food systems. Smaller producers seeking higher margins per acre may seek access to central cities where their marketing effort is sure to bring in more sales than in rural areas. Indeed, Martinez, Hand, et al., (2010) reported that urban centers are crucial for producers participating in farmer's markets—84 percent of all farms engaged in direct-to-consumer sales in 2007 were in or adjacent to urban areas (these farms also accounted for 89 percent of all sales income). Further, direct sales income to farms decreased as farms were located progressively further from urban centers. Figure 5.1-2 shows this relationship for 2012.

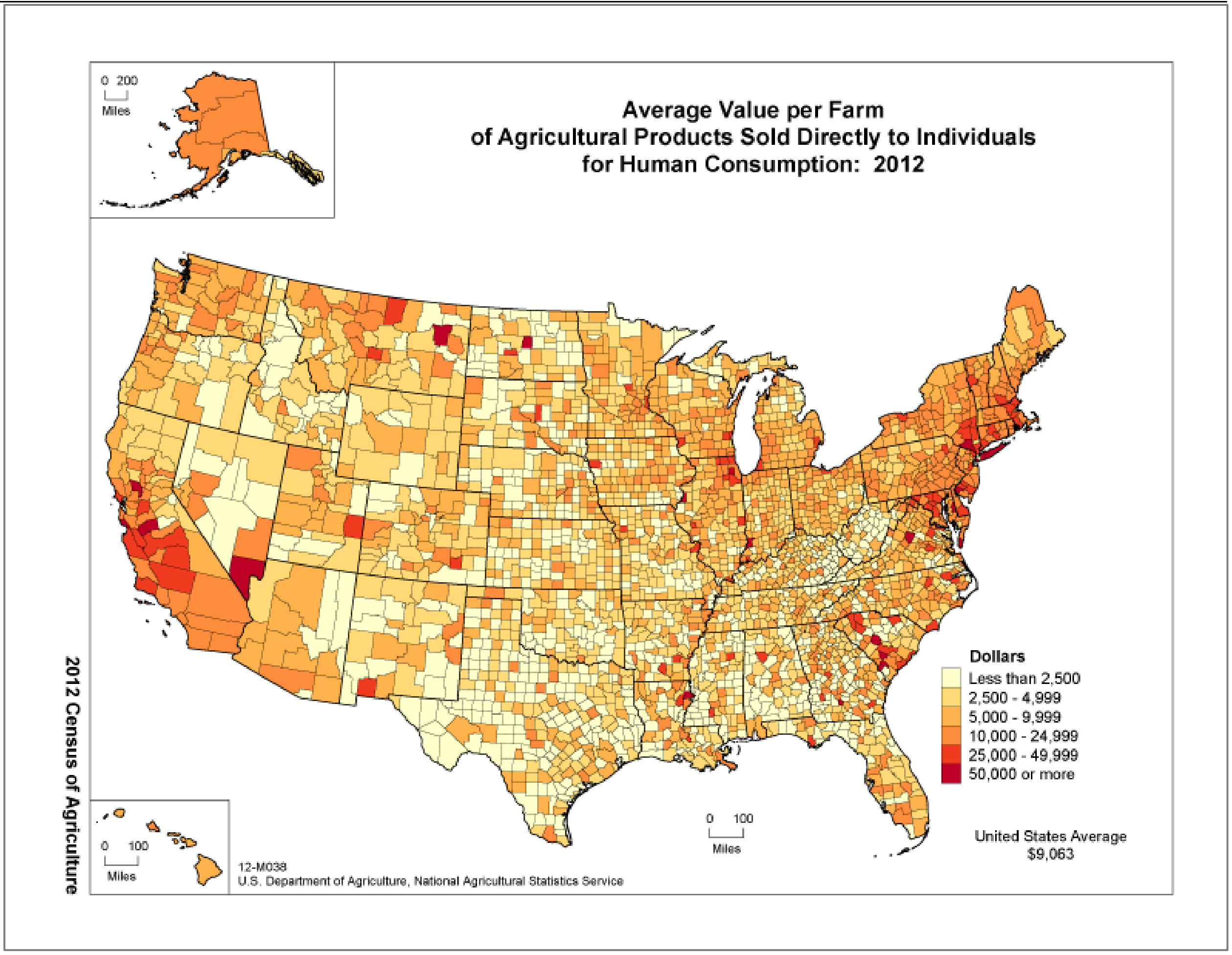

Figure 5.2-2. Income from direct-to-consumer sales by County in the US, 2012.
Source: 2012 US Census of Agriculture

This observation supports regional economic theory, in particular, that production and transportation costs impact how close profit maximizing enterprises locate to their respective markets (Edwards, 2007). In this case, the small local food producers would balance transportation and production costs (including the value of land) with the value of the local food income generated from urban areas (Martinez, Hand, et al., 2010). As producers are located further from their respective markets (e.g., farmers markets), the costs of participating in local food systems becomes more expensive. At the same time, one impact of urban sprawl is that the remaining agricultural lands in and around urban areas become splintered, increasing the production and shipping costs of local production (Edwards 2007; McFadden, Conner, et al., 2016; USDA NASS, 2014). A successful local foods market may encourage individuals to locate high-value crop production systems in agriculturally-zoned urban lands for supplying the local foods market (McFadden, Conner, et al., 2016).[11] There may also be opportunities for technological advances in some of these areas, such as controlled environment agriculture (CEA).

Another relevant locational consideration is the role of intermediaries. Large farms are most likely to market to consumers through intermediaries. More so, intermediary sales from large producers account for the vast majority (93%) of intermediated local food sales (Low and Vogel, 2011; Low, et al., 2015). Intermediaries, like marketing coops and wholesalers, may provide channels to mainstream food outlets and act as facilitators for the transfer of large volumes of goods from producers to consumers. With volume, they can reduce growers' transactions costs for getting to market and can provide an outlet for those producers that are farther from the urban center (Low, et al., 2015). However, smaller producers are less apt to market to such intermediaries and may not meet minimum size (batch) or consistency mandates set by the wholesaler or distributor (Low and Vogel, 2011).

One more relevant producer characteristic to consider is what farmers are supplying to the local food systems. In 2007, about 44 percent of all vegetable and melon producers and 17 percent of all fruit and nut producers also participated in direct to consumer sales (Martinez, Hand, et al., 2010; Low and Vogel, 2011).[12] At the same time, the majority of the fruit and vegetable farms supporting local foods systems operated fewer acres relative to other farms and invested larger proportions of time to their operations (Low and Vogel, 2011). These same small farm operators were less experienced and sophisticated than larger producers, and may not be able to supply consistent baskets of local foods. Again, the effects from policies encouraging small producers versus those of large producers may have different impacts (consider that smaller producers may account for greater product diversity but larger producers provide greater product consistencies).

5.2 Characteristics of Local Food Consumers

This section provides a snapshot of consumers who associate themselves with the local food movement and explores factors driving their local food choices. We also consider some trends in the marketplace that may drive growth in local food systems. Much of the resource used in this section is a summary from Mintel Group Ltd report, *The Locavore: Attitudes toward Locally-Sourced Foods - US, February 2014* (Mintel Group, Ltd., 2014). Other resources include recent academic and USDA studies as well as the authors' expertise in the field of local food demand.

According to Mintel, consumers generally attribute local food as fruit and vegetables sourced within a 100-mile radius of their residence (Mintel Group, Ltd., 2014). However, the notion that

[11] Additionally, Hunt (2007) found that farmers participating in farmers markets in Maine were younger and more educated than the average farmer from the state.

[12] Less than 3% of farms producing other crops (e.g., grain) participated in direct to consumer sales (Martinez, et al., 2010).

demand for local food is solely driven by one's concept of geographic distance is limiting as motivations outside of distance often affect one's choice to purchase locally-sourced foods (Onozaka, Nurse, et al., 2010; Mintel Group, Ltd., 2014). Mintel finds strong support that concepts around freshness (a potential direct effect from fewer food miles and greater immediacy from harvest) and support for community farms are primary reasons for buying local. Similarly, Onozaka, Nurse, et al., (2010) find widespread regard toward community support in buyers' decisions, but also attributed the primary motivation to perceived health benefits of locally-sourced foods. This also coincides with a belief that locally-sourced foods are produced without pesticides – a common confounding of the distinction between local foods and organic foods. While studies have shown an association between local food purchasing behavior and health outcomes, a clear causal link is difficult to assign (Martinez, Hand, et al., 2010).

Economists may place local foods in the spectrum of normal goods, where demand increases as incomes rise. This is in contrast to inferior goods whose demand increases with a decrease in incomes. As such, consumers are more willing to pay premiums for local food when the economy merits such expenditures. To be sure, there exist a cache of consumers for which local foods is the principle choice despite financial proclivity, but mainstream consumers largely view local foods more as a luxury than a fundamental purchase. While it is difficult to assign values to consumers, price is an important factor in one's purchasing decision. For some, low cost is the primary attribute that defines value. For others high quality at a reasonable price denotes value. Increasing mainstream consumer participation in local foods will require lowering the price of locally-sourced foods sold through mainstream channels (Mintel Group, Ltd., 2014) or decreasing the transactions costs associated with purchasing through specialty channels like farmers markets (Low, Adalja, et al., 2015).

Consumer participation in local foods markets varies by age. Older Americans are more likely to participate in local foods markets than younger Americans. Younger shoppers are also more likely to define the geospatial bounds of what is local as being much wider than older shoppers. This is largely attributed to younger generations' more global perspectives where the world appears much smaller than for older Americans. Older shoppers attribute social attributes to local foods, while younger shoppers are more likely to attribute product and processing attributes to local foods – seeking healthier and safer food products with an ecologically sustainable footprint. All consumers appear to respond to headline-grabbing food and product recalls (Mintel Group Ltd 2014). Consumers see local foods as relatively safer alternatives to large-scale food processing, and are reviewing labels more discernably.

While grains and proteins are largely excluded from mainstream consumers' concept of local foods, there is growing interest in specialty products cast as local foods. The healthy eating movement has sparked interest in gluten-free and non-GMO grains, and consumers appear more willing to pursue proteins marketed as local (Maynard, Burdine, et al., 2003). In addition, niche markets around grains and cereals appear to be gaining market potential with consumers. These niche products are mostly directed at health-conscious consumers, but the added "local" element on the label provides further health attributes for consumers that assign health benefits to local foods.

Some other relevant factors are impacting local food systems. Building local branding has become a common community-wide effort for conveying local foods. Local branding informs local residents of the source, where the ability to attach the local brand to produce requires some certification process. It is most commonly associated with agri-food tourism for marketing the flavors of the region. In addition, consumers are demanding more transparency on food-product labeling. In this, state governments are leading efforts to mandate GMO product labeling. Labeling and label claims are also under increasing scrutiny. Relevant for local foods is the concern that foods marketed as local do not meet some generally accepted definition of local. Regional branding, with requisite certification, is one venue of assuring local claims are valid. However, with variations in regional brands and definitions of local, regional branding today is where organic branding was 20 years ago. From the framework of a long-term outlook, one might ask: "will local foods follow in the footsteps of organics to become regulated under the USDA?"

5.3 Local Food System Economic Value

To determine the economic value of the Study Region's local food system, the distribution of production availability in the region measured in sales was first considered. For local food systems, geography plays a central role and an area of research that appears to be lacking in the existing literature is the role of distance and production to local food outlets, especially as they relate to urban centers like Chicago (McFadden, Conner, et al., 2016). The Urban economic literature suggests that land prices (rents) define the distinction between agricultural and urban production (Edwards, 2007). In the conventional model, land prices are highest in the central city and gradually decline with distance from the urban center. The central city is regarded as the key destination point of goods, such that the further away from the city center, the more expensive it is to get goods to market, but land prices gradually decline to compensate for higher transportation costs.

In the von Thunen model (first proposed in the treatise *The Isolated State*, 1826), high-density production takes place up to the point that low-density uses generate more productive value per acre of land. From this framework, high-density production is attributed to urban uses, while lower density production is attributed to agriculture (Edwards, 2007). This stylistic designation between urban and agriculture production is instructive in understanding policy implications and generalized land use, but should be interpreted loosely. For example, agricultural production commonly takes place in urban settings, but, as the model predicts, becomes less common closer to city centers. Additionally, manufacturing production, once common in city centers, is peppered throughout the Rural American landscape. We use county data to show the geographic pattern of agricultural production in the Study Region. Figure 5.3-1 shows that agricultural production, as measured by crop production values, tends to by highest along the Study Region's fringe. However, even though Cook County, IL is in the centroid of the Chicago CBSA, it generates a sizable amount of agricultural production.

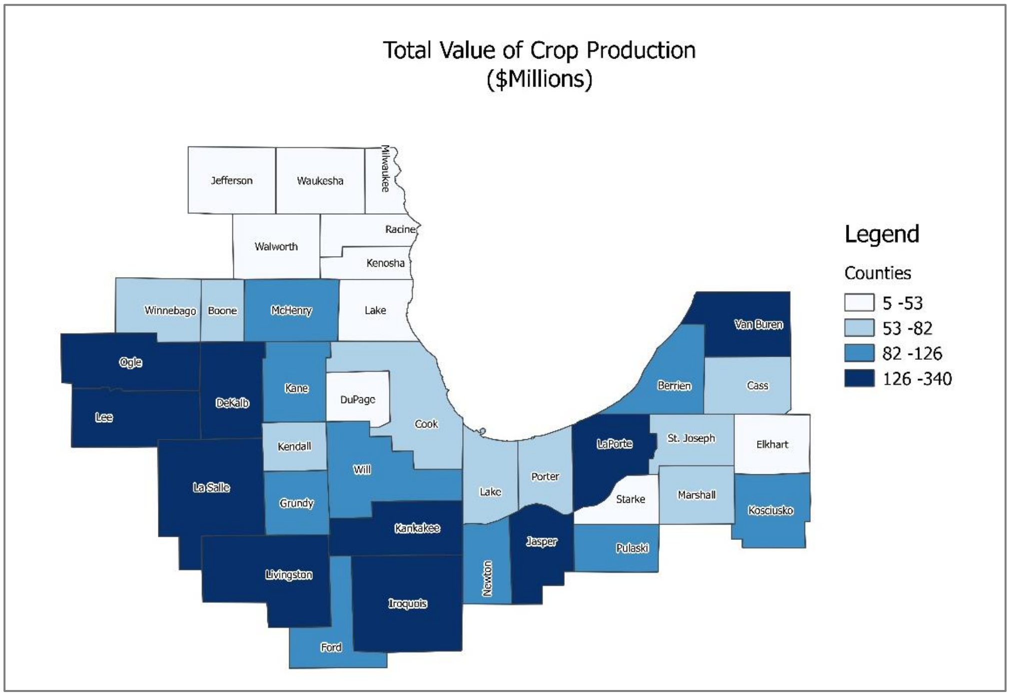

Figure 5.3-1: Crop Production in Sales
Source: USDA

As Figure 5.3-1 shows, crop production takes place throughout the Study Region. With such proximity to urban households and services, the transportation costs to markets are dwindled. However, as postulated from urban economic theory, this low cost access to markets should be capitalized in higher land prices in the inner city. That is, the opportunity costs of agricultural uses of land in the city are higher than that at the urban fringe and beyond. We speculate that such higher inner-city land prices will impact what is produced in the inner city relative to the fringe and how that production is marketed. More specifically, producing higher value crops that generate higher per-acre revenues would be more appropriate in the inner city. Therefore, we would expect to see more fruits and vegetables grown in the inner city (and potentially directed at the local foods market) than grains grown on the same area that are directed at more conventional marketing channels. We would also expect greater vertical integration of agricultural production in the inner city where the grower also builds value-added activity, like marketing, preserving, and others, that increase the total net revenue per productive acre. Figure 5.3-2 supports this notion, indicating that the further we move from the city center, more concentration is placed on grain production, where grains are viewed as commodity-type production with fewer options for building value-added.

However, there are some exceptions which are partly due to soil and environmental characteristics (for example, the counties in Michigan have prime soil characteristics allowing them to produce the majority of the berries and tree fruit in the region).

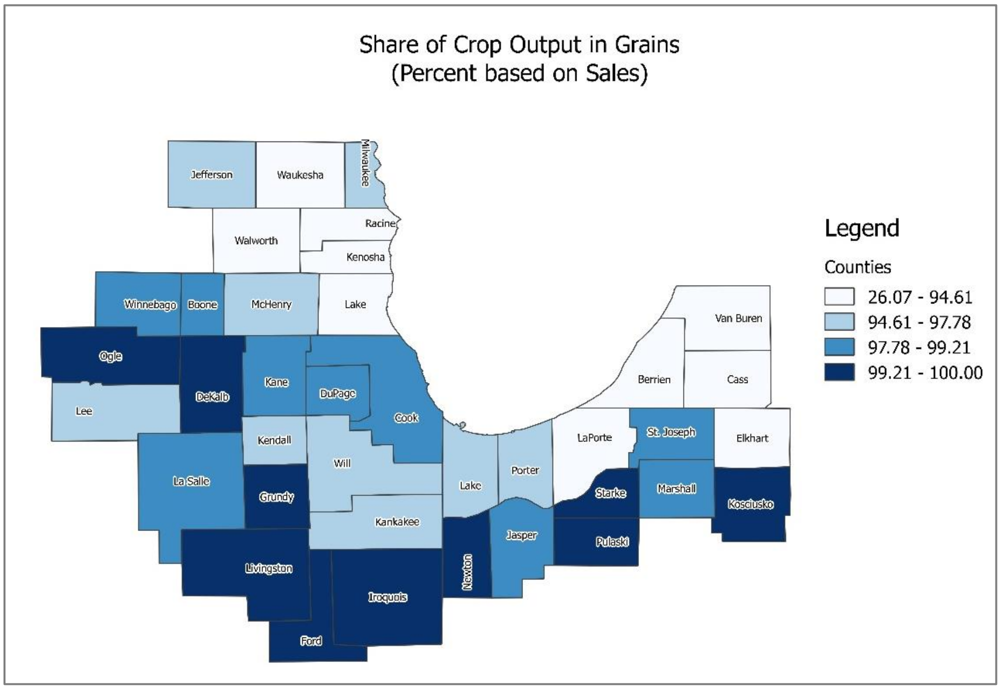

Figure 5.3-2: Distribution of Grain Production in Sales

Source: IMPLAN and authors' calculations

Next, we consider crop-commodity trade flows. While data constraints do not allow for the mapping of sources and destinations of commodity flows at the county level, the share of commodity production that remains in the local community as intermediate inputs to final goods and as final goods for consumption can be assessed. Figure 5.3-3 uses IMPLAN data at the county level to assess the share of crop production that is taken up for local uses. Local uses may include consumption but also includes processing that may ultimately be exported as processed foods. Care should be exercised in interpreting the results as no distinction is made between food and non-food uses of agricultural production in Figure 5.3-3. With a few exceptions, those counties with higher population counts tend to retain a greater share of the county's agricultural production, either for consumption or processing. This finding is consistent with regional economic theory based on the assumption that firms seek to minimize transportation costs, especially on those commodities that exhibit lower values per transportation ton. For raw or unprocessed foods, the transportation costs can command a higher share of the overall sale price.

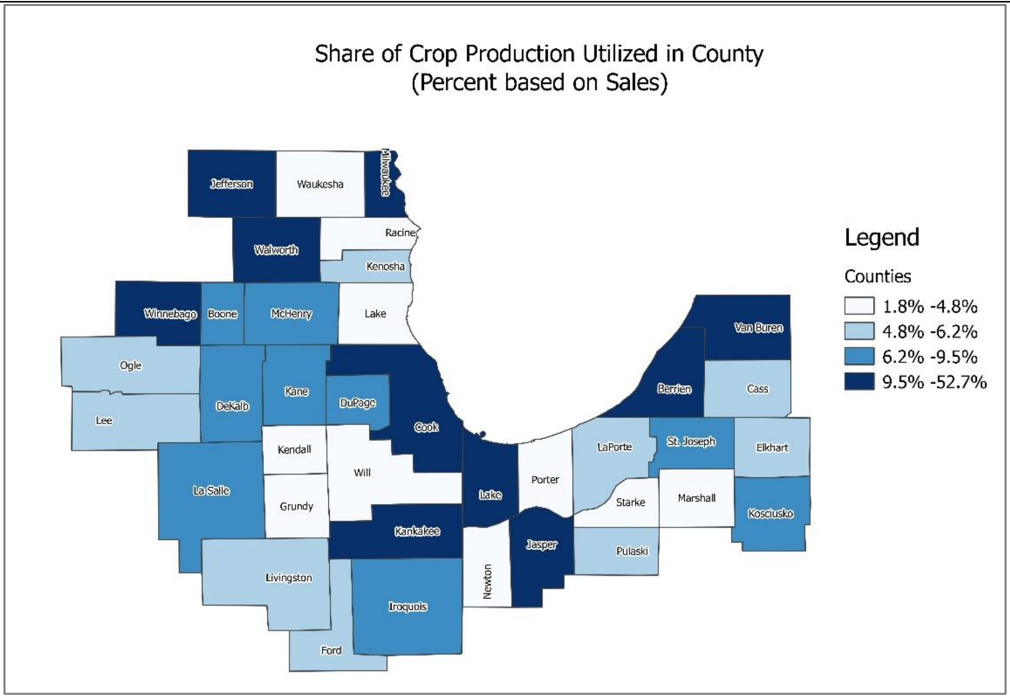

Figure 5.3-3: In County Share of Agricultural Production Usage

Source: IMPLAN and authors' calculations

Figure 5.3-4 takes Figure 5.3-3 one step further by isolating locally processed foods and calculating the shares that remain local. It shows the share of intermediate, or processed, foods that remain in the county. To be sure, the shares of locally processed foods that remain local are not limited to locally processed foods sourced by local farms, but rather represent total processed foods produced. In contrast to agricultural products, shares of processed foods that remain in a county do not follow discernable patterns, but rather the northwest quadrant of the Study Region appears to be more aligned with self-supplying processed foods. While the most densely populated counties around Cook County tend toward higher self-supply of processed goods. Lake County, IN, housing Gary, IN, is an outlier indicating that food processing in that county largely gets exported. Another interesting outcome is that those counties where food processing is largely exported do not necessarily fall along major interstate highways. Highway 55 is largely south of the areas in white in Figure 5.3-4 along the west. However, Lake and Newton Counties in Indiana, which both mostly export locally processed foods, do surround Highway 65. Alternatively, the eastern counties in white have no direct access to an interstate highway.

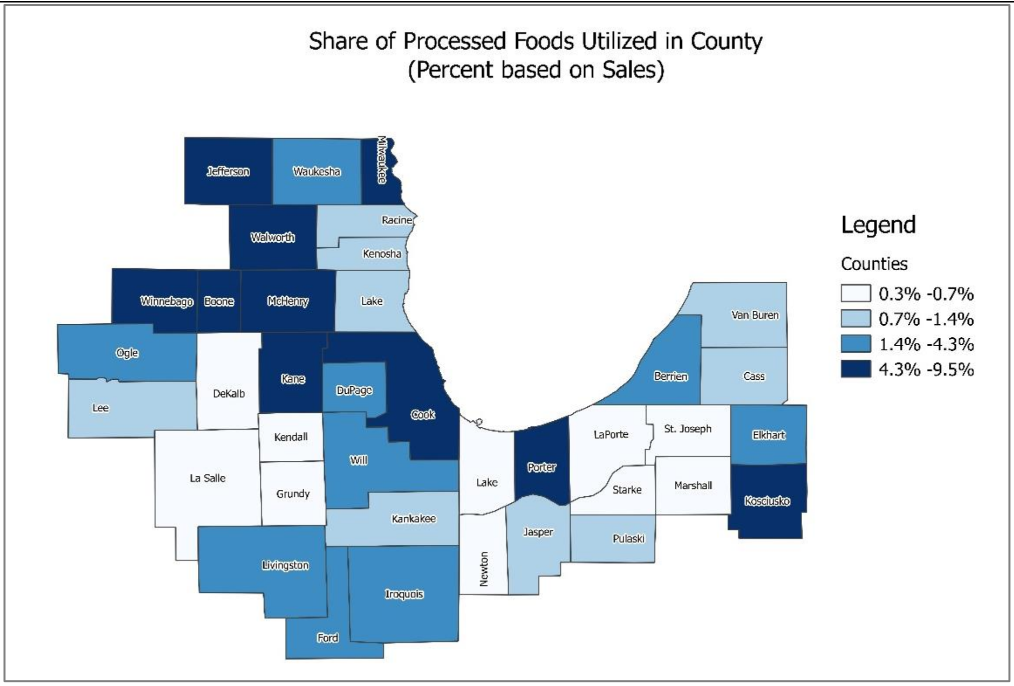

Figure 5.3-4: Share of Intermediate Food Goods that Remain Local
Source: IMPLAN and authors' calculations

5.4 Baseline Local Food System Values

Estimates for the baseline value of the Study Region's local food system were derived using the IMPLAN Pro economic modelling system specified for the 38-county Study Region. Data for the 38 counties was compiled into a single regional transactions table for measuring baseline values. The IMPLAN Pro data encompasses 536 industry breakouts and nine different household types by income. To facilitate calculations, industries were largely aggregated into two-digit NAICS categories, as shown in Table 5.4-1. This table shows the standard 2-digit North American Industry Classification System (NAICS) modified for this analysis. Grain farming, vegetable and melon farming, fruit farming, tree nut farming and greenhouse, nursery and floriculture were broken out of the agricultural sector (NAICS 11).[13] This allows us to track these sectors individually. Further, we separated out food processing sectors from the standard manufacturing sector (NAICS 31-33) to trace out processed food channels. This step is important as agricultural production goes into a great deal of manufacturing activities that are not food related. Primarily, chemical and refining activities purchase a substantial share of agricultural production, where the latter purchase grains from the Midwest for ethanol fuels. The resulting segmentation produced 26 industry sectors rather than the 20 sectors under the standard 2-digit NAICS classification.

[13] Unfortunately, we found the latter to be over-represented by floriculture and non-food crop production, limiting the usefulness of this sector in the evaluation, as discussed below.

Model Industry Aggregates	30 Food Processing
11 Ag, Forestry, Fish & Hunting	Flour milling
Grain farming	Rice milling
Vegetable and melon farming	Malt mfg
Fruit farming	Wet corn milling
Tree nut farming	Soybean and other oilseed processing
Greenhouse, nursery and floriculture	Fats and oils refining and blending
21 Mining	Breakfast cereal mfg
22 Utilities	Beet sugar mfg
23 Construction	Sugar cane mills and refining
31-33 Manufacturing	Non-chocolate confectionery mfg
Food Processing	Chocolate and confectionery mfg from cacao beans
42 Wholesale Trade	Confectionery mfg from purchased chocolate
44-45 Retail trade	Frozen fruits, juices and vegetables mfg
48-49 Transportation & Warehousing	Frozen specialties mfg
51 Information	Canned fruits and vegetables mfg
52 Finance & insurance	Canned specialties
53 Real estate & rental	Dehydrated food products mfg
54 Professional- scientific & tech svcs	Fluid milk mfg
55 Management of companies	Creamery butter mfg
56 Administrative & waste services	Cheese mfg
61 Educational svcs	Dry, condensed, and evaporated dairy product mfg
62 Health & social services	Ice cream and frozen dessert mfg
71 Arts- entertainment & recreation	Animal, except poultry, slaughtering
72 Accommodation & food services	Meat processed from carcasses
81 Other services	Rendering and meat byproduct processing
92 Government & non-NAICS	Poultry processing
	Seafood product preparation and packaging
	Bread and bakery product, except frozen, mfg
	Frozen cakes and other pastries mfg
	Cookie and cracker mfg
	Dry pasta, mixes, and dough mfg
	Tortilla mfg
	Roasted nuts and peanut butter mfg
	Other snack food mfg
	Coffee and tea mfg
	Flavoring syrup and concentrate mfg
	Mayonnaise, dressing, and sauce mfg
	Spice and extract mfg
	All other food mfg

Table 5.4-1: Model Aggregates

Output and purchases of the five crop-related agricultural sectors were tracked, including through food processor sectors.

- Agri-Food Production Sectors
    - Grain farming
    - Vegetable and melon farming
    - Fruit farming
    - Tree nut farming
    - Greenhouse, nursery, and floriculture production

- Food Processing Sectors
    - Food Processing

However, on close inspection of the purchasing patterns across industries and households, we determined that greenhouse, nursery, and floriculture production exhibited a substantial amount of variation that suggested floriculture was the primary driver for this agricultural sector. Rather than speculate on the share that is comprised of food production, we dropped this sector from consideration. While greenhouse-only production of agri-food is largely in its infancy, we anticipate that ignoring this sector, as we have done here, will become more problematic as CEA gains acceptance in the industry. There already appears to be some movement in this direction, as exemplified by such producers in the Study Region as MightyVine.

Table 5.4-2 shows local uses and production for the Study Region and relates those to key measures of economic activity, including employment, labor income, and contributions to gross regional product (regional equivalence to gross domestic product). The Sales/Output column in Table 5.4-2 measures the value of production and uses at producer's prices. The four crop producing sectors in the 38-county region produced $3.9 billion in output in 2013. About $2.5 billion was exported outside the 38-county region for consumption or processing, leaving $1.5 billion for local uses. That is, about 37 percent (~1.5/3.9) of the Study Region's crop production is consumed or processed in the Study Region. Of this, about $134.77 million is purchased for home consumption without further processing, $2.66 million through food services like restaurants and hotels. Finally, institutions like schools, hospitals, and others purchased about $2.71 million. In addition, food processors purchased about $644.26 million as inputs to processed food outputs – some of which were exported as processed foods. In total about $784.42 million of the local supply was accounted for with local uses for local food, with $140.16 million consumed from fresh and $644.3 as fresh inputs into processed goods. This is a little over 50 percent (~784.42/1458.3) of local supply. The remaining output was purchased by sectors not traditionally tied to uses of food, the largest component being manufacturing purchases of agricultural outputs not for food processing. As mentioned before, non-food uses of corn are common in the chemical and petrochemical industries. Some production was also reverted back into agricultural sectors as seed for next year's crop or for home consumption (not reported). Other uses that are not counted may show up in corporate cafeterias which are listed under the NAICS category of the hosting business. Because of these later possibilities, that other industries are utilizing agri-food inputs that are outside the scope of conventional channels that food traverses, the estimates presented here are likely conservative.

	Sales/Output ($000,000s)	Employment	Earnings ($000,000s)	GRP ($000,000s)
Total Output	**3,973.3**	**16,635**	**316.5**	**193.8**
Less Exports	2,515.0	10,079	160.5	57.4
Contribution to Import Substitution	**1,458.3**	**6,556**	**156.0**	**136.5**
Local Supply to Food Processors	644.3	2,835	57.6	41.1
Local Fresh				
Households	134.77	1,114	61.1	89.2
Retail/Wholesale[¥]	0.06	0	0.0	0.0
Food Service	2.66	16	1.0	1.4
Institutions	2.71	14	0.7	0.9
Total Local Fresh	**140.19**	**1,145**	**62.7**	**91.5**
Local Processed				
Households	101.67	210	13.1	22.2
Retail/Wholesale[¥]	0.40	1	0.1	0.1
Food Service	21.66	45	2.8	4.7
Institutions	6.44	13	0.8	1.4
Total Local Processed	**130.17**	**269**	**16.8**	**28.4**
Total (Local Fresh+Local Processed)				
Households	236.44	1,324	74.20	111.37
Retail/Wholesale[¥]	0.46	1	0.07	0.12
Food Service	24.32	61	3.78	6.15
Institutions	9.15	27	1.50	2.30
Total Local Fresh and Processed	**270.36**	**1,414**	**79.6**	**119.9**

Table 5.4-2: Estimated Baseline Local Foods Economics

** may not sum due to rounding*

¥ *Only entails trade margins earned*

We use local share of processors' total input purchases to estimate how much of the processed foods are from local supply. From this we tracked local purchases of processed food production to estimate the share of processed food activity that was local. Hence, household purchases of processed foods that were from local sources make up about $101.67 million. These purchases include direct sales to consumers and intermediated sales. Food services purchase around $21.66 million, while institutions purchase an additional $6.44 million. At this point, processed foods can be sold to other processors in the region as a second source of local uses. For example, the commercial flour mill can sell milled flour to a commercial bakery. However, this second leg of processor transactions is not tracked. Once again, this lends to conservative overall estimates of the size of the local food system.

In total, of the $1.458 billion crop production output in the Study Region, about $140.16 million was retained in the region for consumption in fresh form, and $644.26 was purchased locally for processing. Processed foods sales, from the first leg of processing generated an additional $129.97 million in sales value through local sales for final consumption. That is, about $270.13 million in local food was consumed in fresh or processed states in the Study Region. This final estimate is conservative on three accounts. First, non-conventional channels by which local foods may traverse were not accounted for in the estimates. Second, only the first leg of processing was measured, omitting the value of processed food interindustry sales in the final calculation. Third, informal channels by which consumers get access to locally sourced foods were largely not accounted for in the regional transactions table. Transactions between neighbors that are not reported to statistical reporting agencies cannot be tracked.

Next we applied standard IO modeling techniques to estimate employment, labor income and contributions to the annual gross regional product (GRP). IO modeling assumes some fixed ratio of each to sales by industry. Typical rates for crop production and food manufacturing are calculated and applied accordingly. Expected direct employment in the Study Region limited to local foods was about 1,413 with annual income topping $79.5 million in 2013. The employment counts were based on Bureau of Economic Analysis counts where there is no delineation of part-time and full-time employment and the allocation may differ by industry. Labor income impacts reach about $56,259 annual wages per job. Finally, total local food output from farm to household generated about $119.9 million to GRP in 2013.

The IMPLAN data also allows us to estimate the total household expenditures for food and compare this to our estimates. In this, only household expenditures on crop products and processed foods was considered. Processed foods sales include estimates of protein purchases. To this extent, Study Region residents purchased about $19.937 billion in fresh and processed foods in 2013, where about 1.4 percent was provided by local suppliers of crops.

The estimates in Table 5.4-2 represent best objective estimates of the economic baseline of local foods as measured from crop-food production and consumption using the social account matrix underlying input output models. In this effort and through communications with some wholesale distributors specializing in local foods, it is evident that estimates of trade shares may be underestimating the system. For example, in those conversations, it became apparent that specialty wholesalers command a higher share of the total sale price of local-sourced goods than that reported in the U.S. Census wholesale (United States Census Bureau 2016) and retail (United States Census Bureau 2016) trade reports. We largely attribute the discrepancy to survey methods that tend to weight toward conventional foods and conventional food channels.

5.5 Changes in Local Food Demand

In this section, we look at the empirical estimates of the economy-wide contribution of agri-food production in the Study Region to the local economy. This particular simulation does not consider some of the nuances, such as changes in land use due to increased fruit and vegetable production and decreased grain production, but provides a generalized lens to discuss changes in the economy. Section 5.6 provides estimations based on the three different strategies highlighted in section 4.42.

This section draws heavily from the work of Watson, Kay, et al., (2015) and methods are presented in Section 2.3.2 of this report.

Table 5.5-1 shows the distribution of sector sales where intermediate sales are sector sales to other producing industries. Such industries purchase inputs from other sectors in the process of generating goods and services for final use. For instance, the food processing sector is a large intermediate buyer of agricultural producers' output, where processors convert these inputs to final processed goods for consumption. The local final sales column shows the value of purchases consumers make at the producers' prices.[14] For grains, this would be whole corn purchases that may take place directly from the grower, or through an intermediary, such as through a retailer. Regardless, the key point is the price the grower receives, and the consumers' purchase is for non-processed grains. The total local sales are the sum of intermediate and local final sales. External sales are largely made up of the value of those goods shipped out of the region. Output is the sum of total local and external sales. Evident in Table 5.5-1 is that grain farming and food processing sales are largely driven by external purchases, as about 71 percent of output is accounted for with external sales.

	Intermediate Sales	Local Final Sales	Total Local Sales	External Sales	Output
Ag, Forestry, Fish & Hunting	1,827.4	106.7	1,934.1	2,124.8	4,058.9
Grain farming	1,048.3	24.8	1,073.1	2,655.1	3,728.2
Vegetable and melon farming	26.5	82.8	109.3	25.9	135.2
Fruit farming	32.5	26.7	59.2	48.4	107.6
Tree nut farming	0.3	0.4	0.7	1.5	2.3
Greenhouse, nursery, and floriculture	57.3	78.2	135.5	162.4	297.9
Food Processing	5,010.0	6,322.0	11,332.0	28,726	40,059.0

Table 5.5-1: Sector Demand Profiles

Source: IMPLAN and authors' calculations

In interpreting Table 5.5-1, it is important to realize that these are direct values of transactions and do not take into account secondary effects that give rise to economic impacts. In addition, the sector Ag, Forestry, Fish & Hunting is not included in the baseline measures of the size of the Study Region local food system, but does include non-crop food sales, mostly made up of proteins that are not tracked in this report.

Table 5.5-2 views the sector impact distribution through the lens of secondary effects. Here, the direct base column depicts exogenous, or export sales. These sales are the impetus to larger economic impacts that accrue through the multiplier process. The indirect base column measures secondary transactions to other sectors in the Study Region required in producing the agricultural commodities or processed foods. That is, the $2,655 million in direct sales of grain farming gives rise to $2,644.8 million in secondary transactions. Since direct sales drive these secondary transactions, the sum of the direct and indirect base is the total economic base or the export base.

[14] The model is closed up to the household level. That is all government and non-household institutional purchases are treated as external or export purchases. This amounts to a small share of total output.

The local purchases column is the sum of intermediate (industry purchases) and household purchases for local output. Finally, the ratio gives an indication to the extent that the sector supplies external markets relative to local markets. In this, it is clear that grain production is much more tied to external markets while vegetable and melon farming production is much more directed toward local uses. For fruit farming, while grapes are included in this category and are present throughout the Study Region, the relatively high concentrations in eastern counties favors exports, driving up the export base. For example, the core of U.S. blueberry, cherry and apple production occurs in the three counties of Southeast Michigan included in the Study Region. The nature of this concentration, just as the nature of grain production concentration throughout the region, favors export markets.

	Direct Base	Indirect Base	Total Economic Base	Local Purchases	Ratio TB/LP
Ag, Forestry, Fish & Hunting	2,124.8	1,570.3	3,695.1	4,058.9	0.91
Grain farming	2,655.1	2,644.8	5,299.9	3,728.2	1.42
Vegetable and melon farming	25.9	19.4	45.3	135.2	0.33
Fruit farming	48.4	38.2	86.6	107.6	0.80
Tree nut farming	1.5	1.2	2.7	2.3	1.20
Greenhouse, nursery, and floriculture	162.4	143.6	306.0	297.9	1.03
Food Processing	28,726	22,814	51,540	40,059	1.29

Table 5.5-2: Base versus Gross Output ($Millions)

Source: IMPLAN and authors' calculations

5.6 Simulations of Changes in Local Food Demand and Land Use

This section will present simulation findings based on three hypothetical strategies to increasing the size of the Study Region's local food system. These scenarios represent realistic, yet broad-brushstroke, scenarios of how the Study Region's local food system may expand and posits policy frameworks for setting growth in motion. The simulations follow moderate and aggressive growth scenarios, where moderate growth assumes a 10 percent increase in local food purchases, while aggressive growth assumes a 25 percent growth. The baseline and growth entails local food sales of both unprocessed and processed local foods, where grains make up the dominate share of local, raw inputs and consumer purchases.

These scenarios are accompanied by more optimistic, or long-term changes in the Study Region's local food system which posits that the region self-supplies 10 and 25 percent of total regional consumption. In contrast to the first set of scenarios, which postulates growth of local food sales from the existing baseline of 1.4 percent, the latter assumes the 1.4 percent self-supply increases to 10 and 25 percent, respectively. This represents a seven- and eighteen-fold increase in the size of the regional food system, rather than a 10 percent and 25 percent increase from current levels.

The three scenarios are as follows:

1. Diversion – Divert export (non-local) sales to local purchases
2. Land Use – Shift from export-oriented grains to local food-oriented fruits and vegetables
3. Production Expansion – Expand output of all crop output

The diversion scenario assumes that current export sales are diverted from export markets to local markets resulting in a 10 percent or 25 percent increase in local supply which is assumed to match up to a corresponding increase in demand for local. In addition, we assume that self-supply of local foods reaches 10 and 25 percent share of total regional food purchases. As reaching these levels of self-supply will require significant institutional and structural investment and is likely to meet resource constraints that may include insufficient land resources capable of producing commodities required by local consumers, the latter analysis based on 10 (700% increase in existing supply) and 25 (1800% increase in existing supply) percent self-supply should be viewed as highly speculative and long-term.[15] To keep the analysis manageable, we assume that local purchases are allocated to uses in proportion to current purchases. That is, the analysis does not favor household direct purchases, or food manufacturing purchases of locally-sourced crops, but rather allocates increases in sales proportionately.

The land use scenario assumes that some land is taken out of export grain production and put into local grain, fruit, and vegetable production. In this scenario, we calculate the number of acres required to increase total output by 10 percent and 25 percent, based on existing yields and proportional allocation of production by crop (described in section 4.4.2). The total acres for all local commodities necessary to increase output were then allocated to acres currently in export grain. By netting out export grain acres in the analysis, this simulation nets out the lost sales to grain production for increased local foods production. Further, we calculate the expected outcome under 10 and 25 percent self-supply, along similar grounds. In allocating shares, we assume equal proportional changes over all commodities. Because of regional production constraints, the absolute imposition of 10 and 25 percent self-supply may imply a significant change in local diets. For example, citrus fruits are not currently produced in the region. Therefore, to the extent that such cannot be fulfilled with the remaining 90 or 75 percent that is not local, fruits such as apples may have to fill in these gaps.

The last scenario essentially replicates the second scenario, however lost grain sales due to fewer acres are not accounted for. Instead, the assumption is that the Study Region's local food production increases by 10 percent and 25 percent, respectively, due to either enrolling currently unproductive land into production or increasing yields of existing acres in fruit and vegetable

[15] Consider that there are likely not enough acidic soils available in the region to meet local demands at 10 and 20 percent. Similarly, as a significant crop commodity consumed is citrus, it is quite possible that meeting these self-supply targets is not feasible under conventional agriculture, but would rather require technological advances in controlled environment agriculture.

production (for example, due to facilitating changes in and adoption of new technologies like controlled environment agriculture). Growth in output is reached by increasing all local production by 10 percent and 25 percent from their current levels of output. Similarly, we conjecture that 10 and 25 percent self-supply can be reached without reductions in export output. This conjecture is not likely to be borne out in practice within the foreseeable future, as this posits a significant increase in yields is possible or a significant number of fallow acres exist to go into production – both of which appear implausible in the foreseeable future. However, such levels of production may be attainable in the long-run through extensive adoption of controlled environment agriculture. Regardless, in this final scenario, no netting out of lost sales is assumed, and the analysis implicitly infers that land or untapped yields are accessible to reach projected growths.

As discussed in section 4.4.2, all three scenarios make no assumption on what specific commodities actually generates the growth, but rather assume that growth accrues across all local food sales in proportion to baseline sales, and through an aggregate basket of agricultural products. From a policy perspective, this may not be realistic as some agri-crop products are more amenable to local food markets than others because of local demand, value chains, soils, climate and other considerations that make them better targets for profitable growth. The commodities targeted for growth are largely a market and policy consideration that requires further investigation when setting forth on a policy agenda. We also reiterate that we perceive 10 and 25 percent self-supply to be an unrealistic short-term goal based on the diverseness of what is produced in the Study Region and what is consumed. Key to this is that the majority of fruit consumption is citrus and is not produced in the Study Region.

Simulation Scenario 1: Diversion – Divert export sales to local purchases

In this scenario, a portion of export sales are diverted to local uses. Rather than specifying what those local uses are, we assume that all local purchases increase by either 10 percent or 25 percent, reducing exports by the same. That is, there is no direct change in output, but rather impacts arise due to increased capture of local production. Rather, we simulate that local food purchases increase by $145.76 million under a moderate growth scenario and $364.39 million under an aggressive growth scenario, while decreasing export sales by the same amount (Table 5.7-1). Notice that grain sales make up the bulk of the total change. Most all of grain sales are through intermediaries for processed grains.

	Basis	10% change ($Mills)		25% change ($Mills)	
		Change in Local Purchases	Change in Exports	Change in Local Purchases	Change in Exports
Grains	1287.87	128.79	-.128.79	321.97	-321.97
Vegetables	110.41	11.04	-11.04	27.60	-27.60
Fruit	59.29	5.93	-5.93	14.82	-14.82
Total	169.69	145.76	-145.76	364.39	-364.39

Table 5.7-1: Direct Effects of 10 and 25% Increase in Current Local Purchases from Exports

Simulations are calculated where net impacts are derived from equation 4.2-8, described above. As no direct change in output occurs in this simulation, we would anticipate impacts to be rather muted, and this is reflected in Table 5.7-2. Here, neither increasing local demand by 10 percent or 25 percent through reduced exports generated a significant enough change in employment to show an impact. However, a positive impact would be expected in marginal increases in labor earnings, GRP and sales, and this is reflected in Table 5.7-2. While increasing local demand by 25 percent over current demand may be optimistic, at least in the short-term, it is notable that impacts increase disproportionately. While the 25 percent increase represents an increase 2.5 times that of the 10 percent increase simulation, the impacts of the 25 percent increase are much larger than the 2.5 magnitude change.

	Growth Simulation	
	10%	**25%**
Employment (Persons)	2	15
Labor Earnings ($)	94,294.0	591,482.8
GRP ($)	150,256.5	942,522.5
Sales ($)	530,163.6	3,325,679.8

Table 5.7-2: Impacts of 10 and 25% Increase in Current Local Purchases from Exports

The findings suggest that expanding local food sales through reduced exports by 10 and 25 percent, results in relatively modest increases in total economic activities in the Study Region. However, as the change moves from 10 to 25 percent, the increases become disproportionately large.

Using this same approach, we postulate that local self-supply of processed and unprocessed grains, vegetables and fruit reaches 10 and 25 percent, respectively. That is, 10 and 25 percent of all local final purchases of raw and processed sales are filled by local agricultural producers. Estimates of processed value added used ERS manufacturing shares to allocate total food production sales to grains, fruits and vegetables respectively (Economic Research Service 2016).

Table 5.7-3 shows the direct effects imputed into the model, where reaching 10 percent self-supply will require local final demand for processed and unprocessed grains, fruits and vegetables to reach $507.14 million per year. When compared to total regional production reported in Table 5.5-1, this amounts to less than 10 percent of total grain production, but over 60 percent of fruit and vegetable output in the region, which is not likely to happen without significant investment in new infrastructure and marketing chains. However, these sales also entail value-added prices of processed local foods. Similarly, meeting 25 percent of local demand requires that $1,267.86 million in output be directed toward local uses. In this case, the value of processed and unprocessed local grain sales account for about 23 percent of the value of regional grain production. However, local fruit and grain purchases would be about 160 percent of current value of fresh production. In unprocessed values, this would require 130 percent of the current level of production, such that increasing local consumption by diverting exports is not feasible. There are not enough exports to capture. Hence, a 25 percent self-sufficiency simulation is not undertaken.

		10% Local Supply ($Mills)		25% Local Supply ($Mills)	
	Total Demand	Local Purchases	Export Purchases	Local Purchases	Export Purchases
Grains	3489.07	348.91	-348.91	872.27	-872.27
Vegetables	864.94	86.49	-86.49	216.24	-216.24
Fruit	717.42	71.74	-71.74	179.35	-179.35
Total	5071.43	507.14	-507.14	1267.86	-1267.86

Table 5.7-3: Direct Effects of 10 and 25% Self-Supply from Exports

Simulation results are shown in Table 5.7-4. Here meeting a 10 percent self-supply of processed and unprocessed grains, fruits and vegetables will generate 27 new jobs, with earnings exceeding $1 million per year. This would also contribute about $1.7 billion to annual gross regional product and contribute about $5.86 billion in annual sales, including secondary transactions. As exports are the upper constraint, a 25 percent self-sufficiency by diverting exports is not feasible. To this extent, we also anticipate violating production bounds with the 10 percent scenario, for fruit production, as bananas and citrus collectively commands about 50 percent of fruit consumption and is not a viable crop in the Study Region.

	Self-Supply Simulation	
	10%	**25%**
Employment (Persons)	27	NA
Labor Earnings ($)	1,099,872	NA
GRP ($)	1,748,997	NA
Sales ($)	5,862,253	NA

Table 5.7-4: Impacts of 10 and 25% Self-Supply from Exports

Despite the relative size that 10 percent self-sufficiency implies, meeting this through reductions in exports is not likely to result in large economic impacts. This is largely the result of substitution from one form of economic activity to another. The only source of economic growth is through the deepening of transactions within the region that spurs greater circulation of existing dollars rather than leakage of those dollars to firms importing into the Study Region.

Simulation Scenario 2: Land Use – Shift from export-oriented grains to local food-oriented grains, fruits and vegetables

The second simulation is complicated in that growth in local foods production is offset by declines in grain production proportional to the number of acres required to increase agri-food production for local uses by 10 and 25 percent. In this, acres allocated to grain production for export are reduced by the number of acres necessary to increase crop production of grains, fruit, and vegetable by 10 and 25 percent from baseline, respectively. Similarly, we calculate the number of acres required to meet 10 and 25 percent self-reliance and estimate the net effect on the local economy. In these experiments, the relative economic activity per acre, both direct and secondary, give rise to differential outcomes. For example, fruit production creates much greater value per acre in direct economic activities. Alternatively, as shown below, grains command a greater extent of secondary transactions in the Study Region, primarily because of the clustering of grain production activities in this region. We postulate that fruit and vegetable production does not have this clustering effect in the Study Region, and hence, tends to create fewer secondary transactions than grain.

To estimate the impact of expanding local food acres through reduced export grain acres, we compare the land used in grain production, which is dominated by corn production, to that in fruit and vegetable production. Using planted acres shown in Table 4.3-3 and yields corresponding to per-capita consumption, an assessment of the number of acres that will be allocated to local foods under the 10 and 25 percent growth scenarios can be established. [16] Grain for local use and grain for export acres net out to no change. However, additions to fruit and vegetable acres are assumed to decrease grain acres as shown in Table 5.7-5, resulting in a net decrease in grain output of 0.14 and 0.34 percent.

Change in land acres planted[a]	5,548.5	13,871.3
% change in fruit and vegetable production	**10%**	**25%**
Corresponding % change in grain production	-0.137%	-0.342%

Table 5.7-5: Change in Land in Export Grains Under 10 and 25% Growth Scenarios

[a] Represented and increase for fruits and vegetables and a decrease for grains

Making Table 5.7-5 operational within the economic impact model requires translating acres by commodity to value of farmgate sales. This is shown in Table 5.7-6, where the value of fruit and

[16] This was calculated by summing all fruit and vegetable planted acres and divided by the sum of all grain planted acres.

vegetable sales per acre far exceeds that of grain sales**.** Here, shifting 5,548.5 acres (10% increase in fruit and vegetables) or 13,871.3 acres (25% increase) from grain to fruit and vegetable acres will result in a net increase of agricultural sales of $11.96 million under a 10 percent growth simulation and $29.91 million under a 25 percent growth simulation. That is, as opposed to the prior scenario, new direct effects, or sales, are generated.

	Change in $ Millions	
	10%	**25%**
Grains	-5.11	-12.77
Vegetables	11.04	27.60
Fruit	5.93	14.82
Total	11.96	29.91

Table 5.7-6: Direct Effects of 10 and 25% Increase in Current Local Purchases Through Sifts in Land Use

Table 5.7-7 shows the simulation results for the broader economy, suggesting the added economic sales lead to greater economy-wide impacts than an export diversion strategy. This is the case since exports of other output continue under this scenario and the source of impacts is from switching from lower per-acre value crops with minimal input to higher valued crops that require more grower input in the production process. It should be noted that some of the direct impacts are negated through negative indirect transactions. That is, fruit and vegetable growers tend to supply through local sources less than grain producers, hence generating fewer secondary transactions. In total, employment growth would be expected to increase by 208 under a moderate growth strategy of 10 percent, and by 520 under an aggressive growth strategy of 25 percent.

	Growth Simulation	
	10%	**25%**
Employment (Persons)	208	520
Labor Earnings ($)	11,485,285	28,713,959
GRP ($)	17,618,292	44,046,964
Sales ($)	18,535,269	46,338,663

Table 5.7-7: Impacts of 10 and 25% Increase in Current Local Purchases Through Shifts in Land Use

Alternatively, reaching 10 percent or 25 percent self-supply of grains, fruit and vegetables postulates a larger change in agricultural land use. Once again, increased acres for local grains nets out losses in export acres in grains. However, these scenarios call for many more acres to be allocated to local crop production. As shown in Table 5.7-8, export grain acres would require a net decrease of 125,131 acres to meet 10 percent self-supply and 396,054 to meet 25 percent. This would correspond with a 3.1 and 9.8 percent decrease in total grain production.

Change in land acres planted[a]	125,131	396,054
% change in fruit and vegetable production	10%	25%
Corresponding % change in grain production	-3.089%	-9.777%

Table 5.7-8: Change in Land in Export Grains Under 10 and 25% Self-Supply Scenarios

[a] *Represented and increase for fruits and vegetables and a decrease for grains*

Table 5.7-9 shows the corresponding direct effects of meeting 10 and 25 percent self-sufficiency, respectively. It may be interesting to note that meeting 10 percent self-sufficiency is expected to generate a larger aggregate net impact in terms of direct sales than meeting 25 percent self-sufficiency. That is, as more grain-producing acres are removed from production net total sales will decrease at this level of output, corresponding with bounds to sector output. However, as shown below, sales do not necessarily correspond with employment impacts.

	Change in $ Millions	
	10%	**25%**
Grains	-115.16	-364.50
Vegetables	86.49	216.24
Fruit	71.74	179.35
Total	43.17	31.34

Table 5.7-9: Direct Effects of 10 and 25% Self-Supply Through Sifts in Land Use

Table 5.7-10 shows the expected economic impacts of reaching 10 and 25 percent self-supply by shifting land use. Here, employment impacts increase from 1,464 at 10 percent self-supply to 2,916 at 25 percent. However, aggregate sales impacts decrease from $42.9 million to a negative $46.2 million, respectively. That is, increasing local food sales by shifting into export corn has limits.

	Self-Supply Simulation	
	10%	**25%**
Employment (Persons)	1,464	2,916
Labor Earnings ($)	89,147,732	183,308,066
GRP ($)	134,296,599	274,477,363
Sales ($)	42,904,224	-46,204,424

Impacts of 10 and 25% Self-Supply Through Shifts in Land Use

In summary, shifting land use from export grain to local agri-food production has limitations, but posits positive and significant economic and employment impacts. Such impacts are expected to be larger than diverting exports for local use, because this results in a net increase in direct sales.

Simulation Scenario 3. Production Expansion – Expand all crop output

The final scenario does not net out lost sales, but rather assumes that moderate fruit and vegetable growth of 10 percent and aggressive growth of 25 percent arise through more efficient use of existing agricultural parcels, adoption of new technology increasing per acre yields, or some combination of both. Similarly, a second set of scenarios assumes that the region meets 10 and 25 percent self-supply of grains, fruit and vegetables. This may arise by employing currently fallow or underutilized lands and/or vacant lots, or by widespread adoption of improved agricultural production practices such as CEA. However, in both cases, and especially for meeting self-supply objectives, reaching these objectives may require fixed investment and other costs (such as private costs that growers will have to incur to plant and manage these specialty crops) not captured in this analysis. Therefore, these scenarios may not be entirely feasible without netting out the impact of these additional costs.

Regional production limitations also should be considered. Especially for tree-fruit, there is a significant time lag between planting and yielding marketable output. Similarly, adopting modern-high yield production practices requires more than flipping a switch. It may require significant learning and equipment costs. In addition to private costs, support services, and production chains would have to be in place to make such growth feasible. Despite the potential appeal of enhancing the current regional output of fruits and vegetables, there likely exist several obstacles to realizing such growth under the third scenario.

The growth simulations shown in **Table 5.7-11** shows the direct change simulated. Aside from the positive gains in grain output, this analysis is the same simulation described in the land use strategy.

	Change in $ Millions	
	10%	**25%**
Grains	128.79	321.97
Vegetables	11.04	27.60
Fruit	5.93	14.82
Total	145.86	364.64

Table 5.7-11: Direct Effects of 10 and 25% Increase in Current Local Purchases Through Production Expansion

Table 5.7-12 shows the simulation results and, as anticipated since this strategy does not require netting out opportunity costs, the projected impacts are larger than in scenario 2. For example, a 10 percent increase in fruit and vegetable output would create an estimated 1,507 new jobs in the Study Region, while a 25 percent increase would result in 3,767jobs.

	Growth Simulation	
	10%	**25%**
Employment (Persons)	1,507	3,767
Labor Earnings ($)	59,142,516	147,855,614
GRP ($)	92,327,149	230,816,874
Sales ($)	281,027,705	702,561,911

Table 5.7-12: Impacts of 10 and 25% Increase in Current Local Purchases Through Production Expansion

The proposition that 10 or 25 percent self-supply can be achieved without offsetting declines in exports is not entirely viable in the short- or immediate-term, but may be achievable with significant changes in technologies, especially in regards to controlled environment agriculture. Meeting 10 percent self-supply will generate $145.86 million in grain, fruit and vegetable production, while meeting 25 percent will generate $364.64 million in direct sales.

	Change in $ Millions	
	10%	**25%**
Grains	348.91	872.27
Vegetables	86.49	216.24
Fruit	71.74	179.35
Total	507.24	1,268.11

Table 5.7-13: Direct Effects of 10 and 25% Self-Supply Through Production Expansion

Table 5.7-14 shows the expected impacts, suggesting that reaching these objectives would likely create significant economic impacts of 5,965 and 14,914 jobs at 10 percent and 25 percent self-sufficiency, respectively. Such outcomes would contribute $385.8 and $964.5 million to annual gross regional product. However, we don’t want to oversell the potential to reach these outcomes, as moving from 1.4 percent self-supply to 10, or 25 percent self-supply would be a difficult goal for the Study Region.

	Self-Supply Simulation	
	10%	**25%**
Employment (Persons)	5,965	14,914
Labor Earnings ($)	249,399,514	623,508,392
GRP ($)	385,813,173	964,548,144
Sales ($)	951,348,281	2,378,385,762

Table 5.7-14: Impacts of 10 and 25% Self-Supply Through Production Expansion

In summary, the negated opportunity costs forgone largely impact the total economic contribution of local foods sales. However, retaining a larger share of total intermediate and household sales in the local economy facilitates economic growth. Unfortunately, such growth is generally not sufficient to offset the opportunity costs. This is most evident in the first scenario, where export sales are replaced with local sales. This generates the smallest overall economic impact. When shifting land use from grains to fruits and vegetables, the impacts are larger, because on a per-acre basis, fruit and vegetable production generates greater total economic value than grains. The largest impacts occur where no substitution of grains take effect – that is when increases in fruit and vegetable production is undertaken without reducing grain acres. This is most likely the outcome if existing fallow lands are put to agricultural uses, or when intensive farming practices are put into place like controlled environment agriculture.

6. Summary and Conclusion

The primary motivation of this study was to better understand the economics of the Study Region's local food system and to facilitate policy discussions around growing this local food system. In pursuit of these objectives, we turned to data resources from multiple statistical reporting agencies and from commercial economic impact models. Data include production statistics by county, consumption statistics by commodity, demographic statistics and GIS data maps. Together, with an extensive review of the current literature on local food systems, these statistical resources provide a broad assessment of the size and contribution of the Study Region's local food system to the regional economy. Three objectives were targeted: 1) determine the economic baseline values of local foods for the Study Region; 2) determine the economic impacts of hypothetical increases of the baseline (10% and 25%); 3) determine the necessary and respective changes in land use within the Study Region should local food production be increased from the baseline. This study also makes two main assumptions in the context of potential increases from the baseline: 1) there exists unmet consumer demand at current prices; and 2) farm-producer expenditures vary between conventional and conservation practices.

The Study Region is made up of 38 counties, where 12 counties comprise the relatively densely populated Chicago MSA. While our findings suggest agricultural production takes place within these twelve counties, this production is dwarfed by that of the 24 surrounding counties, which represents a wide spectrum of agricultural production but is primarily focused on corn. Our assessment largely supports the existing location-theory of urban and agricultural production, where inner-city land rents generally do not support profitable agricultural production. This gives way to lower land rents the further one travels from the city center until conventional agriculture takes over as the primary driver of economic activities.

However, it is conventional agriculture that the local food movement has disrupted. Under the local food movement, locally-sourced goods become relatively more valued by consumers. This higher value gives rise to greater profitability that affords more opportunity for urban and peri-urban agriculture to flourish. Agricultural products that are most competitive are those that can be easily identified through product attributes as locally-sourced. Currently, local grains constitute a small market niche. Therefore, promoting local grains with a higher price point is not likely to yield profitable output in high-rent areas. Fresh tree-fruits and nuts, vegetables and many lower-volume agricultural products, however, have favorable profiles for profitability in high-rent areas when marketed as local. In addition, value-added processed foods with local labels may be more viable if incorporated with premium foods that have premium food attributes. This is possible as gourmet attributes command higher prices, where attributes sought by consumers increasingly include “local.”

For this project, a baseline estimate of the size of the Study Region’s local food system was derived using secondary data sources. The same data sources were then used to gauge the economic contribution of the local food system by consideration of all direct and secondary transactions that arise through local food production. Such an analysis affords a comprehensive view of all the local transactions that go into local food sales and include all input purchases that arise to local suppliers. In this assessment, local food is defined as that which is grown, processed (where appropriate) and eventually consumed within the 38-county region. For this analysis, only crop production was measured as this assessment did not consider the complex supply chains of meat production. This omission does constrain total values, but given the low penetration of beef and meat products into local food systems (Kemp, Insch et al. 2010), the largest components of local food are captured in the estimates.

The estimate of the size of the Study Region’s local food system was derived using an input-output (IO) model specified for this region. The IO model allows us to trace commodity sales across industries and households. The estimate suggests about $270.4 million in local food sales were recorded in the Study Region in 2013. This is in contrast to total agricultural production of $3,973.3 million in farm sales of crop output. Based on estimated total consumer expenditures on agricultural crop products, this suggests that less than 1.5 percent of the region’s household expenditures are captured by local supplies. This contrasts with findings undertaken for the state of Michigan, where about 17 percent of household expenditures were captured by the local food system. The differences are expected for multiple reasons. On the other hand, well over half of the fruit and vegetable production in the region makes its way into local channels.

Several factors contribute to this 1.5 percent value which is markedly lower than prior estimates for the state of Michigan. First, the Study Region’s population density is magnitudes greater than that of the state of Michigan (the Chicago MSA is the third largest in the US compared to Detroit, which is ranked fourteen). Hence, there are fewer acres per-capita in the Study Region. For this, it would be difficult for the Study Region to meet local food demand even if all agricultural output was directed at local uses.

Second, agricultural production in the Study Region specializes in commodity crops with less visibility in the collective consumer local food spectrum. The Study Region is nestled in the Grain Belt – a region characterized by agricultural specialty in grain (primarily corn) production. This level of specialty sets the Study Region apart from other local foods systems which benefits from micro-climates that support a wide spectrum of agricultural production. Michigan, like regions along the West Coast, has climatic and geographic conditions that favor the production of specialty crops and discourage large-scale specialization on high-volume commodity crops. This further contributes to Michigan's high local foods shares. Freshness is an important attribute of many such specialty crops, drawing greater consumer interest in source-location. Similarly, regions steeped in specialty crops may be more amenable to a referable local flavor. Such local flavors can be identified in Michigan's Northwest with cherries and apples and Michigan's Southwest with blueberries.

Third, regional specialization affords a level of productivity that increases the opportunity costs of migrating acres away from core commodities toward more specialized goods. Regional specialization in agriculture enhances resources that tend to make production more profitable for all. Such productivity boosts may arise from built up public infrastructure that favors the historically significant sector, support services like that provided by the university Extension services, by private industry like seed companies and technical consultants, and by buying industry location choices. Such specialization effects build on themselves to reinforce the export commodity markets until the point of diminishing marginal returns of further specialization. Higher profitability of commodity crops raises the bar of promised profitability required to encourage one to forgo participation in the regionally specialized commodity and discouraging one from exiting that commodity.

Other measures of the economic size of the Study Region's local food system were also estimated. In particular, the local food system supported about 1,414 jobs and contributed $79.6 million in labor incomes in 2013. The region's local food system contributed about $119.9 million to gross regional product in 2013. This value reflects the value-added activities that local food generates including labor and proprietors' income, land rents and indirect business taxes.

There are some key limitations to these estimates. First, the analysis only traced crop production transactions to the point of final consumption. It did not take into account beef and meat sales that traverse local channels. Second, the definition of what makes up local food may be broader than most analysts consider. Here, the definition of "local foods" included all food goods whether the food was marketed as local or not. For example, conventional food products like Heinz condiments were included in the estimate if it met the local food definition. While this may be broader than traditional definitions of local food, it is consistent with recent interpretations and may be the required measure as local foods become more mainstream and marketed through conventional consumer channels.

To a certain extent, this definition may already be taking hold, as coops and wholesalers label existing supply as local if the source and destination are within some defined geography. In some cases, the grower may not be privy to this channel and the higher prices earned from the commodities marketed as local. In effect, most mainstream channels that local foods may take do not communicate the premium prices they command back to the grower (Low and Vogel 2011). More deliberate local food systems marketing may command greater returns to growers. Growers that sell directly to consumers or food service providers can capture a greater share of food dollars. This takes the form of premiums that compensate for marketing efforts – though these channels are generally limited in flow. Similarly, working with local food hubs and wholesalers to custom-source local food demand may posit higher returns for growers. Here, growers may be able to capture a larger share of food dollars and maintain high levels of volume. However, the margins may be lower than if they directly market to consumers and food service sectors.

An analytical shortcoming was realized in this effort in that the production chains of local foods that are marketed as local generally follow different channels and command different values than what secondary data captures. Key to this is the treatment of trade margins where IO models rely on aggregate measures. Aggregate trade margins are weighted toward conventional channels and goods due to the relative scale of these items compared to local. Recent literature combined with our conversations with industry participants indicated that grower prices can be higher for local markets (especially if vertically integrated with the marketing effort), and that wholesale and retail margins tend to be much higher for local foods. In other words, local foods follow a different value chain of transactions than conventional food before reaching consumers and these differences are not fully captured in this analysis.

The second key objective was to review the policy implications of expanding the Study Region's local food system. In this, we undertake a series of simulations to show how different growth strategies generate different economy-wide economic impacts. Approaches to measuring the economic impact of local food systems should address sales lost through conventional channels, that is, net gains. Following published approaches, we estimated economy-wide changes in regional output, employment, labor income and contributions to gross domestic product along three strategies. For each strategy a conservative (10%) and aggressive (25%) change in local food sales are simulated. These are also accompanied much more aggressive conjecture that the region's self-supply of local agri-food crop purchases increases from its current level of 1.4 percent to 10 and 25 percent respectively. This conjectures a significant increase in the share of crop food purchases that are made from local sources. Based on our assessment, it will be difficult to meet these latter levels of self-supply in the short-term, and for 25 percent self-supply, it may be impracticable in the long-run given that about 50 percent of consumer purchases of fruit is made up of citrus commodities not produced in the Study Region.

The first strategy consisted of diverting export sales to local sales, thereby reducing imports and retaining more dollars in the local economy. As this strategy does not generate new production in the region, the estimated economy-wide impacts were largely muted. The second strategy entailed shifting acres out of grain production sufficient to increase fruit and vegetable production by a pre-defined amount. The findings show a relatively larger net economic impact, showing that per-acre economic activities for fruit and vegetable production far exceed that of grain production. Impacts arise because more inputs are purchased in farming these crops than are used in grain production. This simulation however, does not take into account profitability. Hence, the mode of reaching the simulated states was not explored. More specifically, what may be preferable from a regional economic activity perspective may not be preferable for individual producers who have to choose what crops they will place in production on their limited acres. The third strategy inferred a direct growth in fruit and vegetable production without an associated decline in other economic activities. This simulation has the strong assumption that an increase in local food sales can occur without opportunity costs on the conjecture that currently fallow lands are employed in production to meet output increases, or existing practices are supplanted with innovative production technologies to meet targeted output without the need to offset economic impacts through decreases in grain production. The latter may be interpreted as adopting controlled environment agriculture similar to that of MightyVine. As no offsetting losses are estimated, the simulations suggested this will create the largest economy-wide impacts. However, this assumes the relevant incentives for investments are in place. It also does not take into account the fixed investment required to enroll fallow land or initiate innovative agricultural production practices.

Under the most aggressive scenario, where the Study Region meets 10 and 25 percent self-supply of agricultural crops for both processed and unprocessed consumption, employment impacts can be as high as 5,965 and 14,914, respectively – giving rise to about $951 and $2,378 million in additional regional transactions. However, this assumes that no lost sales are incurred to exports. We largely see this as unattainable, in the short run. Innovations in controlled environment agriculture may be one way in which such outcomes may be realized in the long-run. However, such changes will have profound changes to industries that are difficult to conjecture at this time. We anticipate much more moderate growth from the current level of local food sales is more attainable in the short run. Here, we can expect job growth of 1,464 and 2,916 for a 10 and 25 percent growth from current local food sales, respectively. However, this does not account for the potential lost sales to export markets. Taking into account such opportunity costs of increasing the size of local food markets will reduce the size of these impacts. This is also explored in this report.

The estimates of the economic impacts of these strategies provide broad-stroke assessments of the economic impacts of such outcomes, and provide potential benchmarks for adopting regional policies to further support the local foods system. However, they do not directly explore the feasibility of reaching these outcomes. To do this, several factors must be considered. First, increasing or shifting grower output is not sufficient in making a strategy viable. Value chains, distribution networks and support networks must also be considered. Specialty crops require very different inputs than row crops. Growers and industry respond to incentives – whether profits or public investment. Under the efficient markets theory, land use and production is, or navigates toward, the most efficient outcomes. This suggests that changing regional production from the current commodity mix will necessitate moving the industry away from the most efficient outcomes as dictated by prices and profits. If market forces (like demand for locally-sourced foods) change, market forces will impose production changes toward meeting the change in consumer preferences along a market-driven path. Alternatively, market-divergent paths to change are likely to reduce grower and industry profitability and have adverse impacts on the economy. This implies that the most efficient route toward fostering growth in local food systems is through innate growth brought about by increased demand from consumers. The outcomes from this study suggest a multitude of approaches to fostering growth are appropriate. A demand-pull strategy would focus on consumer demand through marketing efforts and through consumer education. Interest in local foods and healthy foods, in general, are key drivers in changes in consumer purchasing habits. Aiding this, shifting consumer preferences toward eating locally-grown produce may be a low-cost option for effective transformation toward greater local reliance. Conversely, a supply-push strategy would entail creating more venues for consumers to have access to local foods. This strategy has greater risks than a demand-pull strategy in that growers will largely respond to intermediate demands for locally-sourced goods. If demand and potential profits are significant, growers will be more prepared to experiment with alternative agricultural production to meet this new demand. However, if intermediaries cannot maintain profitability, long-term sustainability may be jeopardized. This means that the growth in the supply chain should not exceed the growth in consumer demand.

Regardless, targeting and educating local growers on opportunities for income enhancements may increase the size of the Study Region's local food system from a supplier-push stance. However, providing a full spectrum of local foods may be challenging. Re-channeling existing production to the local food system posits fewer challenges than expanding product lines that serve locavores – especially beyond those products currently produced in the region. Therefore, more effort goes into commercial farming than planting seeds and harvesting the output. Growers rely on an extensive support industry for technical guidance, capital and equipment. Technical guidance comes from university resources, seed and retail companies, and field consultants whose expertise may be limited to select crops common to the region. Developing a full-spectrum of agricultural commodities requires buy-in from support services. Capital resources must also be confident that loans will be repaid, and may not understand the nuances of small-scale production for local food systems. Capital is required for both real and personal property inputs into production as well as financing operations. Finally, modern farming is only competitive with the extensive use of capital equipment. While crop production is labor intensive, the modern farmer is required to have significant up-front investment in capital equipment for pest management and harvesting. Such investment, as well as time investment in knowledge, is less likely to be profitable with small acreage and distributed plots. Another obstacle to consider is the accessibility of a local food value chain that efficiently moves farm products from the farm to the consumer. Conventional food is fine-tuned through a process of social Darwinism to do this at the lowest possible costs and has evolved over decades through trial and error. If both consumers and farmers are interested in operating within a Local food system, the absence of a local food supply chain is a wedge that will deprive the connection of supplier to consumer. While direct to consumer sales posit significant transactions costs that hinder significant growth, farmers markets, CSAs and roadside stands have traditionally served local food needs. A seamless channel that minimizes transactions costs for consumers and suppliers is necessary to leverage local food systems to mainstream channels. This suggests introducing intermediaries that facilitate transactions, removing barriers to trade in local foods and channeling local foods through conventional consumer channels like grocery stores (Low and Vogel 2011).

It is also important to point out that both the demand-pull and supply-push strategies bear some risk of failure. Within the demand-pull strategy, the greatest risk is for the lost expenditures on marketing and education efforts. This risk is largely borne by the NGO and other investing organizations. Since growers are assumed to respond to opportunities, false starts will have minimal impacts on them. However, the risks of failure under the supply-push strategy will, to a greater extent, be placed on intermediaries and outlet channels. Despite these perceived risks, it appears that opportunities for growth exist. Consumers' interest in improving diets and interest in locally-sourced foods is on the rise. Distributors that specialize in local foods have indicated significant growth in the past five years and anticipate further growth in the Study Region. With evidence of such opportunities, and with considerations of the bottlenecks described in this report, there exist opportunities to advance local food in the Study Region.

Through the new knowledge gained during this study, several areas for further investigation have emerged. The first, as identified above, is the need to better understand the differences in margins, especially for wholesalers and distributors, between conventional and local food channels. Based on our interviews, these differences may be substantial and could considerably impact IO modeling outcomes. One idea could be to develop a complementary local food dollar, similar in concept to the USDA's marketing "food dollar." This could include considerations unique to the local food supply chain and may also incorporate poverty-abatement programs. Related to this is also better understanding the production process for smaller producers, including the use of conventional versus conservation production practices. While the previous literature has revealed that local foods do receive a premium, it may also be important to consider how sustainable practices impact consumer preferences and producers' bottom line. The second area for further research includes more detailed investigation of current land use and the potential opportunity for economies of scale by increasing local food production of goods where like goods are already being produced. This study did not go so far as to project what commodity sectors will grow under an expansion in local food sales. However, a thorough assessment of what foods are circulating in the local food channels and how consumers perceive these foods' roles in the locavore diet is important for understanding potential agricultural and economic outcomes of changes in consumer demands.

This need is heightened by the lack of comprehensive agricultural statistics on specialty crops that largely make up the local food system. The third area was revealed through recognizing that dramatic increases in fruit and vegetable production can only occur if an adequate labor supply exists. Much of the labor for these specialized crops may come from migrant workers. Therefore, understanding the impacts of current immigration laws such as the H2A program, and the economic contributions of migrant workers, will be necessary to provide regional support for producers seeking qualified workers.

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