

**The Edible City:
A Technical Policy Assessment
Envisioning the Future Development of
A Locally Integrated Food System in
Washtenaw County,
Southeastern Michigan**

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**Commissioned by Transition Ann Arbor
and the City of Ann Arbor**

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Abstract

The major purpose of this project is to give the citizens and the City of Ann Arbor a roadmap for localizing Washtenaw County's food system. Extensive previous work provides excellent background information about the current state of Washtenaw County's food system and how its local food businesses can be supported. The aims of the current research are:

1. To further strengthen the case for localizing food systems with
 - a. more detailed monetary estimates of the supply and demand of local food, as well as
 - b. new estimates of the amount of land and labor that might need to be committed to the production of local food.
2. To evaluate Washtenaw County's production landscape and the potential effectiveness of the Greenbelt initiative in supporting the development of local food infrastructure.
3. To envision the potential future development of a locally integrated food system in Washtenaw County based upon the present and previous studies, and
4. To propose new directions for city policy, citizen action, and business development consistent with that vision.

Preface and Acknowledgements

The present project has evolved to an almost unrecognizable state from its first visions. When it was first proposed as an SNRE Masters' Project, "The Edible City" was intended to be a literal vision, a landscaping project. To this was added dimensions of GIS-supported analysis, and up went the advertisement that intrigued us both.

We were extremely fortunate to find the Localization Seminar, administered by Professors Princen and De Young, as an auspice under which to continue pursuing our research interests. With their help we were able to form our ideas into a final goal. The chance to use our Master's Opus to study and create a plan for a real local system was challenging, stimulating, and invaluable.

Nearly 15 months after its inception, we now have the opportunity to thank Transition leader Laura Smith and the City's Environmental Coordinator Matthew Naud for offering us the chance to pursue this project, as well as our faculty advisors for the much-needed counseling, feedback, direction and dedication that they gave us over its course. The Project has acquired new aims, new methods, new frames and scopes, but has never strayed from the fundamental vision of providing a municipal policy roadmap to local and sustainable food for everyone.

Daniel: I would further like to acknowledge all of my teachers, mentors, friends, and family for their kind, generous, and thorough support during my years of undergraduate and graduate study.

Special thanks go to Drs. Elizabeth Bertani, Juliann Wolfgram, and Dianne Newman, my recommenders for graduate study at SNRE, and my academic advisor Inés Ibañez, for having taken the chance on my admission, and the whole Field Ecology 2009 crew for providing me with a sense of school camaraderie that has carried me through.

Maria: I would like to thank my husband, Zack, without whom I would never have found my passion for local, sustainable food systems. His unwavering support and confidence in me has been a testament to our friendship.

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Chapter 1. Introduction: Food Localization

Food localization is based on the philosophy that bringing the source of food closer to the consumers benefits both the producers and consumers for several reasons. Over the past century, the distance food must travel to reach consumers has increased. Meanwhile, former polyculture¹ farms that ran independently of chemical inputs have become massive monocultures that require extensive inputs and damage the soil and surrounding environments. This new system alienates consumers from the food system, pulls economic resources out of the community, pollutes the environment, and makes the entire food chain unstable and unsustainable. This document will propose a way to reduce the impacts of the industrial food system on Washtenaw County and provide the local community with a stable, safe source of food. The food system proposed in this document is intended to be sustainable, meaning that current industrial methods that negatively impact the environment through chemical inputs, high levels of fossil fuel-run mechanization, and other unsustainable methods will not be considered. The aim is to propose a system that can operate indefinitely using renewable, local resources.

While it is unrealistic to expect a completely localized food system, over time and investment, the community will be able to source the majority of its food from the surrounding area. This document will outline some actions that can be taken to increase local food production and consumption and detail the difficulty of achieving each one. While some actions may be easier to accomplish than others, the aim is to make them all reasonable, cost-effective, and beneficial for the community as a whole.

When beginning this project there was a struggle with the scale at which to base the research and goals. After much discussion and consultation, it was determined that the City of Ann Arbor simply could not supply itself with sufficient food by using land within the city's boundaries or even within the Greenbelt² area being created in the county. The appropriate size of a food shed can be difficult to determine. Distance as well as formal and informal boundaries need to be taken into account. In the end, the recommendations are based upon a planning area encompassing the whole of Washtenaw County. This was done for several reasons. First, coordinating within a county is easier than coordinating between counties. Second, Washtenaw County already dedicates a significant proportion of its area to agricultural production. Additionally, as the largest city in Washtenaw County, Ann Arbor is poised to lead a shift in the food culture of the county. Finally, an area larger than that of Washtenaw County would begin to reach outside the range of locally sourced food and into the range of regionally sourced food.

This document is broken up into three parts. Chapter 2, "The Current State of Food in Washtenaw County," discusses the current food situation in Washtenaw County using data on diets, local food, agricultural land, imports and exports and local policies and ordinances. Chapter 3, "Food Futures," outlines in detail the possibilities for the county as well as the roles of the government, private industries, and citizens in localizing food. Finally, Chapter 4 provides a summary of the plan for local food in Washtenaw County.

Before diving into the current state of food, it is useful to discuss why localization is important. The justifications and benefits behind localization are crucial to understanding why localization is good for the community and the world.

¹ A polyculture refers to the integration of multiple crops and/or animals on one farm.

² In 2003, Ann Arbor voters established the Greenbelt District to preserve green space and prevent urban sprawl and allow rural areas to remain undeveloped providing space for farmers near the locations where they can sell their products. Using a ballot initiative and a millage, the government has been able to raise funds to purchase development rights for land parcels worthy of being protected from development.

I. Justifications and Benefits

It is difficult to deny that the planet is currently undergoing a lot of changes that are impacting humans, animals, and the environment. As the world changes we must come to face the fact that our current methods of food production are unsustainable and are contributing to climate change, pollution, and overall environmental degradation. Not only are the methods of production unsustainable, but also the way in which food is transported long distances requires fossil fuels and further contributes to the environmental impacts of the food system. The average distance food travels to reach the consumer is about 1000 miles (Weber & Matthews, 2008).

Land Tenure

The industrialization of food production has led to the advent of large “factory farms” in which one or two products are produced in mass quantities requiring extensive inputs and often leading to undesirable and even poisonous byproducts, e.g., fertilizers, pesticides, manure. In the past, farms were polycultures, meaning that farmers grew a variety of crops and raised a variety of animals. In this system, outside inputs were generally unnecessary and byproducts were used on the farm in a cyclical way to maintain soil productivity and the health of the land. In order to effectively run farms this way, farms needed to be small enough to be run and operated by the farmer's family and any workers they could afford to hire. Now, most industrial farms only need a handful of workers to run the automated equipment that does everything from plant the seeds to harvest the crop on farms that are thousands of acres in size. In fact, it is now difficult for small-scale farmers to survive in competition with these types of industrial operations. Each year more small farmers go out of business and surrounding industrial farmers add that land to their farming empire. While some may argue that industrial farming keeps food cheap and affordable for Americans, the cost being paid for this type of agriculture is often ignored and certainly not seen in the price of groceries.

Food Security

One issue with huge monoculture farms is that these farms generally grow one crop. Additionally, there are often only a handful of varieties of most of the staple crops grown in the United States today. History has shown us over and over again that growing only a few varieties of critical crops can lead to famine and mass crop failure. Stories of the Irish Potato Famine are well known. Current monocultures of major commodity crops are remarkably similar to those of the Irish monocultures of potatoes before the famine. One virulent disease could wipe out a certain crop in a matter of years or spread across poultry or cattle operations with shocking speed. Since commercial poultry and cattle breeds are the very limited in variety (Notter, 1999), there would be little pathogen resistance due to the limited gene pool from which they came.

Another security issue results from the distance that most food must travel to reach the consumer. Estimates for how far most food travels to reach the consumers range between 1200 and 1500 miles. In the event of a disturbance in the food transportation system due to natural disasters, fuel price hikes, or any number of other reasons, access to the food normally consumed would be virtually impossible. A substantial source of locally grown food can mitigate the impact on a community in the face of a crisis. Once the infrastructure is in place, excess food can always be exported in times of surplus, but it is difficult to build a food infrastructure under pressure.

Food Safety

Although the national and state governments have policies in place to protect consumers from food-borne illnesses, a shocking number of contaminations are still reported each year. Often these contaminations cannot be traced to their source because large amounts of product are thrown together in processing facilities and the food's source then becomes anonymous. One of the main reasons for the

strict food policies that are in place today is because the current food system often makes it difficult to hold farmers accountable for contaminations since they are frequently untraceable (Blaser, 1996). Bringing the scale of production down can reduce the incidence of contamination significantly (Blaser, 1996) since small scale farmers often sell directly to their consumers or small grocers and must take care to ensure that their products are safely handled and prepared.

The conditions under which commercial animals are grown also increase the likelihood of contamination. In highly stressful, close, and confined conditions, animals are more likely to be exposed to diseases and contaminants. This is why Concentrated Animal Feeding Operations (CAFOs), the primary source of meat, must feed their animals antibiotics constantly (Silbergeld, Graham, & Price, 2008). Nevertheless, CAFO-raised animals still have health-related death rates and have been found to be contaminated with bacteria like *E. coli* and *Salmonella* far more frequently than animals not raised in CAFOs (Shelton, 2000). Simply growing animals in open, sanitary conditions basically eliminate the need for antibiotics and reduce contamination rates significantly.

Environmental Benefits

Localizing food has numerous environmental benefits. By reducing the distance that food must travel to reach the consumer, a substantial decrease in fossil fuels used to transport food can be achieved (Weber & Matthews, 2008). This can reduce greenhouse gas emissions limiting the impact of climate change on current agricultural systems.

By eliminating the use of chemical fertilizers, herbicides and pesticides, the release of toxic chemicals into the environment that alter and disrupt ecosystems can be reduced. Fertilizers have been shown to play a key role in the eutrophication of marine ecosystems by causing algal blooms that result in oxygen depletion and subsequent marine life die-off or abandonment (Committee on Environment and Natural Resources, 2003). Pesticides have been linked to the marked reduction in pollinators and natural enemies of agricultural pests worldwide leading to the pesticide treadmill (Desneux, Decourtye, & Delpuech, 2007). Herbicides have been linked to the evolution of super weeds that resist conventional herbicides and can mutate into weeds that are more aggressive and difficult to manage (R. Marchant & E. M. Marchant, 1999).

By returning to a cyclical method of farming in which wastes such as manure and compost are used to rejuvenate the land and crop rotations and inter-cropping are used to reduce pest outbreaks, a system can exist with minimal inputs and no harmful by-products.

Supporting Local Economies

The movement of goods and money in and out of a region can have a serious impact on the local economy. The global economy has been detrimental to many communities that have more goods and money going out of the community than coming in. Agricultural goods rarely stay in the area in which they are produced and instead are shipped nationally and even internationally. When these items are shipped off, money and resources are used to transport, store, and market the goods. All of these costs reduce the producer's eventual share of the food dollar. By selling food in the region in which it is grown, money stays within the community because it costs much less to transport, store and market goods in a smaller region. More money goes to the farmer who, in turn, can spend his earnings within the community, supporting local business owners. Additionally, money spent on local food by local residents stays within the community instead of going to grocery chains that have no incentive to invest in the community.

Chapter 2. Current State of Food in Washtenaw County

In order to understand what needs to be done with regards to local food, there is a need to understand the current system. This chapter presents a variety of information and small-scale studies that are intended to give a clear picture of what Washtenaw County's current food system. Discussed are current food consumption, local food consumption, the production landscape, Ann Arbor's potential food shed, supply and demand, and policies and ordinances that impact local food production.

I. Current Food Consumption in Washtenaw County

Estimating the current food needs of Washtenaw County is critical to understanding how much food would need to be produced in order to provide a substantial amount of locally sourced food. Using 2000 census data, USDA food pyramid and nutrition information, and USDA consumption and production databases, the food needs of the residents were calculated for the provision of 100% of the necessary food (E. R. S. US Department of Agriculture, 2010).

Assumptions

There were several decisions to make when doing the analysis reported in this section. The first decision was whether food requirements would be based on the actual diets of the average American or on the diet guidelines detailed by the USDA. The primary differences between these two diets are the amount of sweeteners and added fats consumed and the consumption of fruits and vegetables. In order to highlight these differences, estimates for both diet types are provided. This will allow for a range of diets to be considered. One diet will be called the “balanced-reformed diet” and the other the “business-as-usual diet”.

Based on these two model diets other assumptions were made for each diet. For the balanced-reformed diet, people were assumed to eat a balanced diet as dictated by the USDA and food guide pyramid. Additionally, it is assumed that food waste decreases by 25%. This includes food at all parts of the food chain from waste at the farm, to the grocery store, and in the home. By reducing the amount of food that unnecessarily goes in the garbage, it would be possible to produce significantly less food per person. However, some room for food waste has been allotted, as it is practically unavoidable. Additionally, it is assumed that the majority of calories will come from high-nutrient sources. In the case of high caloric needs, high-nutrient options will take the place of sweeteners and added fats. On top of that, sweetener and added fat consumption are assumed to drop by at least 30%.

In essence, the business-as-usual diet is just what it sounds like. In this diet, consumers will continue to eat calories far in excess of their daily needs, consume excessive amounts of sweeteners and added fats, and fail to meet the recommended daily needs of fruits and vegetables. Additionally, food-waste will continue to be an issue with hundreds of pounds of food wasted per capita per year (Kantor, Lipton, Manchester, & Oliveira, 1997). The estimates based on this diet would also mean that residents are not receiving the correct proportion of vitamins and nutrients in their diets.

One major assumption that this analysis makes is that Washtenaw County residents eat the same diet as the average American. Since data on Washtenaw County food consumption is unavailable, the most detailed data available on American food consumption was used. Given that, on average, citizens of Washtenaw County have higher levels of education and higher incomes than the average American (US Department of Commerce, 2009), it can be expected that the diets of Washtenaw County residents are already healthier than that of average Americans.

Methods

Using the USDA’s MyPyramid website, the daily food requirements for individuals based on age and gender were compiled (see Appendix B for data). Next, census data for Washtenaw County was compiled and the population was broken into groups based on the age and gender categories collected from the MyPyramid website. Gender data was unavailable for citizens 18 and under. Thus children were grouped into two age blocks: less than 10 years old and 10 to 18 years old. Some age estimates were performed since the census age blocks and the food pyramid age blocks are not equivalent. In order to do this, it was assumed that the distribution of children 0-17 was uniform and subtracted or added children proportionally to the block in which they were designated³.

After determining the daily dietary needs for each block of individuals, food consumption and availability data were compiled. Extensive data on food consumption and availability was available from the USDA Economic Research Service (E. R. S. US Department of Agriculture, 2010). The ERS has extensive data on food available in the market as well as loss-adjusted data. These data can be broken down into individual types of food or generalized subgroups. Additionally, the data set can be instantly converted into several parameters including pounds per year, grams per day, MyPyramid equivalents⁴, and calories. Food needs were estimated in pounds because it is often easier for people to visualize and measure in pounds. MyPyramid equivalents were also used to determine the amount needed in order to fulfill everyone’s daily needs. A simple equation was used to convert MyPyramid equivalents into pounds per year in order to estimate the balanced-reformed diet. For the business-as-usual data, there was no MyPyramid data available. Instead, the pounds per year available were multiplied by the population of Washtenaw County. Therefore the business-as-usual diet estimates represent the highest estimates of food consumption⁵.

Results

The results are summarized in the tables below. Table I-1 shows the food requirements for the Balanced Reformed Diet. Table I-2 shows the food requirements for the Business as Usual Diet.

Table I-1: Food Requirements for Washtenaw County Assuming Balanced Reformed Diet (lbs/year)

Demographics	Population		Calories	Meat and						
	Estimates	Population		Beans	Grains	Fruit	Vegetables	Dairy	Sweeteners*	Added Fats*
Children Under 9	40425	12.5195497	1700	68.609	71.404	221.654	125.818	227.713	97.038	57.169
Children 10-18	42855	13.27211632	2400	120.066	107.107	258.597	251.635	341.569	97.038	57.169
Women 19-50	85830	26.58139643	2661	120.066	107.107	258.597	251.635	341.569	97.038	57.169
Men 19-50	84747	26.24599328	2661	142.935	133.883	295.54	301.962	341.569	97.038	57.169
Men 51+	33188	10.27826383	2500	125.783	107.107	295.54	251.635	341.569	97.038	57.169
Women 51+	35850	11.10268044	2300	114.348	89.256	221.654	201.308	341.569	97.038	57.169
Totals	322895	100	790904897	38611386.48	34770248.31	85038723.7	78626370.42	105688293.5	31333085.01	18459584.26

**Sweeteners and Added Fats, while lower than the average, are still higher than necessary. These could be traded for healthier nutrient-rich options and may be altered at a later date.*

³ Since serving needs vary within the age groups, servings were averaged based on the age proportions of that block. E.g., if children aged 1-3 need 1 serving per day, children 4-6 need 2 servings per day and children 7-9 need 3 servings per day of a specific food, the daily needs of all ages were averaged and the average was used for that block. In this case, the average would be 2.

⁴ A MyPyramid equivalent is equal to one “serving” of that food group. These serving sizes vary based on food group and the food itself. For specific equivalents see the MyPyramid website.

⁵ Excluding fruit and dairy.

Table I-2: Food Requirements for Washtenaw County Assuming Business As Usual Diet (lbs/year)

Demographics	Population Estimates	Percent Population	Calories	Meat and Breans	Grains	Fruit	Vegetables	Dairy	Sweetners	Added Fats
Children Under 9	40425	12.5195497	3000	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Children 10-18	42855	13.27211632	3500	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Women 19-50	85830	26.58139643	4000	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Men 19-50	84747	26.24599328	4000	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Men 51+	33188	10.27826383	3500	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Women 51+	35850	11.10268044	3300	239.142	196.533	249.225	393.38	266.174	136.15	87.014
Totals	322895	100	1188038500	77217756.09	63459523.04	80473506.38	127020435.1	85946253.73	43962154.25	28096385.53

As the results indicate, there is a need for more research on the role of added fats and sweeteners in the diet to determine how much should be consumed in the balanced-reformed diet scenario. The extra processing used in manufacturing sweet and fatty foods is a major consideration for these foods because they take more time and energy to process in factories than most other foods. Regardless, even at the lower end, the amount of food needed to feed Washtenaw County is enormous.

One important result from this analysis is the discovery that there is a lack of available fruit and dairy in the United States at this time. These totals for fruit and vegetables are the only ones higher in the balanced-reformed diet than in the business-as-usual diet. This indicates that there is currently not enough fruit or dairy on the market in the United States to meet the dietary needs of all Americans. In order to fully meet the needs of Washtenaw County, farmers would need to produce at least the amounts indicated in the column totals for these food categories.

Further Research

Within the MyPyramid vegetable guidelines there is information about requirements of different types of vegetables: Dark Green, Orange, Starchy, and Other. Data are available on these types of vegetables through the USDA Economic Research Service (E. R. S. US Department of Agriculture, 2010). In the future it may be important to further break down the vegetable section of the analysis and indicate the quantity of different types of vegetable that is required for proper nutrition. This may be important to ensure that a healthy assortment of locally produced vegetables is available for consumers if and when local food production constitutes a high enough percentage to warrant such analyses.

II. Local Food Consumption in Washtenaw County

A Washtenaw County resident's local food profile varies greatly from that of the average American and even that of the average Michigander. The average local food consumption in Michigan is around 1%. In other words, approximately \$58.9 million of \$5.8 billion of food grown in Michigan is sold directly to the consumer (N. A. S. S. US Department of Agriculture, 2009). In 2007, direct sales of locally grown food accounted for about 3.2% of Washtenaw County agricultural sales or approximately \$1.9 million of \$73 million. Additionally, local food consumption appears to be experiencing a sharp increase within Washtenaw County over the past decade. Data from 2002 estimates that local food consumption in the county at that time was only about 1.8%, indicating a 1.4% increase in local food consumption over that five-year period (N. A. S. S. US Department of Agriculture, 2009). This data does not account for locally sourced foods that are sold through retail establishments such as food co-ops and specialty stores like Arbor Farms in Ann Arbor, nor does it include community garden projects. Therefore, local food consumption could be higher than estimated. Currently, data does not exist to calculate the percent of locally sourced food that is sold to consumers in retail establishments or grown in community and private gardens.

Sources for local food direct sales include farmers' markets, CSAs (Community Supported Agriculture), farm stands, and other direct-to-consumer methods. On average, each county in Michigan has approximately 3 farmers markets and approximately 2.5 CSAs. Compared with other counties in Michigan Washtenaw County has significantly more farmers markets and CSAs than average with 9 farmers markets (MIFMA, 2011) and 28 CSAs (LocalHarvest, 2011).

The county produces a variety of crops and animal products and uses about 37% (166,811 acres) of its land in agricultural production with 80% (133,089 acres) of farmland being used for crop production. This is diagrammed in Figure A-1 in the Large Maps and Charts section in Appendix A. The primary products produced in Washtenaw are grain (corn, soy, and wheat). These products account for 59.5% (99,288 acres) of cropland and are heavily exported. Vegetable production accounts for 1.2% (2000 acres) of cropland and fruit and nut trees account for 0.3% (400 acres). Animal products represent 10.6% (17, 647 acres) of farmland use and include dairy, egg, and meat operations. Additionally, Washtenaw County is the primary producer of sheep and goat products in Michigan with annual sales around \$1,383,000 (MI Department of Agriculture and Rural Development, 2009).

This data can be used to posit some hypotheses about the food culture and demand in Washtenaw County. It is clear that demand for locally-sourced food has risen in the past decade as the number of farmers markets and CSAs in the county have risen significantly. Additionally, according to anecdotal reports, the size and number of farmers at many of these markets has also continued to increase. If this demand continues to rise at present rates, locally sourced food will be in very high demand in the near future.

While it would be difficult to assert concrete reasons for this increase in demand, pro-local community organizations and the general national interest in local and seasonal food may have played a significant role in increasing demand for local foods. Another reason for turning to local foods may be the recent publication of books regarding the intricacies of the food system. Books by Barbara Kingsolver and Michael Pollan have been very popular and caused many people to reevaluate the way they choose their food. "Know your farmer" has become a popular phrase and many people have taken it to heart in one way or another. In this day and age, the peace of mind of knowing where your food came from and how it was grown is comforting to many people whose confidence in the industrial food system has been forever shaken.

Yet, the greatest indicator of local food demand in Washtenaw County is the diversity of local foods that can be accessed. Farmers markets carry a wide array of meats, cheeses, fruits, vegetables, and grains. Unlike many northern farmers' markets, the Ann Arbor Farmers Market is open year round and even has (carbon neutral) green house tomatoes in January. Many farmers have or will soon have

hoop houses to allow for year-round production of leafy greens and have learned to cold-cellar their root vegetables and gourds to sell in the winter. Even winter CSAs have become popular and offer everything from fresh hoop house greens to late season tomatoes and stored root vegetables. Washtenaw County also boasts the ability to find local meat, dairy, and vegetables at many grocery stores, including chains such as Busch's. Restaurants have also recognized this demand and several are now serving dishes featuring local foods. This large network supporting local food makes it clear that the demand for local food in Washtenaw County is high and could experience significant increases in demand especially if access to local food became even easier than it is now.

III. Current Production Landscape in Washtenaw County

A major purpose of the present work is to set down some numeric goalposts and benchmarks for local food systems development that might be led by Ann Arbor's citizenry and government. One of the key uncertainties many municipal governments and citizen groups alike face when planning for localization is the issue of adequacy of scale. On one hand, purely urban farming is clearly inadequate to the task, due to land limitation. Urban planners also tend to think of food systems as being a problem to be solved by rural policymakers (Pothukuchi & Kaufman, 1999). On the other hand, many of the social and environmental ills of the current food system have been inherent consequences of large, nationwide scale. Clearly, advocates for intentionally localized food systems seek some middle ground. But on what scale does the problem of building a local food system for every resident of a region start becoming tractable? At what spatial level should government intervene in food systems?

A foodshed as defined by (Peters, Bills, Lembo, Wilkins, & Fick, 2009) is an area within which a population center would derive all of its food needs. Eating within one's foodshed seems to be a straightforward and simple way to abstract the concept of local food for the purposes of spatial analysis, even if natural scales of transport for different food commodities may be different.

Politically, the idea of a foodshed is also easily justified; the influence of any bioregionally organized government (Sale, 2000) should naturally extend to encompass that area from which its citizens derive their environmental services.

This report set out to map the spatial extents of Ann Arbor's potential foodsheds under different scenarios of land requirements. The intent was to spatially distinguish the potential conflicts of interest between Ann Arbor and its neighboring conurbations and in doing so provide a lower bound to the scale that might be necessary to tackle the problem of developing more localized food systems in general.

Methods

The methodology used here for finding potential foodsheds is adapted from (Peters et al., 2009), who integrated a dietary model, a GIS-based model of agricultural productivity and population centers, and a spreadsheet model of food transport to minimize the tonnage-distance associated with food transport and determine the extent of foodsheds. (See Figure III-1.) This methodology was selected over that used by Hopkins, Thurstain-Goodwin, & Fairlie (2009) in "Can Totnes Feed Itself" because it explicitly takes into account the local distribution of population and does not isolate the study population from others in its area. The model is of an abstractly localized system; that is to say, it ignores the geography of any intermediate processors/distributors within the food system and posits that food passes directly (as the crow flies) from the producer to the final consumer, from the farm gate to the table.

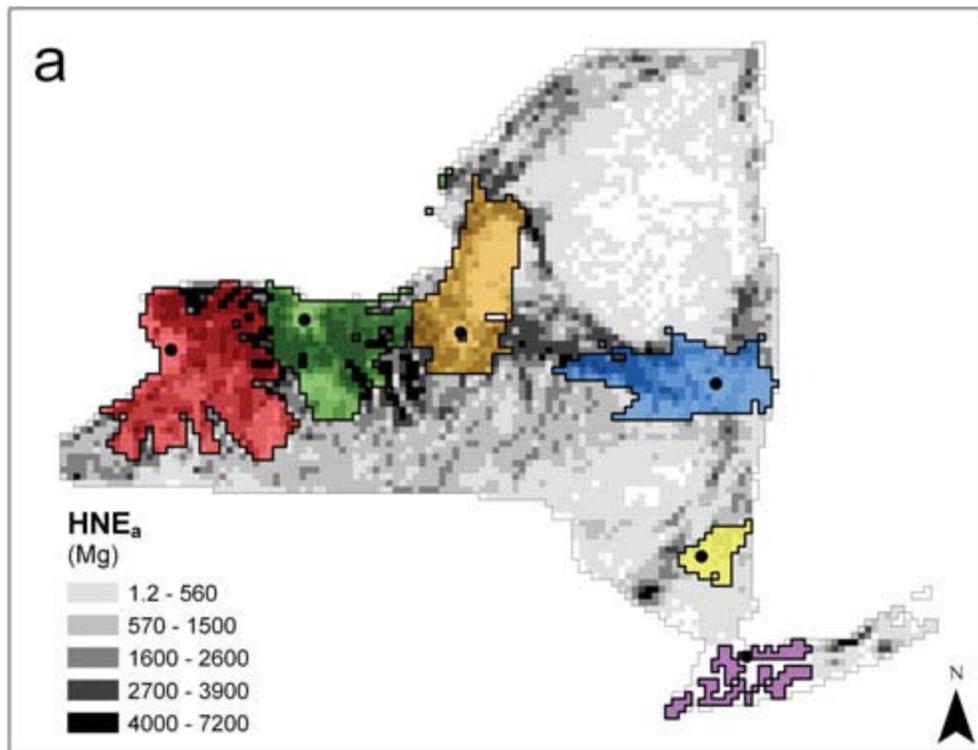


Figure III-1: showing the partial distribution of the production of annual crops in New York State, originating from a single model. Reproduced in part from (Peters et al. 2009.)

Soils data analysis

A data layer of Washtenaw County land use in 2000 and a data layer of soil types present in Washtenaw County were both obtained from the Southeastern Michigan Council of Governments (SEMCOG, n.d.). See Figure A-2 in Appendix A for an introduction to the County's landscape. Peters et al. (2009) used the yields of two indicator crops, corn silage and hays/grasses, as a proxy for the yields of two *crop types*, high-valued annual crops and perennial crops suitable for forage, respectively. A table of predicted yields of the indicator crops and a table of soil capability classes from the 1977 Soil Survey of Washtenaw County (Engel, USDA Soil Conservation Service, & Michigan Agricultural Experiment Station, 1977) were manually digitized; this table was then joined to the soils layer (see Figure A-3 in Appendix A for a general overview of this data.) The soils layer was then intersected with the agricultural land use layer and a layer containing the municipalities to give a layer of polygons representing distinct soil regimes under agricultural use located within a given municipality.

Due to the computational difficulties that would have been associated with optimizing the allocation of each individual soil polygon to a population center, some form of spatial aggregation was necessary. Peters et al. (2009) aggregated their production zones into 5 km by 5 km squares. Instead, this analysis is aggregated by township. For each township, the production potential was computed as follows:

$$P_{ij} = \sum_k (A_k * Y_{jk})$$

where P is production potential in tons (Mg), A is area in acres, and Y is yield in tons/acre for township i, crop type j, and soil polygon k within township i.

Visualizing foodsheds: A transport model

Since data for population and land use was readily available for the entire SEMCOG region, the analysis extent was expanded to that region. From the layer of land use, the areas used for agriculture were selected, and then dissolved to give one multipart polygon feature for computational ease. This feature was then intersected with a layer containing the municipality boundaries to give a group of features containing the agricultural land in use within any individual municipal boundary. The areas of these features were then calculated, and these data were joined to a table of 2008 municipality populations extrapolated from the 2000 census.

A model of food transport was then constructed with the goal of identifying the extent of foodsheds associated with given population centers, especially with Ann Arbor. Each municipality within the study region contains a population and a set amount of farmland. The model attempts to find a solution to the problem of transporting food from the farmland to the population centers in such a way that minimizes the total transport required: the sum total of the quantity of food multiplied by the distance it travels. The model can handle cases where not enough food can be produced to feed every population center inside the study extent with only minimal modification.

The model was specified within the GNU MathProg programming language, and the GNU linear programming solver (glpsol) was used to allocate the production of food under the model constraints⁶. Details of model operation can be found in Appendix C.

Results

Plotting the aggregated production potential of a township versus the area of land devoted to agriculture within the township reveals a very close linear relationship between these two parameters (see Figure III-2). This suggests that the quality of soil for purposes of agriculture does not actually vary very much across Washtenaw County. This validates the reduction from the more difficult problem of finding enough *suitable land* upon which to support a population center to the simpler problem of finding enough *land*.

Based on this linear relationship, it is possible to make an estimate of the amount of land that a population center such as Ann Arbor would need to feed itself. For reference, the Greenbelt covers about 100,000 acres, about 80,000 of which lie outside of the Ann Arbor City limits; given the Greenbelt's primary mission of maintaining environmental quality for the City, it seems questionable that its area should be used primarily for agriculture. (Peters, Wilkins, & Fick, 2007) gave a figure of about 1 acre per capita to support a diet containing 120 g fat per day with about 3 oz. of daily meat consumption. This figure was derived from agricultural data from New York State, which shares a similar Lower Great Lakes climate with the Ann Arbor region. Multiplying this by the population of Ann Arbor, which is approximately 114,000 (U. S Department of Commerce, 2009), gives a figure of about 110,000 acres; clearly the Greenbelt does not suffice. Even a more land efficient estimate of 0.625 acres per capita that (Peters et al., 2007) associated with a completely vegetarian diet would give an estimate of about 68,000 acres necessary to feed Ann Arbor, which still represents a majority of the land in the Greenbelt.

⁶ <http://www.gnu.org/software/glpsol/>

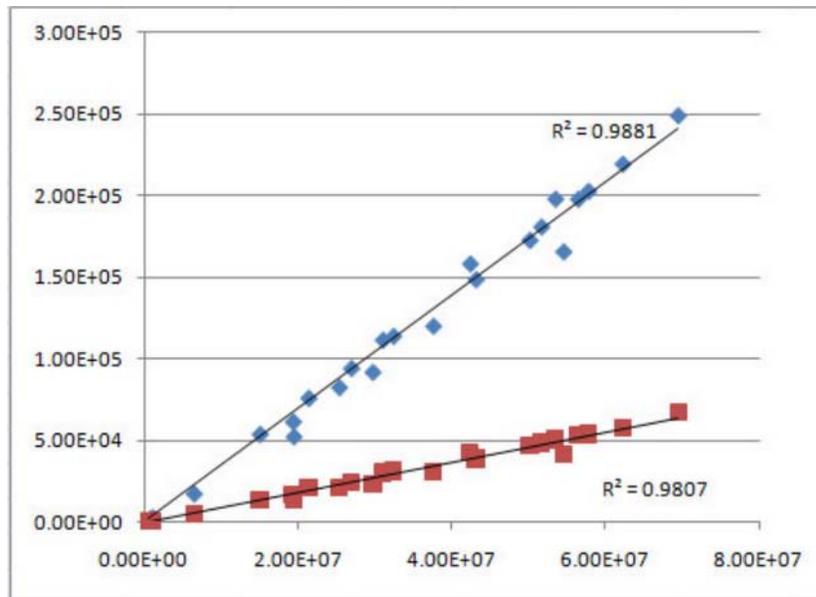
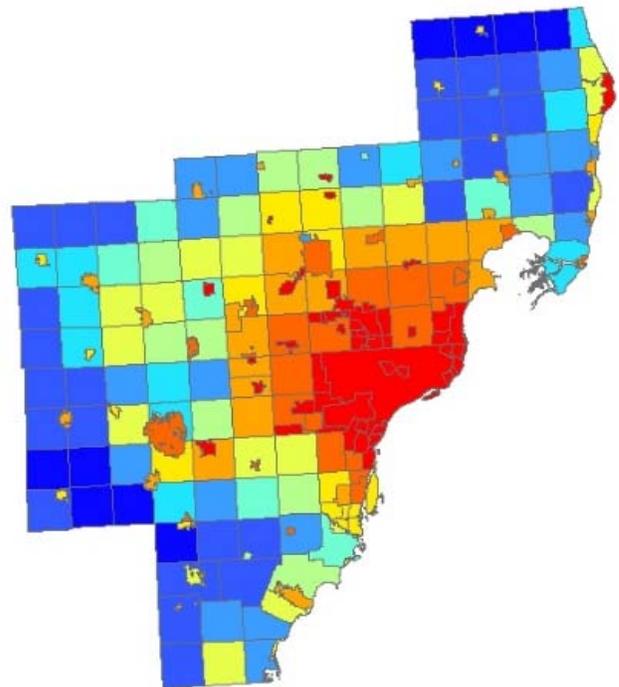


Figure III-2: Soils underlying agricultural land in 2000 were aggregated by township, and their potential productivity for high-value annual crops (in red) and lower-value pasture crops (blue) was plotted versus the area of agricultural land within each township. A linear relationship between agricultural productivity of soils is evident.

Another consequence of this linear relationship between production and area is that the ratio of production area to population can be used to define areas which are likely to be net importers and net exporters of food under a completely localized system. In order to visualize the likely geography of food transport, a map of the SEMCOG region color-coded based upon the density of food production with respect to population was made (Figure III-3.) Areas colored blue, which have more farmland per capita, will tend to export to areas with more red, which have more population per acre agricultural land.

Figure III-3: Municipalities of the 7-county SEMCOG region. The color of each municipality in this map is determined by the area of its agricultural land normalized to its population. Blue areas have more land, red areas have more population.



In order to further resolve potential foodsheds within this landscape of production and consumption, the transport model was used. The transport model explicitly models the direct transportation from farm gate to consumer plate as the crow flies. The model was run with two boundary extents: one where the boundaries of the study region were restricted to the extent of Washtenaw County, and one where all of the municipalities in the SEMCOG region were considered. Under each boundary extent, two diet scenarios were run using different values for land requirements per capita that were intended to simulate meat-eating and vegetarian options. The actual parameter values used, 0.4 and 0.25 ha per person for meat eating and vegetarian options respectively, corresponding to figures derived from (Peters et al., 2007).

The results of the model are shown in Figures A-4 in the Appendix A. When the boundaries of the modeled extent are restricted to Washtenaw County, most of Ann Arbor's food comes from the region to the north and west of the county. This is because the other two major population centers in the county, Ypsilanti and Pittsfield Township, are located to Ann Arbor's southeast. Extending the boundaries of the analysis to include Detroit and its outlying metropolitan area changes the model results. Metro Detroit's population, which is located mostly to northeast of Washtenaw County, blows Ann Arbor's prospective foodshed out towards the southwest of the county.

Comparing the results of the model runs under vegetarian (Figure A-4a) and meat-eating diets (Figure A-4b) reveals how Washtenaw County does not have enough agricultural land to feed itself. Under a vegetarian diet the shortfall is minimal. But under a meat-eating diet, the amount of land available to Ann Arbor visibly constricts due to the expanding extents of foodsheds of Chelsea, Dexter, and other outlying population centers in the county, which are fed first by the model.

One major caveat to be aware of when interpreting maps generated by this model is that the model always produces hard and definitive assignment of farmland to certain population centers even though this does not reflect the reality that farmers will sell their produce wherever and however they can within a reasonable traveling range. What this means is that in visualizing a localized and locally integrated production landscape, the City of Ann Arbor can expect a significant portion of its food to come from within the county, but it cannot be certain from where within the county.

Another major model flaw is that does not take urban green space into account. One obviously flawed modeling consequence of this behavior is illustrated by the fact that when the model is run using the entire SEMCOG extent, the city of Detroit itself goes entirely unfed. Since the SEMCOG data set, which encompasses the seven counties that constitute the major urban and economic centers around Detroit (*i.e.*, Wayne, Monroe, Washtenaw, Livingston, Oakland, Macomb, and St. Clair), does not contain enough farmland to feed its entire population, populations like the city of Detroit, which lies farther from farmland because it is insulated from them by other population centers, goes entirely unfed, even when Detroit has close to 30 square miles of vacant and publicly owned land that could easily find use within the context of urban agriculture. This is completely unrealistic. Nevertheless, this model is useful for calibrating expectations of how much land might be required to feed Ann Arbor and where it might be found within the landscape of the county. The maps confirm the idea put forth earlier that Ann Arbor's foodshed is larger than the Greenbelt, and give an additional spatial dimension to that intuition, suggesting that the balance might be found in the county's southwest.

Discussion

The whole idea of choosing the foodshed as a unit of analysis relies on the premise that the food production within the foodshed feeds the population within the foodshed. Upon a cursory visual examination of the map in Figure III-3 one would immediately question whether or not “Ann Arbor's potential foodshed” is spatially well defined, especially in comparison to Detroit's potential foodshed. The agricultural geography of the Ann Arbor-Detroit region makes it highly dubious whether farmers

that are established within the Greenbelt will end up selling their products to Ann Arbor or to Detroit, or to some other local population center within that region.

Some other concerns arise when relaxing the assumptions underlying an abstractly localized system. Introducing food processing and food distribution into the model is the most important of these. Food processing is a major factor that governs how farmers make choices about what to grow on their land. Davis et al. (2004) clarifies how farmers in Washtenaw County grow wheat to sell to Toledo, where Nabisco has a major grain silo. (Buck, Kaminski, Stockmann, & Vail, 2007) identified lack of processor interest in processing foods that farmers grow is one of the major impediments to local food system development that farmers perceive.

One obvious way to improve this situation, unfortunately outside of the bounds of the City of Ann Arbor to determine, might be to concentrate the development of food processing and food distribution entrepreneurship in Detroit. Shuman (2006) estimated if a regional food system localization effort centered on the city of Detroit resulted in a 20% shift in food consumption towards the local, nearly 36,000 jobs would be created.

Given the many inherent abstractions and sensitivities of the model reported here how might the City and its activist residents to proceed? First, from this analysis the argument is weak that the Greenbelt can provide for Ann Arbor's food needs. Ann Arbor's foodshed is bigger than the Greenbelt. Instead, the City and its citizens are advised to take leadership in strengthening agricultural infrastructure elsewhere in the county, particularly in its southwest.

The appropriate scale for food systems analysis is the scale on which the agendas of its key stakeholders can best be advanced (Born & Purcell, 2006; Davis et al., 2004). Buck et al., (2007) showed how small farmers of Southeastern Michigan feel that the current policy and economic climate is not favorable to them. Since there can obviously be no local food without local farmers, it makes the most sense to focus analysis upon the scale at which local farmers see the system. This means that we are looking for a true rural-urban dynamic. The City of Ann Arbor cannot dominate that dynamic as long as it lies within the shadow of Detroit's population. Yet it can be expected to take leadership on a county level, and is the municipality best poised to do so within Washtenaw County.

IV. Supply, Demand, and Localization Potential within Washtenaw County's Current Food System

The justifications for food systems localization being offered up to this point have been mostly based in the external social costs of the current food system to consumer health, food safety, and environmental quality. This chapter supplements these arguments with a more economic case for localizing the food system.

Understanding local food economically requires looking at the material flow in terms of supply and demand. Most food system stakeholders do this instinctively; there is a common recognition among processors, distributors, and retailers that producers and consumers have special places within this system, as its basic providers of material and creators of value (Buck et al., 2007).

Washtenaw County's current situation is one where local food commands a high price premium over food of uncertain origin. Also, the total volume of local sales is small compared to the overall volume of food sales. These observations correctly suggest that the supply of local food is more limiting than the demand for local food within Washtenaw County. (J. Fike, personal communication.)

Given that the immediate development priority in the county is to expand local supply, a natural set of questions arises. Can a case be made for municipal-scale investment into local food infrastructure? How can cities effectively invest in their food systems? What economic returns can they expect for their financial commitment?

To our knowledge, (Davis et al., 2004) was the first publication to offer a dollar-value estimate of Washtenaw County's demand for food. By simply estimating the number of households and multiplying by average Midwestern household food expenditure, they obtained a value of \$600 million annual demand for the county. A 2006 report by the Fair Food Foundation (Shuman, 2006) later evaluated the economic impact of localizing Detroit's food system. In his analysis, Shuman also considered the possibility of developing a processing and distribution infrastructure that would service not only Detroit but also its neighboring 5 counties (which includes Washtenaw County), and estimated the annual demand for the entire region.

The present analysis adopts part of Shuman's methodology to make food group-by-food group estimates of the potential economic impact of localizing food systems here in Washtenaw County. By not only evaluating consumer demand, but also estimating the farmgate value of that consumption and comparing those figures to the county's agricultural sales, this analysis provides an understanding of the relative balance of local supply and demand within four major nutritional food groups.

Methods

The first goal is to compare current supply with current demand as it relates to the development of local food production infrastructure. It was decided that the most appropriate measures to use for this purpose would be agricultural sales (for supply) and the farmgate production value equivalent of consumer expenditures (for demand). The farmgate production value is an estimate of the money received by farmers for agricultural goods. Timmons, Wang, & Lass (2008) also used farmgate production value as a proxy for demand; as such this approach is not without precedent. However, Timmons et al., (2008) derived their demand estimates from averaging national data for the food system; this is inappropriate for the current analysis because Washtenaw County is significantly richer than a typical U.S. county, and was as such likely to have different consumption habits than normal for the United States as a whole.

Expenditures and Demand

Data from the Consumer Expenditure Survey (US Department of Labor, 2009) and the

American Community Survey (US Department of Commerce, 2009) were used to estimate aggregate consumption, as in (Shuman, 2006). The ACS data provided an income distribution for county households. The CEX data provided statistics for average consumer expenditures in 20 food categories and 8 aggregate categories for consumer units within five income ranges. Treating each household as a consumer unit, Washtenaw County households were partitioned into the five CEX income ranges. Multiplying the number of households within each range with the average expenditure for each range and totaling the results gave an estimate for the total countywide consumer expenditure on each food category. These categories were then aggregated into the five major food groups defined by the CEX: 1) cereals and bakery products, 2) meats, poultry, fish and eggs, 3) dairy, 4) fruits and vegetables, and 5) other foods.

To convert consumer expenditures to farmgate value, the total expenditure in each food category was then multiplied by a factor representing the farmer's share of the proceeds from final sale to the consumer. These factors were estimated to one or two significant figures and correct order of magnitude by dividing the figures in (N. A. S. S. US Department of Agriculture, 2011) by observed grocery store prices. In general, farmers' shares varied by food type and degree of processing, from about 0.3 for foods that can be distributed to wholesalers/retailers as they are (e.g. fruits, vegetables), down to about 0.04 for foods that needed extensive processing (bakery goods, from wheat). The farmer's share of food that was purchased and consumed away from home was estimated as the lowest of all the observed shares, 0.03.

To estimate *demand* as perceived by producers, total consumer expenditures of each food category were multiplied by factors that represented the farmers' share of consumer food dollar for that food category to give estimates of farmgate value of consumption. These figures were also aggregated into the five CEX food groups.

Sales and supply

To estimate *supply*, agricultural sales data were obtained from the Michigan Agricultural Census 2007 (N. A. S. S. US Department of Agriculture, 2009). Sales were aggregated into the five major groups of foods defined in the Consumer Expenditure Survey to enable direct comparison of the figures for supply and demand. Soybean sales were assigned to "other foods". Alcoholic beverages were not included.

The Michigan Agricultural Census also collects information on the total volume of direct sales from producers to individuals of food intended for human consumption. This analysis uses this figure as an estimate for the monetary value of current local food consumption under the presumption that local food processing currently accounts for only a small part of county consumption. Unfortunately the sales data in the Census does not break this figure down into food groups, which precludes a group-by-group evaluation.

Results

On the supply side, Washtenaw County producers grossed just over \$55 million in 2007 food sales. Of that total, \$19M came from cereals (corn and wheat), \$13M from soybeans, \$9M in meat and \$5M in fruits and vegetables (mostly vegetables).

On the other hand, Washtenaw County households consume over \$900 million worth of food annually, accounting for an estimated \$76 million in farmgate value of food. Of the food categories examined, the greatest proportion of the roughly \$900M consumer expenditures is attributed to meat, followed by baked goods and nonalcoholic beverages. However, farmers do not receive as high a share of those proceeds. Instead, the \$76M farmgate value of consumption is dominated by dairy and fresh fruits and vegetables, for which the farmers' share is higher.

All of the above results for 2007 are tabulated in table IV-1 below.

Table 1: Supply and Demand in Washtenaw County	Consumer Expenditure	Farmgate Demand	Farmgate Demand %	Farmgate Supply	Potential Local Food	Potential Local %
Cereals and bakery products	\$71.4M	\$5.5M	8%	\$19.2M	\$5.5M	8%
Meats, poultry, fish, and eggs	\$117.8M	\$14.2M	20%	\$9.7M	\$9.7M	13%
Dairy products	\$57.6M	\$18.2M	25%	\$8.7M	\$8.7M	12%
Fruits and vegetables	\$93.0M	\$20.3M	28%	\$5.0M	\$5.0M	7%
Other food at home	\$190.1M	\$12.2M	17%	\$13.4M	-	-
Food at home	\$529.6M	\$61.1M	84%	\$55.9M	\$28.9M	40%
Food away from home	\$386.7M	\$11.6M	16%	-	-	-
All Food	\$916.4M	\$72.7M	100%	-	-	-

Comparing these figures reveals a food-group mismatch between county production and county consumption. Washtenaw County produces significantly more grains and soybeans than it consumes, by a factor of about 4. It also produces far less fruits and vegetables than it consumes, by a similar factor of about 4. Demand for meat and dairy also exceed supply by a factor of about 2. Local direct sales of food for human consumption in Washtenaw County totaled \$1.9 million in 2007, representing 2.6% of farmgate demand and 3.5 % of estimated farmgate supply.

Discussion

How much of Washtenaw County's food expenditure can theoretically be localized given current production patterns and consumption habits? One can give an approximate answer by taking the minimum of supply and demand in each food group as an estimate of potential maximum local sales in that group, and summing across the categories. "Other foods" were neglected for this purpose, since all of Washtenaw County's soybean production was previously categorized under the umbrella of "other foods", and it is unreasonable to assume that a significant fraction of miscellaneous consumption expenditure is of soy products. Ignoring the "other foods" group and summing the minimum of supply and demand in each other group gives an initial estimate of \$28 million maximum potential local sales, which is roughly 40% of the estimated farmgate equivalent of current local consumption.

It is important to realize that since this about 40%, a localized system should be possible without changes in either supply or demand. Thus, the fact that the current system does not capitalize on this existing potential suggests a failure or unwillingness to alter the intermediate stages of the food system that currently separate the consumer table from the production gate, (*e.g.*, processing, distribution, and retailing). Computing the non-farmer share of the production expenditures associated with this 40% of farmgate value suggests that the potential economic activity directly associated with the localization of these intermediate stages amounts to about \$175 million per year.

Breaking the balance of supply and demand down by food group suggests that only in grains and cereals does current supply exceed current demand. In three other major food groups, meat, dairy, and produce, demand exceeds supply. The groups in which demand exceeds supply, furthermore, are all groups which have higher farmer's share of the consumer dollar than grains and cereals do, and are in higher overall demand (both in terms of consumer expenditure and farmgate value) than grains and grain products. Thus, incentives already exist for Washtenaw County farmers to shift their production from grains to other, more economically intensive crops. Current barriers to such shifts could lie in the investment of time and money in the production infrastructure and the social and informational connections necessary to bring their new goods to market (Davis et al., 2004).

One might rightly question to what degree the development of economy on a county level can or should be specialized considering the overall scale of potential food system localization. One robust result stands out. Attracting local grain growers first into the cultivation of fruits and vegetables for

local markets is a possible first step. Produce is high-value for its land use and accounts for about 30% of the farm value of consumer expenditure. It also requires minimal processing, which makes it easy for farmers to capture more of the consumer dollar through direct sales and CSA arrangements. Even in this climate it would take a relatively small amount of land⁷ to support the county's population with fruits and vegetables throughout the year. With investment in season extension and storage infrastructure, this number would drop even more.

These economic estimates also build upon pre-existing work to give a more complete picture of demand within Washtenaw County's agricultural economy. Buck et al., (2007) investigated the premium that consumers in Southeastern Michigan would be willing to pay for local food over nonlocal retail food, shown in Figure IV-1.

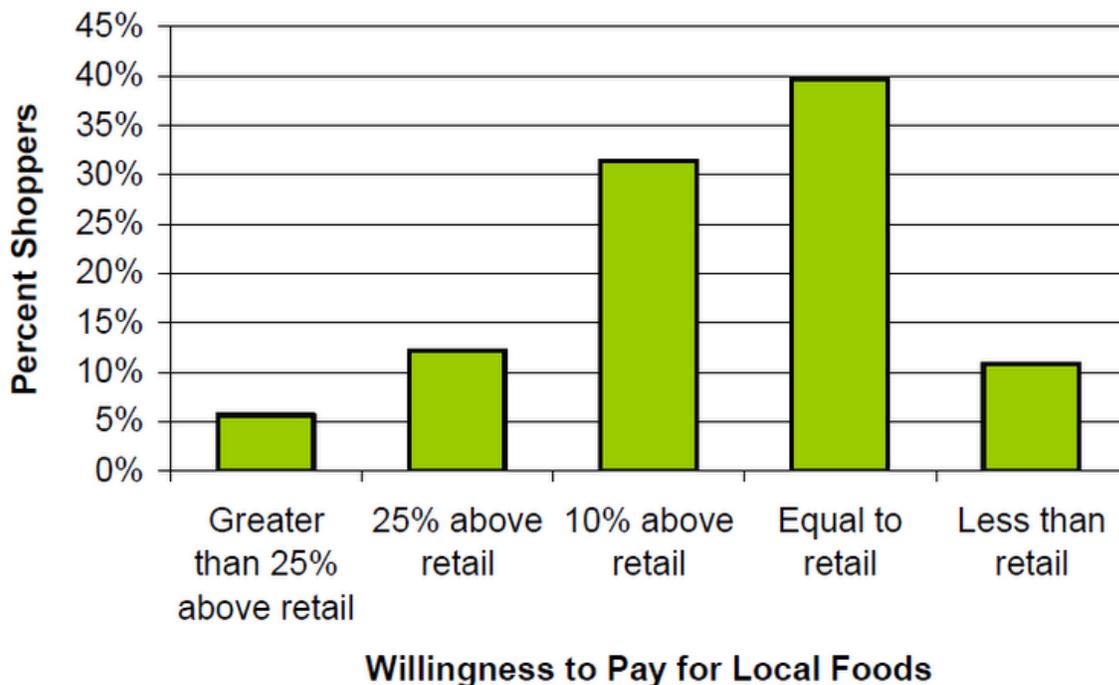


Figure IV-1: Willingness of SE MI Consumers to pay for local foods, reproduced from (Buck et al. 2007).

Integrating this distribution produces a demand curve for local foods, shown as Figure IV-2 below. As can be seen from the demand curve, efforts to increase demand for local foods will only be effective at improving the total volume of local food sales if market demand is elastic compared to market supply (*i.e.* the demand curve is flat.) However, market demand is currently inelastic, (*i.e.* the demand curve is steep,) because supply is so constrained that local food is a luxury of the rich and the dedicated. As Figure IV-2 suggests, only when the price premium for local foods comes down to 10-25% over retail will demand become elastic and will local food become mainstream. Prices will only decrease to that point if supply increases first. This highlights a major paradox of local food systems development in supply-limited regions: supply has to increase, but increasing supply will cause price premiums to fall, reducing the profits of existing suppliers.

⁷ It is estimated that about 8000 acres might be necessary to meet current fruit and vegetable demand locally on the basis of dividing estimated farmgate value of current consumption by the economic areal intensity of production.

Policy intervention is appropriate to internalize this and other externalities. The environmental and social benefits of engagement with the food system have already been discussed in the Introduction; economic resilience to fluctuating commodity prices is also important for municipal food security. To this we add two more economic arguments. First, policy must support farmers and farming livelihoods, to alleviate barriers to entry in an expanding market which demands more supply. Second, the economic activity associated with the more frequent recirculation of money within a more localized food system is a common social benefit that is not captured by any individual stakeholder within the food system. The case is strong for cities in general to develop municipal food policy, and Ann Arbor is no exception.

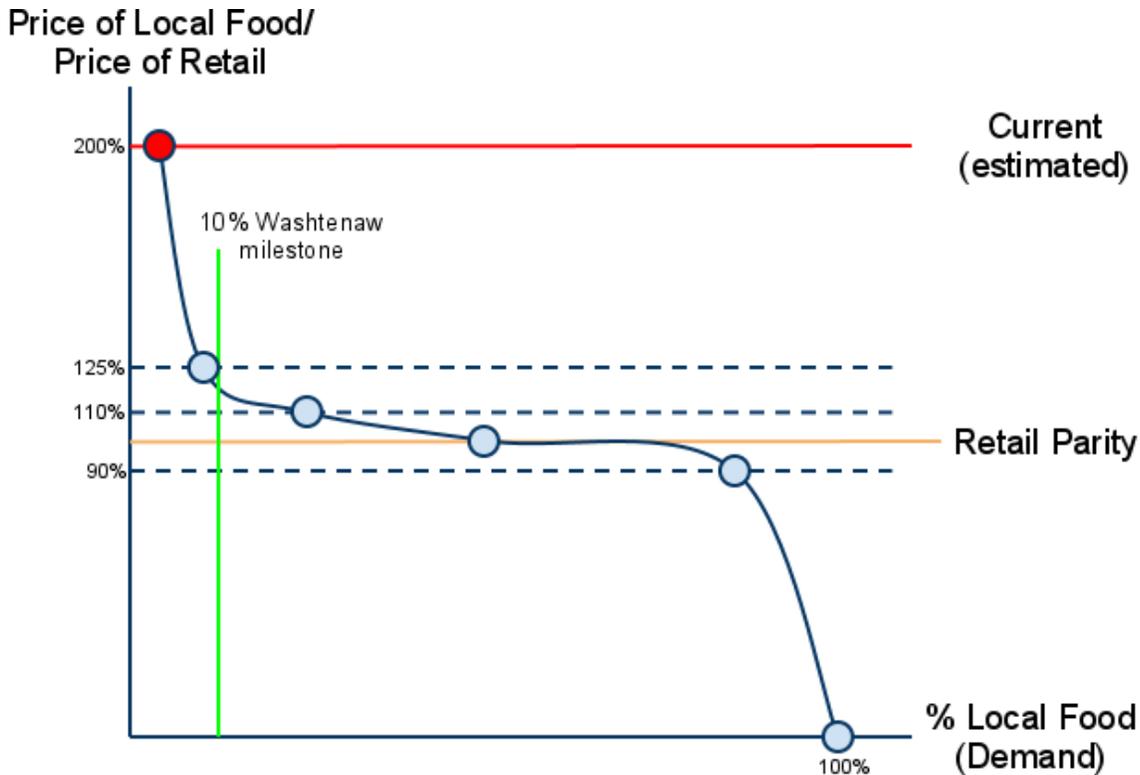


Figure IV-2: Reconstructed demand curve for local food in Washtenaw County. The five blue data points to the right are visually approximated to the nearest percent from Figure IV-1; the uppermost point in red is our estimate from the above results. The demand curve is extrapolated by connecting all of the points with a smooth curve. The green vertical line represents the goal of “10% Washtenaw” local food. Note the emergent price point at about 120% of nonlocal retail.

V. Food Related Ordinances and Policies

Policies and ordinances relating to food production vary widely within the county. While this study did not examine the codes and ordinances for every city and township in Washtenaw County, it was able to get a general idea of the standards through reviewing several cities. For the most part, within cities and towns it is permitted for residents to have a small garden from which they can produce food for themselves. Some cities and townships also allow a limited number of chickens to be raised for egg production. The typical number of chickens allowed is 4 and regulations regarding them vary widely. In some places you must get permission from your neighbors, while in other places that is not a requirement. Apiaries are generally forbidden, for reasons that are unclear, but perhaps due to fears and misperceptions about bee swarming and attacks.

One of the most important laws that relates to the topic of local food is the Michigan Right to Farm Act (MRFA). This law overrules any city or township ordinance and, if applied correctly, can allow farming within city limits. The MRFA gives anyone in Michigan⁸ the right to farm as long as they are doing so commercially⁹ and following the Generally Accepted Agricultural and Management Practices (GAAMPs) set forth by the Michigan Department of Agriculture (1981 PA 93, MCL 286.471). The GAAMPs are basic guidelines for agricultural management and do not appear to have any special or unusual requirements. As long as a farmer is adhering to the GAAMPs, they cannot be charged as a public nuisance regardless of odors, noises, or dust emanating from their property. This being said, cities and townships regularly take “farmers” to court to try to stop nuisance behaviors. Outcomes are not always consistent and so it is not always clear if the MRFA will protect small city “farmers”.

⁸ House Bill 6458 of 2010 would exempt Detroit residents from the Michigan Right to Farm Act. The bill is currently under review by the Michigan House Committee on Urban Policy.

⁹ This technically means selling any product of their operation in undefined quantities.

Summary Notes: Current State of Food in Washtenaw County

Washtenaw County is already a leader in food system localization within the State of Michigan. Its relatively affluent residents provide a willing consumer base for local food, and the quality of the soils that underlie this county's agricultural areas is relatively uniform and well suited to the production of high-value crops.

Based upon evaluation of the spatial distribution of county soils and county populations, there is not enough land currently used for agriculture within the county to feed everyone within it. This is even more true if residents choose to eat meat. However, a large proportion of the food value could be captured with a relatively small commitment of land to high-value fruit and vegetable specialty crops, and any significant commitment would easily enable Washtenaw County to become a net exporter of food value. Increasing local production of fruit and dairy in particular will be necessary to satisfy residents' recommended diet.

Under a locally integrated food system, Ann Arbor and Washtenaw County will both lie within the shadow of Metro Detroit's foodshed. While it is reasonable to expect that a large portion of Ann Arbor's food to come from Washtenaw County, it is unclear what portion of the food that Washtenaw County produces will stay within the county.

Based upon comparisons of estimated farmgate value of county consumption with farm sales from county production, it is estimated that Washtenaw County is currently eating about 3% local food. Over 95% of the county's consumer food expenditures leave the county; furthermore, over 95% of the county's farmer revenue from food comes from outside of the county. To achieve the "10% Washtenaw"¹⁰ milestone would require the monetary volume of local sales to approximately triple. Under such a scenario, local food prices will decline to approximately 110-125% of non-local retail.

Ignoring the intermediate steps of processing, distribution, retailing, without changing either production patterns or consumption preferences, the county could achieve an estimated maximum of 40% local food by farmgate value. Further localization would require Washtenaw County to either produce more of what it eats (mostly fruits and vegetables, but also meat and dairy) or eat more of what it produces (corn, wheat, and soy.)

The discrepancy between actual 3% local and estimated potential 40% local consumption accounts for about \$24 million in annual farm sales and about \$200 million in annual economic activity. The \$175 million difference indicates the estimated potential in developing local processing, distribution, and retailing. Hundreds to thousands of jobs could be created.

The case for governmental involvement in food systems development is more than strong. For a municipal government in an agriculturally productive region to invest money in developing its local food system is one of its most potentially lucrative investment options.

¹⁰ <http://tenpercentwashtenaw.org/>

Chapter 3. Food Futures

This chapter outlines a plan for Washtenaw County. The Future Scenarios section discusses the ways in which the county could transition into a more robust local food system. The following three sections discuss the steps that would lead to the establishment of a more self-sufficient food system. They are broken down into foundational steps, intermediate steps, and advanced steps. Finally, the local food system is put a regional and national context with a discussion of the implications of operating a local food system within a global world.

I. Future Scenarios

The future of food in Washtenaw County could take many forms. This section poses suggestions on how the county could improve its local food self-sufficiency, both in terms of production and consumption. A number of different sustainable projects and programs are proposed, each of which would incrementally bolster the integrity of the local food system.

The integration of local food systems can be modeled as a four-stage process throughout which relationships and economics evolve, eventually achieving key milestones.

Stage 1: Infrastructure Investment to expand Supply

At this stage, local food system actors are still making local niches within a larger food system. Investment is being made in production infrastructure and producer organization to increase available supply. Local food carries a high luxury premium due to limited supply. Less than 10% of food consumed is local in origin.

Stage 2: Vertical Integration to Achieve Competitiveness

This stage is characterized by vertical integration within the local food system, cutting out the middlemen of the larger-scale system. Producer cooperatives jump-start local distribution. Price premiums for local food drop sharply once consumers obtain better and wider access to local food through multiple distributional channels. More than 10% of food consumed is local in origin. Programs that increase consumer demand start to become very effective.

Stage 3: Scaling Up to Meet Demand

This stage is characterized by an expansion of local food operations. Producers aim to achieve competitive economies of scale that enable them to compete for mainstream retail channels and undercut the prices of imported food; up to 50% of food consumed may be local in origin.

Stage 4: Local Specialization defines Regional Role

This stage is characterized by specialization of the local food businesses. Local processors settle and stabilize; thematic local specialization within a new regional economy becomes well defined. A certification agency for local food may become necessary. Most of the high-value items of a healthy diet are local in origin, and the majority of the remainder is accounted for by regional imports. Regional exports and imports form a solid base of economic activity for the region as a whole.

Washtenaw County is currently at Stage 1. Local food niches are widely distributed, but remain a small fraction of the market. The “Foundational Steps” of the plan are designed to bring the county into Stage 2, in which improved distribution channels will develop and supply and demand will increase while price premiums decrease. The movement from Stage 2 to Stage 3 will require further steps such as increased local food availability in retail establishments, vested consumer interest in local food, and price competition between local and imported foods. These will be addressed with steps

outlined in the “Low Hanging Fruit” section. Finally, Stage 4 will be reached when a local food infrastructure has developed to support all levels of local food production and consumption including processing, distribution, and marketing. In order to reach this stage, steps requiring more dedication and effort will have to be completed. These steps are discussed in the “Reaching Higher” section of this paper.

While these stages are designed with voluntary adoption in mind, this may not be the case under certain circumstances. However, whether the local food system expands voluntarily or obligatorily, these four stages are a reasonable sequence in which local food expansion might occur. With this in mind, there are two ways in which local food production and consumption can increase in Washtenaw County: as an option or as a necessity.

Washtenaw County can choose to pursue an expanded local food system optionally for a number of reasons including economic vitality, social welfare, and improved human and environmental health. In this scenario, there is assumed to be a strong public demand for locally sourced food. Community members want to support local businesses and keep their money within the local economy as much as possible thereby increasing the wealth of the community. Keeping food dollars in the community is not only good for the farmer, but also good for the community as a whole. Purchasing and consuming local foods help to build strong community relationships among farmers, distributors, and consumers. This allows for trust building among community members and mutual investment in the future of the community. When local resources are a common interest, there is more support for the care and protection of those resources.

Health and environmental concerns can also play a role in a shift towards local food production and consumption. Knowing and interacting with farmers allows people to understand the story behind the food they choose to eat. Unlike the predominant system of mass production, long-distance shipping, and expansive distribution centers that reduces accountability in the health and safety of food, local food keeps farmers accountable for their management practices and how those practices affect humans and the environment. Local food also travels much less than conventional food thereby reducing emissions associated with transportation. While all of these are good reasons to seek locally sourced food, they require public demand in order to create the conditions under which local food production and consumption will increase.

In the other scenario, local food self-sufficiency will become necessary due to any number of emerging environmental and/or economic factors. As the climate begins to change and resources continue to decline in their availability there is a high probability that the way in which the current food system operates will have to change. Increased climate variability means that the security of the current sources of food may be in jeopardy. Drought, disease, and any number of environmental factors could cause a breakdown in the current food system in a matter of years. Additionally, the cost of fossil fuels for transportation of these foods is likely to continue rising over the near future, yet there are no new reliable sources of transportation prepared to step in when petroleum powered vehicles become too expensive to operate. It is under these harsh biophysical constraints that having access to local food will become essential. Rising food costs due to increased transportation costs and crop failure will make local food the only affordable option for many communities.

Washtenaw County is in a good position to develop its local food production since much of its land is already being used for agricultural purposes. Additionally, water is not a limiting factor in this area, unlike it is for other agriculturally productive regions of the United States, such as California’s Central Valley. For Washtenaw County, the key will be to diversify crops and livestock to meet the nutritional needs of citizens and to ensure farmers can sell their products within the community while still earning a living wage.

Ideally, Washtenaw County will begin a proactive and self-directed transition to increased local food consumption. In the face of fossil fuel shortages and climate change impacts on agriculture, beginning the move towards local food production and consumption before it becomes a necessity

would make the transition easier to complete. The following chapters present a series of actions that would increase local food production and consumption. Some steps would become obsolete if local food were suddenly to become a necessity, (as in the second scenario outlined above,) but at the present time, these foundational steps would likely have to be implemented to create the basis for a successful local food economy.

II. Building a Foundation: Critical Steps for Food Localization

The following steps consist of actions that are believed to be crucial to building a resilient local food system. Currently, local food in Washtenaw County exists on the periphery and is prevented from significant expansion by a number of barriers that are addressed here. These steps will create a strong foundation on which to build a diverse and vibrant local food system. Failure to create a base on which to build to the local food system will make any other actions less effective.

Increasing Demand and Supply

The most crucial elements of improving local food self-sufficiency are increasing the demand for and the supply of locally sourced food. While the local food movement has been gaining popularity nationwide for over a decade, locally sourced food continues to remain a fraction of a percent of the food consumed by most Americans. In Washtenaw County, citizens consume more local food than average, with local food consumption around 3 percent of total food consumed by farmgate value. Washtenaw County produces large amounts of food for human consumption, but the kinds of food that county producers produce are not the kinds that county consumers purchase for their own consumption. As a result, much of the food produced within the county is exported. Both demand and supply need to increase in order to improve local food self-sufficiency.

There are two ways to promote local food and potentially increase demand. First, consumers need to be educated on why locally sourced food is beneficial to their community. There are many social, economic, and environmental reasons that can appeal to many audiences. The current buyers of local food in Washtenaw County already have reasons for buying local food. It is those who purchase little or no local food that need to be targeted with information or campaigns encouraging local food consumption. If residents do not know why buying local food can benefit themselves and their community, than they are unlikely to make buying local food a priority. Since local foods provide so many benefits, at least one of the many benefits are likely to resonate with the different interests of local residents. Harvest festivals and other annual activities are great ways to present the variety of foods that are produced in the area, but they often do not address why buying local foods is good for the economy, community, and local environment. Using widely attended events to present the benefits of locally sourced food could help to increase consumer knowledge and therefore increase demand.

Using existing community organizations¹¹ to promote local food purchases is one way in which an education campaign could begin. These groups often already have booths at community events to promote their organization and future events. Incorporating information about local food and promoting its consumption could easily fit into the agenda of many of these groups and there are many creative ways to draw residents to their booth to engage them in conversation. Cities and townships can also create campaigns to encourage local food consumption as part of their mission to support local farmers and businesses. Media campaigns including billboards and radio ads may help to bring attention to the benefits of local food. Additionally, using local radio and newspapers to highlight local food benefits can reach a wide audience. Local groups and organizations that are promoting local food can reach out to the media to request more in-depth coverage of their local food-related actions. Regardless of the methods used, the benefits of purchasing local food need to be more widely presented to local residents to encourage local food consumption.

¹¹ Transition Ann Arbor - <http://www.transitionannarbor.org/pages/?q=node/1>, SELMA - <http://www.selmaannarbor.org/>, Think Local First - <http://www.thinklocalfirst.net/>, Etc.

Local Product Campaigns: A Look at What Works in Michigan

There have been several campaigns throughout the recent past that have encouraged buying local foods and other locally produced goods. On the large end of the scale, the “Buy Michigan Now” campaign encourages Michiganders to buy goods and services from Michigan to support our economy and small businesses and farmers. The campaign website is a resource for consumers seeking Michigan businesses, events, and other relevant information. While the campaign itself is not widely recognized throughout Michigan, its sentiment is sweeping through the state like wildfire. Due, in part, to the economic downturn, Michigan residents are interested in methods to revitalize Michigan’s economy and keeping their money local has turned out to be a very popular option. In response to this interest, retail establishments have begun clearly labeling Michigan grown and made products. Some have even gone as far as to advertise these products in a separate section of their weekly flyer. This “campaign”, which some may even call a movement, appears to be largely fueled by economic benefits and the need to pull together in times of crisis.

Buying “Michigan” appears to have caught on all over the state and certainly helps in the success of local businesses, but what about buying even more locally, within the County or region?

The “Think Local First”² campaign of Washtenaw County is a great example of successfully encouraging the purchase of local products and services on a more localized scale. Established in 2005, this local-business-owner-run group has been working to encourage the support of locally owned, independent businesses throughout Washtenaw County. Their website supplies an extensive list of businesses that are locally owned and operated and a list of events organized around supporting local businesses. In addition to their web resources, Think Local First periodically publishes a booklet/directory with information on local businesses. It is widely available throughout the county and provides a great resource for locating local businesses without needing to have access to the internet. This highly accessible and visible campaign works on several fronts in order to reach multiple audiences, which likely contributes to its success. The easy to navigate website, publications, and frequent events make it easy to participate in a variety of ways. Additionally targeting both business owners and consumers allows them to be a meeting ground where consumers and businesses can connect. The combination of high community involvement and visibility, high local business participation, and excellent marketing allows Think Local First to attract the attention of a wide variety of consumers and creates interest in local businesses and products.

¹ <http://www.buymichigannow.com/>

² <http://www.thinklocalfirst.net/>

Second, accessibility to local food needs to be improved. Many local food sources require special planning on the part of the consumer. Farmers markets often operate only 1 or 2 days a week for limited hours. Community supported agriculture (CSAs) often require members to pick up their items during a certain day at a certain time. Most grocery stores do not carry a large supply of locally sourced food, so buying local may mean making two or more trips in order to complete one’s food-shopping needs.

Inconvenience is one of the principal enemies of local food. There has already been an improvement in the availability of local food and this likely corresponds with the relatively high rate of local food consumption in the county. In Washtenaw County there are at least nine farmers markets operating on various days of the week (MIFMA, 2011). Additionally, the abundance of CSAs allows for some flexibility in produce pick-up. However, neither of these options are the same as a conventional grocery store that operates at least 12 hours per day, 7 days a week. Food co-ops that are open regular hours often do not carry a large variety of items or the items are far more expensive than conventional grocery stores. Convincing grocery stores to carry locally-sourced items can be a challenge, but increasing demand may solve this problem on its own. Local chain stores like Meijer now display signs or label their products “Michigan Grown” or “Made in Michigan” as a response to consumer demand for Michigan products. That is only one step away from products marked “Locally Grown” or “Made in Washtenaw County”.

Increasing local supply would create a market in which local food is more affordable and more easily accessible. As supply increases, the local food market will open to buyers who previously found

locally sourced food to be too expensive or too difficult to access. In order to increase supply the county needs to attract new farmers, diversify production, and improve local processing and distribution. New farmers need to be able to make their money by growing what people eat and selling their produce locally rather than growing commodity crops for sale nationally or internationally. Farmers have indicated that the primary barriers to selling food locally include a lack of processing facilities, a lack of local distribution methods, and a lack of time (Buck et al., 2007). In addition, new farmers face significant barriers to entry. All of these barriers will be addressed in detail in future sections.

Solutions to Local Distribution Barriers

Farmers have indicated that the lack of a local distribution system is one of the primary barriers preventing them from selling their produce locally (Buck et al., 2007). The extra effort involved on the part of the farmer can make selling locally more time and cost intensive and even prohibitive. In order to encourage farmers to sell their produce locally, a more formal system of distribution, that does not involve direct sales, needs to be introduced. In order to address this problem the formation of a distribution cooperative that deals solely with locally grown foods is proposed. This would eliminate the need for farmers to negotiate contracts with retailers directly, reduce the individual cost burden due to cost aggregation, and allow for more stable local food supply chains.

Local Farmer's Distribution Cooperative

The motivation behind a farmer's distribution cooperative is the notion that few farmers have the time to successfully grow sufficient products to support their family and market those products locally. Time and money spent marketing, transporting, and distributing products from an individual farm can seriously cut into the time and profits of a farm. However, creating a local distribution cooperative that farmers can join would allow for expenses and tasks to be combined in a way that can save time and money for all farmers involved.

Ideally the distribution cooperative would work to aid local farmers in distributing their produce to local grocers and restaurants. All farmers would pay a fee, likely relative to the volume or value of products they sell through the cooperative. These fees would combine to quantities sufficient to hire one or more full time staff members to act as a distribution liaison. Liaisons would negotiate contracts with grocers and restaurants, estimate the quantities of all products that will come into the cooperative on a daily/weekly/monthly basis, and organize the general day-to-day activities of the cooperative.

Having a distribution cooperative would also allow farmers to have a better understanding of the local market and the items that are in high demand. This would allow farmers wishing to expand or diversity to choose crops that they know are in demand and could sell easily. It could also encourage farmers to expand into niche markets that draw significant profits such as winter greens and mushroom growing.

By having a way to distribute food locally without having to distribute it directly, farmers would gain both time and bargaining power. A distribution cooperative would release farmers from the burden of negotiating contracts while still giving them the power to ask a fair price for their products. The cooperative would sell its shareholders' products locally and the farmers would have a way to influence decisions about how the cooperative operates. The details of such a cooperative would need to be worked out by the farmers involved, but the general idea provides solutions for many of the issues that currently inhibit the success of local food.

Attracting New Farmers: The Key to Diversifying Products

One of the barriers to increasing the supply of locally sourced foods is the lack of farmers willing to grow non-commodity¹² crops. The vast majority of crops grown in Washtenaw County are

Who will do the farming?

This is a question that is often asked but doesn't often get answered. In discussions, people tend to dance around the subject of actual farmers. Policymakers talk about farmland preservation, but not farmer preservation. Academic analysts of food systems calculate spatial extents of foodsheds and use sophisticated input-output models to predict the economic effects of localizing food systems, but often finish with only a vague statement that "a significant degree of reruralization will be necessary" to achieve the transition. Translation: "Someone's got to be on the land raising the crops." Who are those "someones"? From what familial backgrounds will they hail? What will attract them to farming, keep them in farming, and keep them in business?

Farming is hard work, and farmers are rare. While America as a nation may be developing a new pride and nostalgia for its agrarian past, the facts stand today that most Americans are accustomed to a non-agrarian life. Many American families have had no agricultural background for multiple generations. It is part of the culture of an urbanized, industrial economy that we expect someone else to do the farming for us. This culture is unsustainable, and already comes with its costs in personal health, in community integrity, and in the quality of the food we eat.

Under a more localized food system, farmers will be much more common. Consider vegetable farming in Washtenaw County. Our estimates are that about 8000 acres of vegetable and fruit production would be required to supply Washtenaw County's residents with local vegetables and fruits. Two people, often a husband-and-wife team, can reasonably expect to farm about two acres of land. That's an acre a person. So we can also expect that about 8000 people will be involved and employed full-time in vegetable production alone.

Not all of the 8000 people need be farmer-entrepreneurs, of course. A sizeable proportion of them will almost certainly be hired workers who don't own the land they farm, and many of them will probably end up working on large-scale commercial farms that sell predominantly through local distributors. Still, we can expect that over the transitioning years, we will have to train hundreds of new farmer-entrepreneurs, attract them to settle on County land, and help them establish hundreds of new farming businesses.

commodity crops and most are sent to a grain elevator and shipped off immediately after harvest. It can be difficult to convince farmers who have been growing the same crops and selling them to the same distributors for decades to change their methods. This is why it is important to attract a new generation of farmers to the county and encourage the production of specialty crops¹³.

To attract new farmers who are interested in growing specialty crops there need to be motivating factors. This generally entails financial benefits for operating a farm in the area, since farming is a capital-intensive business that yields low returns on investment. Financial motivations could include start-up and improvement grants, low or no-interest start-up loans, property tax credits, or the existence of a local food distribution program or cooperative. Some of these resources already exist, on a small scale, in Washtenaw County.

For example, some local organizations such as SELMA¹⁴ currently use proceeds from a weekly fundraiser to provide small farmers with micro-credit loans that can be used to build hoop houses and create "four-season" farms in the area. While the program is currently limited to hoop houses, the SELMA model can easily translate into other farm grants for specific improvements or general farm needs. What is remarkable about the SELMA model is that it has been entirely funded

by community members and organizations that want to support local farmers and local food. Additionally, it ensures that its funds go towards the production of specialty crops because hoop houses are designed for growing non-commodity vegetables.

¹² Commodity crops are food products that are heavily subsidized by the government and are often not fit for human consumption. This includes grains such as corn (for animal feed), soybeans, wheat, and sugar beets.

¹³ The USDA defines specialty crops as "fruits, vegetables, tree nuts, dried fruits, horticulture, and nursery crops (including floriculture)." In essence, any crop that is not a commodity crop.

¹⁴ <http://www.selmaannarbor.org/>

An expansion of these types of loans and grants that specifically benefit small-scale specialty crop growers could aid in the creation of many new farms where start-up capital is generally one of the largest barriers to success. As one Minnesota farmer puts it, “the most important asset a farmer can have is a good relationship with their banker” (Kern, personal communication). While non-profit organizations are a great place to start, the necessary capital for providing loans on a large scale would require participation from those with more financial assets. Local banks have the capital necessary to provide low-interest loans and an interest in the community that would make supporting local farmers beneficial to their business. This would still require farmers to have the credit to qualify for these loans. However, lower interest rates may make it easier for farmers to pay back their loans. City and township governments can also encourage farmers to grow specialty crops by providing financial benefits and making it easier for farmers to obtain land on which to grow their crops. This is being done in one way by the City of Ann Arbor along with Webster and Scio Townships. The creation of the Greenbelt District to preserve green space and prevent urban sprawl allows land near urban areas to remain

Who Will Do the Farming? *(continued)*

Washtenaw County has just over 100,000 households, so if 8000 people are employed full time in vegetable farming, that’s 5-10% of County households. But that’s not all. What about all of the people who process these vegetables and fruits so that we can enjoy them year-round? What about all of the farmers who cultivate other kinds of food? Adding in other kinds of farming as well as processing and distributing, and more like 15-20% of County households would be directly, financially supported by the agricultural sector. That’s a large fraction of our County’s labor force, certainly worth municipal- and County-level planning.

So already, with having answered the question, “how many?” we can begin to visualize a different socioeconomic landscape for the County and its workers. But here’s some food for thought: I still haven’t answered the question, “who?”. If 1 in 5 or 6 households in the County will be supported by breadwinners in the agricultural sector, which households will they be? The rich or the poor? Whites, blacks, or people of other ethnicities? Men or women? Young or old? Washtenaw County, by virtue of the University of Michigan’s presence, has long been privileged to enjoy an economy driven by high-tech commercial ventures. Many of the County’s residents are well cognizant of its history as a center for education and talent in Michigan. They are reluctant to relegate any substantial portion of the County’s future to the agricultural sector.

Yet someone will have to do the farming. Localization, like any other socioeconomic strategy, is not inherently just. It has much potential to exacerbate existing patterns of self-segregation along lines of race and class and gender. We had better start thinking about these emergent justice issues now, before they threaten to leave yet another generation of disadvantaged people behind.

undeveloped therefore providing space for farmers near the locations where they can sell their products. Using a ballot initiative and a millage, the governments have been able to raise funds to purchase development rights for land parcels worthy of being protected from development. The next step envisioned here would be to lease unused properties at low cost to new farmers who want to grow products to sell locally. As of now, this has not been done, but as current farmers retire or move, filling in empty Greenbelt land with small specialty farmers would be essential to increasing supplies of locally grown food.

Cities and townships can also encourage small specialty farmers by offering property and business tax credits for businesses that sell and buy their products locally. This could benefit local farms and businesses in multiple ways. By rewarding farmers for selling their products locally, farmers have an incentive to keep selling their products locally, increasing supply. Giving tax credits to businesses that buy local products helps to increase demand by making buying locally more affordable. Therefore, tax credits can lead to an increase in both supply and demand as well as attract farmers wishing to sell locally to the area.

The Washtenaw County Land Bank could have a significant role to play in the increase of specialty crop farmers in Washtenaw County. Currently, the land bank is in formative stages and has not yet

implemented policies and procedures to govern its activities. Now is an excellent time to help shape the land banks future trajectory to increase the number of small specialty-crop farms. Adopting acquisition

policies that give preference to farmers that will grow high value goods and sell them locally would be good for the local economy and can help to attract new farmers. Since the land bank should be used to benefit the local economy and the county residents, it would not be inappropriate to develop policies that favor local businesses over national or international corporations. Pressure from local authorities, businesses, citizens, and non-profits is necessary to convey an interest in developing policies to support local farmers. Without outside input, the land bank authorities may not choose policies and procedures that will benefit the county as a whole.

As previously mentioned, many farmers find local distribution to be a significant barrier to selling crops locally. This is because it takes time and money to market, distribute, and sell products than to sell directly to a large national distributor. The development of a cooperative where farmers can work collectively to market and distribute their products could be an important financial factor in attracting local farmers.

All of these potential benefits carry along with them the requirement that farmers produce specialty crops or livestock and sell it locally. This is the most important part of all of these benefits. In order to increase crop diversity and keep those crops in the area, stipulations need to be attached to financial advantages in order to attract the kind of farmers that would improve local food production in the county. Without guidelines, these benefits could create perverse incentives that could be exploited by farmers who do not contribute meaningfully to building a more localized food system.

Make Selling Locally Competitive with Selling Nationally

A crucial element of increasing the amount of local food sold within the area is making selling locally competitive with selling nationally or internationally. If a farmer could make more money by selling their products locally, they would naturally choose the option that leads to a higher income. Theoretically, farmers should make more by selling their products in a more direct manner as opposed to working through lengthy distribution chains. In practice, this is rarely the case. In conventional supply chains the farmer grows their product, harvests it, and sends it off to a distributor, never to be heard from again. The distributor pays an agreed upon price to the farmer and that is the end of the transaction. When small farmers distribute food locally, many options and barriers exist.

If the farmer wants to sell to a grocer, they must contact the grocer, convince the grocer to carry their product, negotiate a fair price, and ensure that they can meet the grocer's supply demands. These negotiations and actions are usually done by a distributor, who has no problem meeting demand since they have products coming in from hundreds, or even thousands, of locations and can maintain a set price because prices paid to the farmers for their product can be aggregated to result in a stable price. This is much more difficult for an individual farmer who can experience different costs depending on the demands of a growing season and the resulting crop. They must also be responsible for transporting the goods, which would traditionally fall upon the distributor. Additionally, these negotiations take a significant amount of time, resulting in time lost working on the farm.

If the farmer chooses to sell directly to the consumer, they must market his goods somewhere. This can be anywhere from on-site to an official farmers market. Large-scale on-site marketing requires extra labor to maintain and run the market as well as advertisements to attract customers. This results in costs to the farmer for building a "market" area, paying at least one employee, and promoting the market. Choosing to bring products to a public farmers market prevents some of those costs, but can still result in significant financial costs. First, the goods must be transported to the market, requiring a vehicle large enough for transport. The farmer must pay for table space at the market as well as spend time loading and unloading the truck. Additionally, time spent at the market is time that is not spent working on the farm.

The combination of time and financial investment often deters many farmers from selling their products locally. The financial incentives outlined above can aid in easing the financial burden that

farmers experience from selling their produce locally. Additionally, a distribution system that caters to farmers wishing to sell locally can ease the time burden experienced by many farmers. The margins of profit are very small for most farmers. In order to tip the scale in favor of selling locally, resources for farmers need to be in place to make selling locally more profitable and distributing local products less time and resource intensive for the farmer. The local farmer distribution cooperative could significantly release these burdens making selling locally more profitable, and therefore competitive with selling nationally.

III. Low Hanging Fruit: Cost Effective, Uncontroversial, and Low Effort Steps To Food Localization

The following steps classified as “low hanging fruit” because they represent steps that require relatively little time, effort, and/or commitment to increase overall local food production and consumption. While some require more resources than others to achieve, they would also result in larger improvements in the overall system and address issues that more pressing. The steps address a variety of issues relating to local food promotion, production, marketing, distribution, and consumption. Some propose changes to currently existing programs while others call for a new approach to local food barriers.

The “12 for 10” Campaign

The 10 Percent Washtenaw campaign encourages Washtenaw County residents to purchase 10% locally sourced foods in an effort to increase local food consumption in the area¹⁵. The website hosts a list of 10 “things” you can do to bring your local food consumption up to 10% as well as a host of resources on where to buy local food and what restaurants serve locally sourced foods. While this website is a helpful resource for those wishing to increase their local food consumption, it fails to give concrete actions that will lead to increased local food consumption. This campaign could benefit from a simpler message. If each household in Washtenaw County bought \$12 worth of local food per week, this would equal about 10% of the money spent on food per household thereby increasing local food consumption to about 10%. This puts local food consumption into terms that are easy to understand and act upon. This “12 for 10” campaign could easily fit into the 10 Percent Washtenaw campaign and give consumers a more concrete and simplified goal to follow when making local food purchases.

Encouraging Grocers to Carry Local Foods

While many privately owned grocers in the area carry some local foods, it can be very difficult to convince grocers to break away from their normal distributors and work either directly with a farm or a small local distributor. This is especially true for large chain stores that require reliable supplies of specific quality and large quantities. There are three main problems that impact grocer’s ability to carry local foods: connecting with producers, supply volume and dependability, and consumer demand (Buck et al, 2007). First, finding farmers that wish to sell their products locally can be a serious barrier to carrying local foods. Since grocers traditionally work with distributors that bring them specific foods on a set schedule and at a stable price, it requires more effort, time, and (sometimes) money to locate local farmers and negotiate supply contracts. By nature, supply from individual farmers is less reliable because one problem on the farm can translate to a decrease in harvest volumes or even crop failure. In the case of a grocer/farmer relationship, this would leave the grocer with insufficient quantities of the farmer’s product and create a supply gap for the grocer. This is one of the reasons why grocers avoid individual farmer contracts. Another reason that grocers do not purchase food directly from local farmers is that seasonality is not something that grocery stores typically observe anymore. Consumers want all fruits and vegetables year-round. Grocers supply these fruits and vegetables by offering imported goods from warmer climates when regional weather limits local vegetable growth. Switching from local farmers to national distributors seasonally requires extra work on the part of the grocer and thereby limits the willingness of the grocer to provide seasonally available foods. However, if consumer demand for local products is high, grocers will go through the extra trouble of purchasing

¹⁵ <http://tenpercentwashtenaw.org/>

local foods. High demand usually entails multiple requests per week from customers that want to purchase locally sourced foods.

In order to increase the amount of local foods carried by grocers, consumers need to let their grocers know that they have an interest in purchasing local foods (Buck et al, 2007). It is literally as easy as telling a manager that you want to see more local foods at the store or filling out a comment card with the same sentiment. Grocers need to feel pressure from consumers to carry local foods in order to know that local foods are in demand and will be purchased by consumers.

A local food distribution system, like the local farmers distribution cooperative, can be used to address the remaining barriers identified by grocers. By working with a distribution coordinator instead

of as individuals, grocers can reduce the amount of individual negotiations that must occur. The distribution coordinator would be able to offer many products in larger quantities, instead of the few crops offered by individual farmers. Additionally, since comparable products would come from multiple farmers, the stability and longevity of the products to the grocer would increase.

Aggregating Local Farm Products for Maximum Sales Potential: Good Natured Family Farms

One great example of successful local farm cooperation is the Good Natured Family Farms Alliance. This group of farmers has bound together to create a brand of foods that they sell throughout the Kansas City area. By creating a label, they have a recognizable brand for consumers that guarantee certain standards. Additionally, they offer a large variety of products ranging across all food groups. Because they have so many farmers involved, they are able to reliably supply a steady stream of products. This has allowed them to set up contracts with large commercial grocery stores in the area.

By working together and creating a recognizable and respected brand, these farmers have been able to ensure a market for their products at a fair price. This benefits all of the farmers involved and gives them selling power as a group. Unlike farmers who are working alone, they do not have to worry about finding a buyer for their products or marketing the products to grocers in order to sell their food locally.

Learning Through Doing Campaigns

One way to encourage community members to buy local foods is to engage them in the local food system and activities that incorporate local foods. Agriculture tours, seasonal

cooking classes, harvest festivals, and other activities that encourage residents to interact with their local food shed can help to create a community where residents actively seek sources of local food. Many great examples already exist in Washtenaw County. Transition Ann Arbor's ReSkilling Festival is a great example of an event where community members can meet to learn about a variety of skills that include local food. Previous workshops have included: backyard chickens, permaculture, growing an orchard, dairy processing, cold frames, and intro to preserving. Companies like Michigan Agritours serves to engage community members in the local agricultural landscape by offering a variety of tours involving local agriculturists. Continuing these activities as well as expanding their scope is an inexpensive and fun way to create interest in and demand for local foods.

Some hesitance towards local foods stems from the lack of knowledge on what to do with these foods when they are fresh and how to store them to use later. Classes and information on cooking seasonally and using unfamiliar but local foods can help to residents to feel more comfortable buying and using local foods. Additionally, many people who consume local foods during the summer stop during the winter because they are unaware of how to store foods for the winter. Classes on preserving, freezing, fermenting, and root cellaring could help enthusiastic community members to increase their year round local food consumption. The existing groups and companies that encourage local food and agriculture can easily help to increase local food participation by offering more workshops and activities involving local food or even dedicating entire events to local food education.

One aspect of local food education that needs to be emphasized is the importance of seasonality. As previously discussed, Americans have access to a huge variety of fruits and vegetables all times. While some extended seasons are possible due to advancements in agricultural technology, there is a

clear limit on what can be grown in this region. This does not mean that the occasional tomato in January should be forbidden, but in order to increase local food consumption, people need to have a better understanding of the limits of the current system and the environmental and social costs associated with purchasing and consuming large amounts of imported foods. Educating on seasonality can help to create a community that is more receptive to seasonal limitations and prepared to become less dependent on imported foods.

Social Inequities: Local for All

One of the frequent criticisms of local food is that it is too expensive and a luxury that many low-income families cannot afford. There have been many efforts to combat this view and decrease the cost of local food for those who are living on a limited budget. While accepting Supplemental Nutrition Assistance Program (SNAP) bridge cards¹⁶ at farmers markets is a step in the right direction, this does not make the food any less expensive for low-income consumers. One local effort to combat local food equity issues of this is the Double Up Food Bucks¹⁷ program that has been created by the Fair Food Network. This program allows people who are enrolled in SNAP and use their bridge card at a participating farmers market to receive matching funds for the money they spend on fresh, Michigan-grown fruits and vegetables. This effectively doubles their food budget at the farmers market. While the program is already available at four Washtenaw County farmers markets, it can only be used on fruits and vegetables. This leaves a gap in grains, meat, and dairy that needs to be addressed.

This gap could be addressed in a variety of ways. The easiest way would be to integrate grains, meat, and dairy into the existing Double Bucks structure. This would be entirely at the discretion of the Fair Foods Network, as they are the program administrator. Another way to address the issue would be to develop a similar county program to decrease the costs of local foods for low-income consumers. By using the county, the program could cater to Washtenaw County residents and have a broader scope to include retail establishments as well as farmers markets. Several departments exist that could administer this program, but the funds to support it would have to come from the county.

¹⁶ Food Stamps

¹⁷ <http://www.fairfoodnetwork.org/food-system/equity>

IV. Reaching Higher: Steps Requiring More Time, Money, and Desire

There will be a point in food localization where low effort, inexpensive actions no longer have an impact on the expansion of the local food system. It is at this point that steps that require more commitment, desire, and money will need to be implemented in order to complete the local food infrastructure necessary to provide locally sourced food in sufficient quantities, year round. The following steps represent actions that will fill in the remaining gaps in the local food system and allow the county to supply the majority of it's own food throughout the year.

Increasing Local Processing Capacity

Foods for Long-term Storage

One consistent problem identified by both farmers and consumers is the lack of processing capacity in most areas. For farmers, this is a problem because they must sell all of their products for immediate consumption. This can be difficult when products are in peak season and the market is flooded with whatever product the farmer is trying to sell. However, if processing facilities are present, surplus perishables can be purchased by processors for canning, freezing, or turning into prepared foods. This creates more demand in the market as well as prevents food waste. This is also good for the consumer since many consumers claim that their failure to buy local foods during the winter is due to the lack of availability. If foods were available in processed forms, this would give consumers a local option for out-of-season perishables.

Investment in processing infrastructure would likely need to be initiated by private industry.

Mobile Meat Processing Units

Mobile meat processing units (MMPUs) have been gaining popularity as the numbers of small-scale farms across the United States have increased. Unlike larger processors that cost a lot of money to build, require special areas for keeping waiting animals, create undesirable areas due to odors, and result in animal waste, MMPUs are far less expensive, reduce animal stress by going to where the animal lives, relieves concerns about land use, and recycles animal waste.

The MMPUs are USDA certified just like a regular plant, so the farmer can sell the meat to stores or directly to the consumer. Different types of MMPUs exist for different larger and smaller types of animals. An MMPU for larger animals such as cattle, lamb, and hogs can process. Depending on the individual MMPU and the number of butchers the average MMPU can process around 10 head of cattle, 40 lambs, or 24 hogs per day. There is a built in cooler that can hold the carcasses until they are brought to the butcher for aging and butchering. The waste from the slaughter is composted on site allowing the nutrients to be reintroduced into the land after it has been thoroughly composted.

However, offering financial incentives to companies wishing to build processing plants could help to encourage investment in local processing infrastructure. Processing plants of all sorts would be necessary and useful. Plants to freeze, can, and produce prepared foods would all be necessary in order to provide the processed products that consumers want and need. It would be ideal to have plants that have multiple functions and capacities so that they can adapt to changes in produce as different items become seasonal. Unlike some processing plants that make only a single item, processors would need to be able to adapt to different products based on the seasonal availability of different perishable items.

There are several potential benefits from processing food within the county. It creates a new level of food security that

transcends seasonal bounds on a large scale. This brings the county much closer to food independence. Additionally, the presence of more plants will create jobs for local residents. In some cases, preexisting plants that have been closed due to cutbacks in the automobile industry can be used, making it less expensive and more ecological than building plants from the ground up. Food processing could also

lead to economic gains for the county as a whole by providing a value added product that can be exported.

Meat Processing

Another type of specialized processing that will need to be available in the county is meat processing. Unlike processing for long-term storage, which will occur in larger plants, meat processing will need to meet the needs of many different types of farmers and citizens. While large meat processing plants will be good for large scale farmers, the majority of small scale farmers will need processing that is easily accessible and specializes in small batches. The mobile meat-processing unit could be a great solution for small-scale farmers who do not have the means to move their animals to far away plants for processing. These processing plants on wheels are USDA approved and so would allow farmers to sell their products in grocery stores. An increase in the use of these units could make farming meat locally more economical and easy for farmers to do since the processors come to the farm. While multiple options for meat processing will be necessary to meet the needs of all of the farmers in the county, the availability of options is promising.

Funding for Food System Infrastructure

While many local food system infrastructure components will be created by private industry and farmers, some parts of the system may need extra aid from county and local governments in order to reach their full potential. This would be especially true if the need for local food infrastructure building was urgent due to a food or peak oil crisis. In the case that the local food system needs government assistance to succeed, there are several ways in which governments can choose to procure these funds.

Millage

A millage to support the local food system would put the burden of local food system funds on the citizens of the area rather than directly on the city and county governments. However, this would require consent of the citizens through the voting process. It is unlikely that a millage would pass to increase funding for local food infrastructure, unless the desire or need for local food infrastructure became strong. However, a substantial proportion of the U.S. public considers the multifunctionality of agriculture, which includes rural development, environmental conservation, and agricultural research, as an important social issue, and feel that the government should be engaged in its support and enhancement with public funds (Moon, Kuethe, Kraft, & Esseks, 2005). This indicates that an awareness campaign could yield strong support for a millage.

If a millage were to pass, the money raised could be used to fund any number of projects to fill gaps in the local food industry. It could also be used to create some programs that are administered by the city, if private industry could not provide the necessary components to the food system. Additionally, money raised could be used to purchase green space to be used to local food production. This would provide farmers with space to grow food, while preventing the space from being taken over by industry or residential neighborhoods.

Government Funding

Funding from national and state government agencies can be used to build local food infrastructure under certain circumstances. The federal government supplies funding through several programs that include Community Development Block Grants, Community Food Services, the Aquaculture Program, and the Farmland Protection Program¹⁸. These funding sources provide money for certain community development initiatives that could aid in the development of the local food

¹⁸ This is by no means an exhaustive list.

system. Depending on the project at hand, different types of funding would be more appropriate than others. For the most part, these funding sources are competitive and need to be applied for in order to receive the funds. However, if the proposal is necessary, innovative, and benefits the community, funding may be available through the federal government. State government funding is also available through similar programs. Special Project Grants through the Michigan Department of Agriculture can be used to initiate projects involving farms and local food systems. Additionally, Community Development Grants are available for projects and programs that work to advance the resiliency and welfare of communities. Like federal funding, these funds must be applied for and are competitive so proposals that are well written and developed are essential to successful funding applications.

Private Grants

The wide array of grants available to those who are working in improve local food system infrastructure can be used for special projects within the local food shed. Like government funding, these grants are usually competitive and must be applied for with a grant proposal or application. Unlike government funds, private grants can fund a wide variety of projects that government funds may not cover. Additionally, there are literally thousands of grants to choose from, so finding the right grant for a project is important and can increase its chances of being funded. Another benefit of private grants is the ability to receive grants from multiple sources. If one grant is not enough to cover the costs of a project, another grant may be available elsewhere to pick up the slack.

Farmer Preservation

While attracting new farmers has been discussed in detail, keeping existing farmers still needs to be addressed. While many actions both locally and nationally aim to preserve farmland, the retention of actual farmers has been relatively ignored. When farmers retire, a neighboring farmer typically purchases the farmland and adds the land to their existing farm, making their farm larger. Over time, this can result in a dozen or more small farms, owned individually, becoming one huge farm run by a single farmer. Additionally, these huge farms usually grow commodity crops that are shipped out of the state. In order to keep farms small and their interests local, there is a need to prevent the loss of farmers in the community.

One reason farmers may be selling their farms is the high cost of property taxes in comparison with the profits gained from farming the land (Buck et al, 2007). The low value commodity crops grown by farmers do not draw in enough profit to make farming worth the cost of owning the land. In order to increase profits, farmers need to transition to higher value crops and land uses. Coincidentally, this is what needs to happen in the county to improve the local food system. The key is to ensure that farmers can make a good living by producing specialty crops and encouraging retiring farmers to sell their land to another small farmer instead of a large farmer. Some of the actions mentioned in the “Attracting New Farmers” section can be used to encourage farmers to transition to specialty crops, but programs to encourage and support transitioning farmers will also be necessary. These programs can be paid for with funding from the methods mentioned above. Without special assistance and funding, it unlikely that farmers will make the transition on their own since shifting from commodity to specialty crops can create initial confusion and expenses for farmers due to government regulations and subsidies for commodity crops that do not exist for specialty crops. Regardless of the methods used, keeping and transitioning existing farmers is a difficult and important aspect of local food production. Many farmers may be resistant to changing crop types, but providing farmers with incentives and evidence to show that specialty crops are profitable could alleviate this. This could result in many farmers may be saved from unnecessary retirement and many farms may be saved from conglomeration into a large commodity crop farms.

Winter Food Production

Increasing local food production in winter will require multiple solutions. A combination of hoop houses, greenhouses, and season extension will be necessary to provide increased quantities of local food. It is unlikely that fresh produce importation during winter, or even year round, will stop completely unless the cost of transport becomes so costly that it is no longer feasible to import foods

What can we grow in winter?

Most standard hoop houses grow cold-hardy winter greens and a few other cold tolerant vegetables. This may not seem like much, but using sustainable technologies, the array of fruits and vegetables that can be grown can increase significantly. Harnessing wind, solar, and geothermal energy are all sustainable ways to increase the temperature of a hoop house or greenhouse. Another effective and much cheaper method is to use the heat emitted by compost to heat the insides of hoop houses and greenhouses. Either way, sustainable methods do exist for growing vegetables year-round. The limiting factor during winter is light, which means that the vegetables grow more slowly, but given enough warmth, we can grow most vegetables typically seen in summer.

There are several foods that we may never be able to grow in this region without the aid of green houses. There are three options when it comes to items like these. We may choose to always import these items, we may choose to grow certain plants in greenhouses, or we may choose to stop using these items altogether. It is unlikely that voluntary adoption of the last option will occur, so realistically there is a need to choose between importing or mass greenhouse production. That decision will have to be made later on and will probably be determined by the costs associated with growing or importing, the potential capacity of greenhouses, and the strength of public desire for local foods.

In the case that we do choose to grow some plants indoors, there are several popular fruits and vegetables that could be successfully grown in greenhouses. The following is a sample list of plants that can successfully be cultivated in a greenhouse: citrus fruits, olives, bananas, pomegranates, figs, pineapples, globe artichokes, avocados, and mangoes. Realistically, most non-native plants can be grown in a green house as long as they have the right conditions and the variety allows the plant to stay small. Therefore, fears that eating local means never eating a lemon again are unfounded. In fact, there are many varieties of potted dwarf fruit trees that can live outdoors in summer and indoors in winter. Cultivation of these plants at home could supply individuals with several varieties of fruits and vegetables that typically must be imported.

long distances. However, it is reasonable to believe that through a combination of winter production and seasonality education the county can significantly reduce the amount of imported foods.

While support for winter food production in this region is on the rise, there are still a lot of things that will need to be done in order to bring winter production up to a level that would significantly impact winter produce consumption. Support for hoop houses through groups like SELMA¹⁹, will not be able to meet the need for winter production that Washtenaw County should expect to experience as local food demand rises. The acquisition of government funding and private grants would allow for experimental projects to see what works in this region and understand the scale that would be necessary to produce significant amounts of different types of produce. However, this effort is not dependent solely upon funding. Most hoop houses and greenhouses will need to be built and maintained by professional

farmers. There are several actions that could be taken to help mitigate the costs of building and maintaining these structures. Property tax credits for farmers who build winter production structures on their farms would be one way to encourage farmers to build hoop houses and greenhouses and help to make building the structures more affordable. Assuming that a millage is passed, some of that money could be used to subsidize building costs. Local banks could also offer special interest rates on loans for building winter production structures.

As more structures are built, more produce will be supplied to the market. This will

¹⁹ <http://www.selmaannarbor.org/>

significantly reduce the price premiums currently seen on local winter produce. It is in the best interest of community to support winter food production now, so that capacity is built over time, eventually leading to a system that can produce a significant amount and array of winter produce.

Redefine Best Management Practices

Current best management practices (BMP) as defined by the USDA (Emmert & Makuch, 1998) encourage farmers to operate their farms in ways that reduce inputs, increase efficiency, and minimize negative impacts on the environment and human health. However, these BMPs are too lax and do not go far enough in promoting sustainable farming practices. In order to ensure that the local food system operates in a sustainable ways, the best management practices must be redefined to encourage farmers to operate their farms in ways that are sustainable and protect human and environmental health.

Several aspects of industrial farming need to be reevaluated and alternatives to the system need to be adopted in order to make the county agricultural system sustainable. As a whole, the system needs to become cyclical. This means that instead of importing large amounts of chemicals and additives to the farm and creating outputs of erosion, chemical runoff, and GHG emissions, a system needs to be created that minimizes inputs and uses locally available and natural inputs to maintain soil health and control pests.

In industrial and conventional systems, the most energy intense components of a farm are maintaining soil fertility, pest control, and irrigation. The best management alternatives for these three components are worth more discussion. Although other components can also be altered to increase efficiency, these three components make up the bulk of energy use and environmental harm on a farm. This does not imply that all systems should be organic. While some of these methods are used in organic agriculture, this is coincidental. However, decreasing the energy and chemicals that go into farms will increase the sustainability of the farms and the overall environmental and human health of the community.

Soil fertility is usually maintained by adding to the soil synthetic fertilizers that are manufactured through a variety of energy-intensive processes. These fertilizers are predominantly comprised of nitrogen, phosphorus, and potassium, which are considered the three most important elements in plant growth. Other micronutrients may sometimes be added, but vary depending on the type of crop, soil conditions, and other variables. The largest issue with synthetic fertilizers is that they need to be manufactured, shipped, and applied to the land through processes that require a lot of energy. The amount of nutrients that are actually absorbed by the plants is also relatively low, and so excess nutrients often run off into nearby water sources. By using natural fertilizers such as nitrogen fixing cover crops, compost, and animal manure, plants can be provided with the nutrients they need without synthetically manufacturing and shipping fertilizers to local farms. Each of the natural fertilization methods provides multiple ecosystem services for the farm. Cover crops fix nitrogen from the air, while simultaneously reducing soil erosion and runoff. The cover crop can also be tilled back into the land before planting, used as fodder for livestock, or harvested for animal or human consumption²⁰. Compost provides a variety of nutrients to the soil including a large variety of micronutrient that can help plants to grow more efficiently. Compost is made out of biodegradable waste and so diverts food waste from landfills and back into the land. Manure is a very concentrated form of fertilizer and also provides a large variety of nutrients to the soil. In some systems, manure is the source of serious pollution problems, but when recycled back into the system, it can aid in the creation of very healthy and fertile soil.

Pests are typically controlled by the use of manufactured chemicals that have a variety of impacts on the surrounding environment, wildlife, and humans. Some of the currently used pesticides

²⁰ Depending on the crop.

are known to be carcinogenic, endocrine disrupting, and ozone depleting (EPA, 2007a). Like fertilizers, these pesticides often run off into nearby water sources where they are concentrated and may negatively impact humans, animals, and the environment. Additionally, they are very energy intensive to manufacture. One major issue with synthetic pesticides is that once you begin using them, it is almost impossible to stop. Since many pesticides do not target one species, but simply kill the majority of invertebrates, the result is a complex situation in which the pests come back stronger and with fewer natural enemies. This is called the pesticide treadmill. When a broad-spectrum pesticide is sprayed, it kills the majority of invertebrates in the area. This stops damage to the crops temporarily, but the remaining pests will soon resurge stronger than ever. This is because the ones that survive are more likely to have built up a resistance to the pesticide that they will pass on to their offspring. Additionally, the pesticide will likely have killed the pest's natural predators. Since the lifecycle of natural predators is typically longer than that of its prey, it will take longer for the predator to recuperate from the impacts of the pesticide. The pests will likely experience a resurgence before the natural predator can bounce back and you will need to spray the pesticide again, except this time the existing pests will be more resistant than last time. Less will die than before, but you will still kill off enough natural predators to put them back at square one. This cycle can repeat itself until the pesticide no longer impacts the pest and more powerful, and often more toxic, chemicals need to be used. There are several effective alternatives to this pesticide treadmill. Some of the most popular include integrated pest management and naturally derived pest deterrents, which could be considered a subset of integrated pest management.

Integrated pest management is an approach that relies on knowledge of the lifecycle of pests in order to control them effectively (EPA, 2007b). While this approach does not ban the use of synthetic pesticides, it does encourage the use of environmentally sound methods to control pests. This makes sense for the purposes of this paper. While the use of synthetic pesticides should not be encouraged, acknowledging that they will probably be used is important. The key is to discourage their use when other alternatives are available. These alternatives include introduction of natural predators, use of integrated plants that deter the pest, spraying of naturally derived deterrents such as essential oils, and introduction of pest killing bacteria or fungi. Introducing natural predators keep the pests under control through predation. There are a number of deterrent plants that create an environment that the pests find unappealing. Spraying naturally derived pesticides is similar to planting deterrent plants, but it is generally more effective. By spraying the essence of a plant that the pest finds unappealing onto the plant they are consuming, the pest will find the plant much less appetizing. There are also some types of bacteria and fungi that can attack and kill certain pests. These bacteria and fungi have no impact on humans, but are often deadly to the pests on which they prey. Using one or more of these methods can be very effective for controlling pests without the use of synthetic chemicals.

Irrigation uses large quantities of water to keep plants well watered. Many commercial operations use disposable plastic drip tape to water their plants, which they throw out at the end of each year. Although the solutions to this are limited, there are a few options. Reusable micro-drip irrigation systems can be used if irrigation is absolutely necessary. When irrigation systems are in used, they should be used in conjunction with systems that capture rainwater. However, Michigan receives a large amount of annual rainfall without very high average temperatures. In the case of a drought it may be necessary to provide water for plants, but in most cases the use of good mulch could be sufficient for keeping plants hydrated. Mulches can be made out of many items including plastic, but using natural compostable mulches such as woodchips or grass clippings is preferable. The mulch provides two benefits. It keeps water from evaporating from the soil at the base of the plant and it prevents weeds from growing effectively eliminating the need for harmful herbicides. Even when irrigation systems are used, using mulches can significantly reduce the amount of water needed to maintain crops.

Using these redefined BMPs along with a combination of other sustainable methods will greatly

increase the sustainability of local farms while improving public health and the environment. While it may take time to convince conventional farmers to switch to these sustainable methods, it is crucial to the longevity of the system and necessary in order to have a system that can operate independently of manufactured inputs. It will also reduce the amount of waste from both agriculture and animal husbandry.

Local Food Certification

One optional but potentially important step in localizing the food system would be an independent certification system for local foods. The system would ensure that local foods were grown locally and that processed foods that claimed local ingredients were truthfully advertising. Ideally the system would have tiers of certification that indicated its level of sustainability and, for processed foods, the percentage of local food included. This would give consumers the comfort of knowing that the foods they are buying are local and also give an idea of the sustainability of the foods. While this may prove to be unnecessary, it could ensure accountability of farmers and processors once the local food system becomes too complicated for the consumers to navigate for themselves. As the food system currently stands, it is relatively easy to discover where your local food was grown and many farmers will even welcome you to their farm to see their operations. However, in a larger system it may be less apparent where each item comes from and what practices were used to grow it. Some local food labeling would be necessary in order to allow consumers to exercise preference in the local food market.

Existing organizations like Local Food Plus²¹ of Canada certify locally grown foods. Using social, environmental and economic factors in the certification process, they strive to certify food that is locally and sustainably grown. Like the proposed certification system for Washtenaw County, Local Food Plus considers a wide variety of factors when granting certification. Pre-existing organizations like these can serve as a model for future local certification systems.

²¹ <http://localfoodplus.ca/>

V. Food Realities: Scaling up and Integrating a Local Food System into Regional Context

Up to this point, this assessment has focused predominantly upon the county scale, as that is the approximate geographic scale on which the immediate interests of local farmers play out.

Economically speaking, however, local producers and retailers tend to create their niches within a food system that is designed to work at larger scales (Maye & Ilbery, 2006). This section is devoted to envisioning the potential economic forces inherent to the relationship between the local scale and other scales. It concludes by evaluating some business solutions for food policy's most significant target demographic, new farmers.

Trading off Small Scale and Comparative Advantage

Comparative advantage is the driving force of any economic landscape. It creates exchange and trade between areas with different strengths and fuels the growth of economies, as well as a general tendency towards increase in the scale and extent of an economy's operations.

The emergent problem with *centralized* large-scale systems, enabled by low transport costs and large returns to scale, is that the degree of comparative advantage required to turn a competitive profit in the large scale is often too high for local food businesses to survive everywhere. Once a single region has achieved an economy of scale, little incentive exists to invest in infrastructure anywhere else until that region's capacity is exhausted (Krugman, 1990). This results in wasted opportunities to capitalize on smaller advantages.

Fruit production in Western Michigan is a good example of this type of situation. Producing fruit in Western Michigan is currently an underdeveloped opportunity, but not because of a lack of comparative advantage with respect to the rest of Michigan. Rather, fruit production in Western Michigan is not competitive against producing fruit in Florida or California. The paradox is that fruit production in California's Central Valley carries a much higher environmental cost than fruit production in Western Michigan does because water is limited in California. Over the long term it would be more economically robust and environmentally sound for the nation as a whole to have its fruit production distributed over multiple productive regions, of which Western Michigan is one. Yet development of infrastructure in other regions is lacking because it costs less to produce the next crate of fruit in California where the economies of scale have already been reached.

But under a peak-oil scenario, what would happen to such a system and the actors within it when a national-scale economy becomes increasingly inaccessible due to prohibitively high transport costs? Thinking in terms of comparative advantage, peak oil will create opportunities for the development of regional resources as goods from far away become more and more expensive to transport. Even if national-scale dynamics of comparative advantage do not inherently diminish, rising transport costs will likely result in an overall *decentralization* of the American agricultural production landscape (Krugman, 1990). Investing in local and regional food systems infrastructure is a way of preparing for this more decentralized future.

In Southeastern Michigan, such efforts will help build enough capacity and increase local supply to the 10% milestone. But past that point, small differences in price or quality will make or break the mainstreaming of local food. Further inroads will require local food businesses to diversify their products and expand their offerings to cover a wider range of consumer food demands. How can comparative advantage be created and maintained within the small scale of an intentionally localized food system?

One option is to specialize on a small scale. Transition Town Totnes has adopted this approach

by ordaining itself the Nut Capital of Britain²²; Washtenaw County might support more specialties, including nuts, wheat, meat, cheese, and micro brewed alcoholic beverages. This approach sets the stage for other towns and counties to follow suit and choose different specializations when localizing their own food systems.

Another possible option is for local food system actors to systematically cut out enough resellers. Large-scale systems rely on many resellers to move a large volume of goods, and consumer trust is lost along the way. Even if the profit margins are smaller on each unit, a large enough volume of goods is being moved that there is still more economic room for resellers to eke out their business. In contrast, smaller-scale systems just don't have room for that many resellers. Fixed transaction costs accrue too quickly for the small volume of goods to offset. High transaction costs lead to vertical coordination in food systems (Frank and Henderson, 1992). In the context of localization, this naturally advantages the survival of communally managed, low-maintenance information centers that directly connect producers with processors and retailers, and keep the web of consumer trust tight.

Cutting out resellers can happen naturally as a result of the vertical integration of local food systems. For example, existing farmers already look to processing as a side business, because the value added to their produce from processing is often a more stable source of revenue than the actual produce itself (Michael Score, former Washtenaw County Extension agent, pers. comm.). Distribution and retailing is another pair of activities that often occur under the same roof, as the existence of large wholesale retailers like Costco and Sam's Club attests. Every agent in a local food system benefits from a limited degree of vertical integration.

Know Your Farmers, Trust Your Distributors and Grocers

Under the vision presented above, the kinds of commercial ventures that food system stakeholders undertake are limited by the propagation of information. The centralization and effective diffusion of information is key to the functioning of a more local food system. Buck et al., (2007) have found that the most consistent barrier perceived by Southeastern Michigan producers, processors, distributors, and retailers alike in a local food system is the time they would have to spend seeking out and dealing with other food system agents. One would expect that this would be especially true for new farmers, who already bear the highest capital risk and work for the lowest margins of any food system actor.

The Western Michigan Co-op is a good example of an organization that has emerged to fill these informational gaps. This Co-op started as a side project run by its owner, who was inspired by the inconveniences that his wife, a restaurateur, suffered to source local foods for her restaurant from five different local farms. Over the years, the Western Michigan Co-op has managed to arrive at a business model which preserves the personal nature of direct sales while achieving an economy of scale for information through centralization.

The two-chambered heart of the Western Michigan Co-op's operations comprises its database and its distribution model. The Co-op meets once every month. Each producer posts their available goods to the Co-op's database two weeks ahead of the meeting day; each buyer sees all of the goods for sale and submits their orders directly to the Co-op's database by one week ahead of the meeting day.

The Co-op then distributes lists of orders to the producers. On the day of the meeting, the producers bring their goods, pre-packaged into the ordered quantities. The buyers go to the Co-op's central desk, pay for their orders, pick up their invoice and claim their produce from the stands of each of the producers from whom they have ordered products. The Co-op then cuts checks to the producers for the total value of goods that were ordered. This low-infrastructure provides a low-risk proving ground for newer producers who seek to make an entrance into the local foods marketplace.

²² <http://www.transitiontowntotnes.org/Food/TotnesTheNutCapitalOfBritain>

In recent years the local food movement in Ann Arbor has also made market gains. Already the local food movement in Washtenaw County has managed to extend itself from those consumers who “buy their produce from Goetz Farms and their poultry from Harnois Farms” to include people who now “buy their local food at the farmer’s market.” The next step is not to go backwards and cultivate more personal relationships between farmers and consumers. Instead, future efforts should try to bring local food one more step towards the consumer, making it possible for even more people to “buy their local produce at their local grocer’s”.

Golden Bowl is a retailer in Fresno, the heart of California’s fruit-growing Central Valley. Its owners operate a single store that specializes in selling ethnic Hmong goods including hardware, clothing, imported frozen goods, and fresh produce. Most of the specialty ethnic produce is sourced from Hmong farmers who farm locally. For Golden Bowl, buying local keeps costs down. Customers naturally trust that whatever seasonal produce the store sells is local. There is no luxury premium for local food.

These case studies are presented because they exemplify commercial operations that are advantageous to new farmers. In the Western Michigan Co-op, trust is implicitly extended from the buyer through the Co-op itself to any new producer that enters that marketplace. In this way, the Western Michigan Co-op fulfills the mission of the “Gatherer” proposed by (Bush, Graul, & Luria, 2009), acting as “a sommelier of local produce,” facilitating the efficient marketing of local foods. Similarly, Golden Bowl is a local grocer that deals with local producers. Golden Bowl’s customers trust that store’s managers to deal with local farmers for local food, which in turn enables local farmers to sell local produce at Golden Bowl without having to invest the time in making personal contact with each and every consumer. Both of these extremely brief case studies represent design patterns for businesses that could thrive in Washtenaw County and would help attract the next generation of new farmers and help them establish their businesses.

Chapter 4: Conclusions and Summary

The major purpose of this project is to give the citizens and the City of Ann Arbor a roadmap for localizing Washtenaw County's food system. Extensive previous work provides excellent background information about the current state of Washtenaw County's food system and how its local food businesses can be supported. The aims of the current research are:

1. To further strengthen the case for localizing food systems with
 - a. more detailed monetary estimates of the supply and demand of local food, as well as
 - b. new estimates of the amount of land and labor that might need to be committed to the production of local food,
2. To evaluate Washtenaw County's production landscape and the potential effectiveness of the Greenbelt initiative in supporting the development of local food infrastructure,
3. To envision the potential future development of a locally integrated food system in Washtenaw County based upon the present and previous studies, and
4. To propose new directions for city policy, citizen action, and business development consistent with that vision.

How much money is in local food?

The economic benefits of localizing the county's food system would be large. Consumers in Washtenaw County spend about \$900 million on food annually, of which about \$70 million is eventually received by a farmer (i.e., farmgate demand). Of that \$70 million farmgate demand, \$1.8 million is direct local sales. Thus Washtenaw County currently consumes about 3% local food; out of every \$100 that farmers somewhere receive of Washtenaw County food expenditures, Washtenaw County farmers receive \$3.

Comparing the balance of supply and demand in different food groups makes clear a broad mismatch across the food groups. Washtenaw County exhibits a typical Midwestern production landscape, with just under 100,000 acres, over half of the county's cropland, devoted to corn, soybeans and wheat, the main agricultural exports. In contrast, vegetables and fruits are grown on only about 2,000 acres in the county, and they constitute a very value-intensive sector of the imports. The amount of land that will need to be dedicated to vegetable and fruit production will need to quadruple to an estimated 8,000 acres in order to meet current local demand, and will need to increase even further to meet future demand for healthier foods.

Since Washtenaw County farmers only gross about \$55 million in food-related agricultural sales, Washtenaw County is currently an importer of food value. It seems intuitively strange that a county such as Washtenaw County, which currently devotes over 40% of its land area to agriculture, should be an importer of food value. Even with no changes to its production landscape, Washtenaw County is capable of sourcing up to 40% of its food locally, compared to the current 3%. This would account for an additional approximately \$25 million in local agricultural sales annually and about \$200 million of economic activity annually from the development of locally owned processing, distribution, and retailing of those goods. Changes in the County's production landscape could further increase the percentage of local food purchased from 40% to well over a majority.

Can Ann Arbor feed itself?

A foodshed is the area from which a population center derives its food needs. A transport model that minimizes the distance that food travels from farmgate to table shows that the likely extent of Ann Arbor's potential foodshed is quite literally larger than the Greenbelt's boundary extent, regardless of the dietary assumptions underlying the model. Ann Arbor's foodshed is also, figuratively, expanded outwards towards the west of the County, driven by conflicts with the foodsheds of neighboring population centers to the east, especially Metro Detroit's foodshed.

Washtenaw County does not currently have enough agricultural land to feed itself, regardless of diet. The predicted shortfall would be significantly smaller if residents were to eat a vegetarian diet. While most of the economic benefit of localization could be captured with only a relatively small land commitment, the labor commitment would be larger. Several thousand agricultural workers would likely be required. Despite these results, it is still reasonable for Ann Arbor to source most of its food from Washtenaw County itself. However, it will be necessary for the City to assume a position of leadership within the county and propose stronger and larger countywide measures if it is serious about farmland preservation and farmer preservation for its own foodshed.

What might the future look like?

Against this backdrop, the current challenge is to cultivate a new, locally integrated, and sustainable food system operating alongside the current food system, something that will eventually supplant and succeed the current system. Reference is made to a locally integrated food system as a way of acknowledging that a completely local food system is not likely to operate alongside the current food system without being utterly marginalized by it. Simultaneously, this alternate vision of local integration can be held to the highest standards of sustainability, which is fully environmental, social, and economic in nature.

One compelling vision for the future of local food in Washtenaw County involves growing this new system in four stages: infrastructure investment, vertical integration, expansion of operational scale, and regional specialization. This vision is based upon analogy with patterns of development in rural non-farm sectors of developing countries, which follow a similar pattern of productivity increase, investment in human and social capital, expansion of scale, and regional specialization.

Stage 1: Infrastructure Investment to expand Supply

At this stage, local food system actors are still making local niches within a larger food system. Investment is being made in production infrastructure and producer organization to increase available supply. Local food carries a high luxury premium due to limited supply. Less than 10% of food consumed is local in origin.

Stage 2: Vertical Integration to Achieve Competitiveness

This stage is characterized by vertical integration within the local food system, cutting out the many resellers of the larger-scale system. Producer cooperatives jump-start local distribution. Price premiums for local food drop sharply once consumers obtain better and wider access to local food through multiple distributional channels. More than 10% of food consumed is local in origin. Programs that increase consumer demand start to become very effective.

Stage 3: Scaling Up to Meet Demand

This stage is characterized by an expansion of local food operations. Producers aim to achieve competitive economies of scale that enable them to compete for mainstream retail channels and undercut the prices of imported food; up to 50% of food consumed may be local in origin.

Stage 4: Local Specialization defines Regional Role

This stage is characterized by specialization of the local food businesses. Local processors settle and stabilize; thematic local specialization within a new regional economy becomes well defined. A certification agency for local food may become necessary. Most of the high-value items of a healthy diet are local in origin, and the majority of the remainder is accounted for by regional imports. Regional exports and imports form a solid base of economic activity for the region as a whole.

This study only seriously considers those options that would be implementable with minimal funding. Executing this four-stage plan will likely span 20-30 years of local food systems development and will involve the participation of many new stakeholders and the formation of many new businesses and enterprises. The training and settling of new farmer-entrepreneurs will likely be the most time-consuming of these processes. If the localization of food systems is to be achieved on an accelerated time scale as a civic response to a major stressor such as peak oil, then more urgent financial commitment from City and county governments to attract and stabilize new farmers may be necessary to achieve a smooth transition.

Currently only the steps involved in the first stage, production infrastructure investment, can be outlined in detail. Key among these is the establishment of a producer's cooperative, whose responsibility it is to market the agricultural products of new farmers, and provide a single contact point for any processor, retailer, distributor, or institutional buyer to reach all of the local farmers in this region.

Having studied the state of the food system as it currently stands, and evaluated some of the options that exist going forward, the vision has so far been mostly the authors'. It would be wholly inappropriate for a few individuals to write a community action plan. Thus, the next step is to hold a community visioning session focused upon the county's food system, wherein community organizing will craft a more truly shared vision of the future. This shared vision will necessarily be even more extensive and detailed than the one reported here, having been better informed by the emerging studies done on the topic of intentionally localizing food systems in southeastern Michigan.

What about Regionalization? by Daniel Poon

I have lately found that when I read commentary written by actual farmers, as opposed to policymakers or academics like myself, I will more often hear talk about the “regionalization”, as opposed to the “localization”, of food systems. Exactly what sort of spatial extent constitutes a natural region is a topic that remains quite unresolved within the academic community, and depends highly on the particular commodity being discussed, but a “region” is always bigger than a “locality”.

In principle many of the driving factors for an economic reorganization along regional lines are the same as those given for localization: sustainability, regional economic welfare, pride in regional culture, and the like. The difference tends to be a recognition that for certain economies, such as the production, processing, and distribution of meat, the local scale is just too small; costs accumulate too quickly, and economies of scale can't be reached that are competitive with vertically integrated meat suppliers operating on a national scale. That is to say, some proponents of regionalization are people that have already attempted the economic dimension of localization and have concluded from their experience that localization is economically unsustainable for their sector.

Our own analysis has independently mirrored the intuition is that the scale on which “local food” ought to be tackled is somehow bigger than the local, so we've taken to calling it “locally integrated” instead. (We're not quite ready to give up on the idea, you see.) But taking for a moment the premise that “regionalization” might eventually emerge as a more workable solution, how big might such a “region” be?

I offer one system for consideration. When I first explained to my mother that I was studying local food systems for my opus, she immediately responded, “Oh, I know what you're talking about. That's just like what we used to have in Taiwan.”

She then proceeded to detail a production landscape of her hometown of Lo-Tung, Taiwan. Back in her childhood, Lo-Tung specialized in producing rice. A neighboring town, Wu-Jie (Five Knots), produced vegetables, and Nan-Fang-Au (South Bay) specialized in fishing. All of these towns were within 7 miles of each other, yet each was distinct enough to be a separate locality. Each had its own specialization within the region, and these local specializations created comparative advantage within their region.

As in Southeast Michigan today, it took far too much time for farmers to deal directly with all of their potential customers. These included household buyers who wanted the firsts of the produce, restaurants who wanted the seconds, and processors who wanted the thirds. Instead, the task of selling the produce within this system was communalized and dealt with by a producer cooperative, which would not only deal with the town's own buyers and processors; it would also deal with regional distributors who were responsible for marketing the special goods that each town produced to all of the buyers in the markets in the other towns.

Since my mother's childhood, population growth has caused these towns to sprawl into each other. They are now barely distinct. There are also many more people living in that area than there were in my mother's childhood. The region no longer produces enough food to feed itself, but now has enough money to import its food from abroad. Improvements in transportation infrastructure have blurred the economic distinctions that formerly existed between these places, and producer cooperatives in the region largely failed due to their inability to compete economically against the low prices offered by imported food from abroad.

What inspiration might we take from this as we envision our own future local food system?

To start on a general note, a homogeneous production landscape without specialization is an economic landscape with no internally exploitable gradients and no natural internal boundaries. There would be no reason to expect that distributors would find any advantage to operate within such a system. On the other hand, a regional system with internal diversity and local specializations would not only attract distributors; it would ensure their survival, as they would have a significant informational advantage over any larger-scale competitors who sought to break into their home-turf market. Perhaps we have to cultivate comparative local advantage within an otherwise homogeneous region in order to make it stable and sustainable.

So on one hand we might want to consider specialization on an even finer geographic scale than we've considered so far, down to what we Americans might consider neighborhoods. Maybe Dixboro should be growing grain, and Pittsfield Township raising chickens, and Chelsea producing vegetables, and Dexter planting barley and brewing beer. On the other hand, maybe we should be instead thinking about how Southeastern Michigan can produce grain for Michigan as a whole, buy its peaches from Western Michigan and fuel its biomass energy power plants with feedstock from the Upper Peninsula.

Or maybe both.

Appendices

Appendix A: Large Maps and Charts

Contents:

- A-1. Washtenaw County: Cropland Use
- A-2. Washtenaw County: Land Use and Population Centers
- A-3. Washtenaw County: Soils and Productivity
- A-4. Ann Arbor's Potential Foodsheds:
 - a. Vegetarian Scenario
 - b. Meat-Eating Scenario

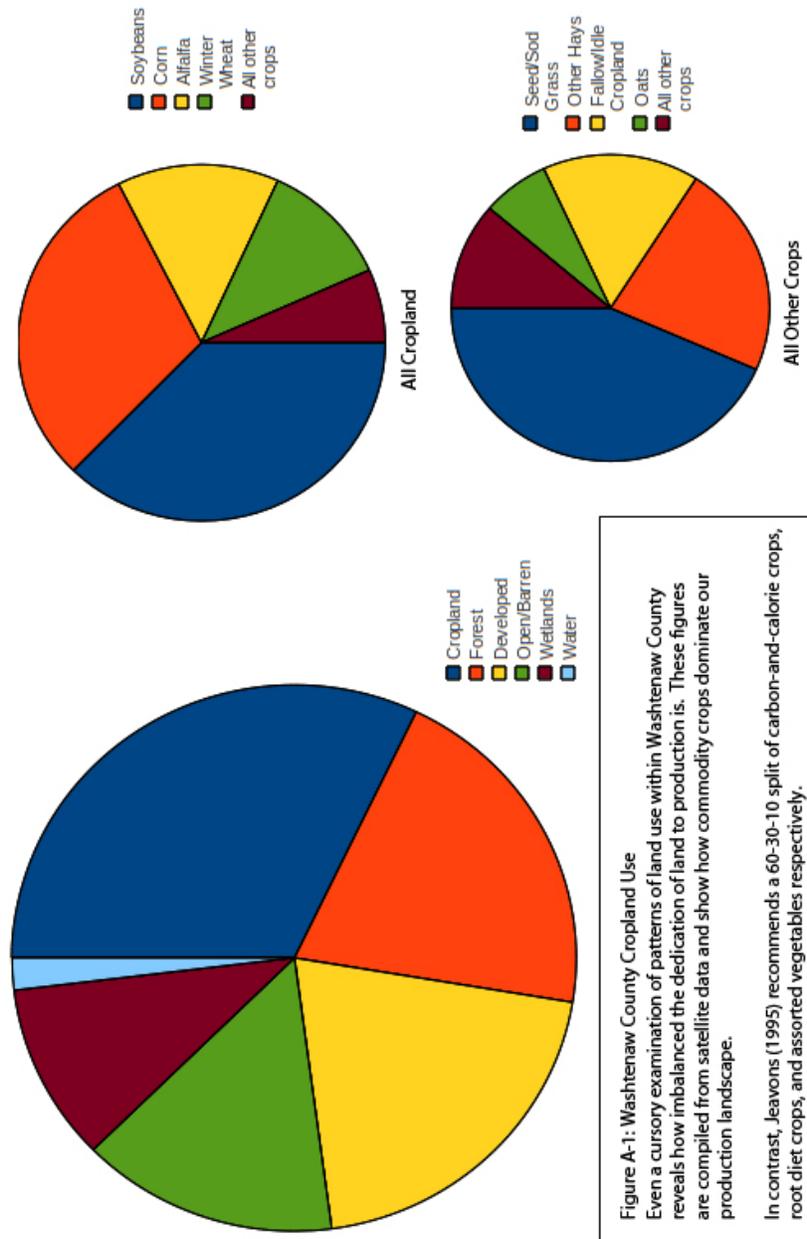
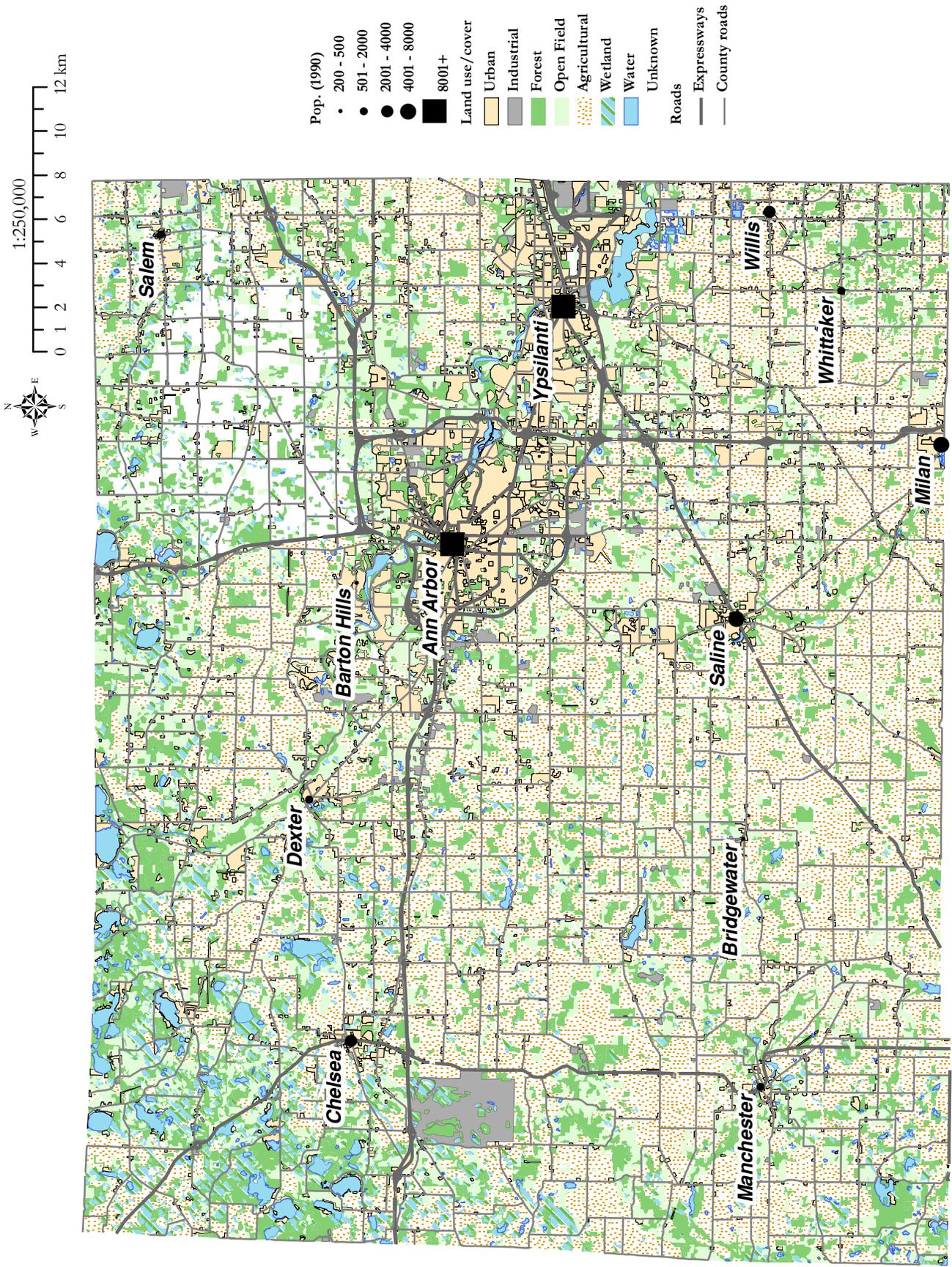


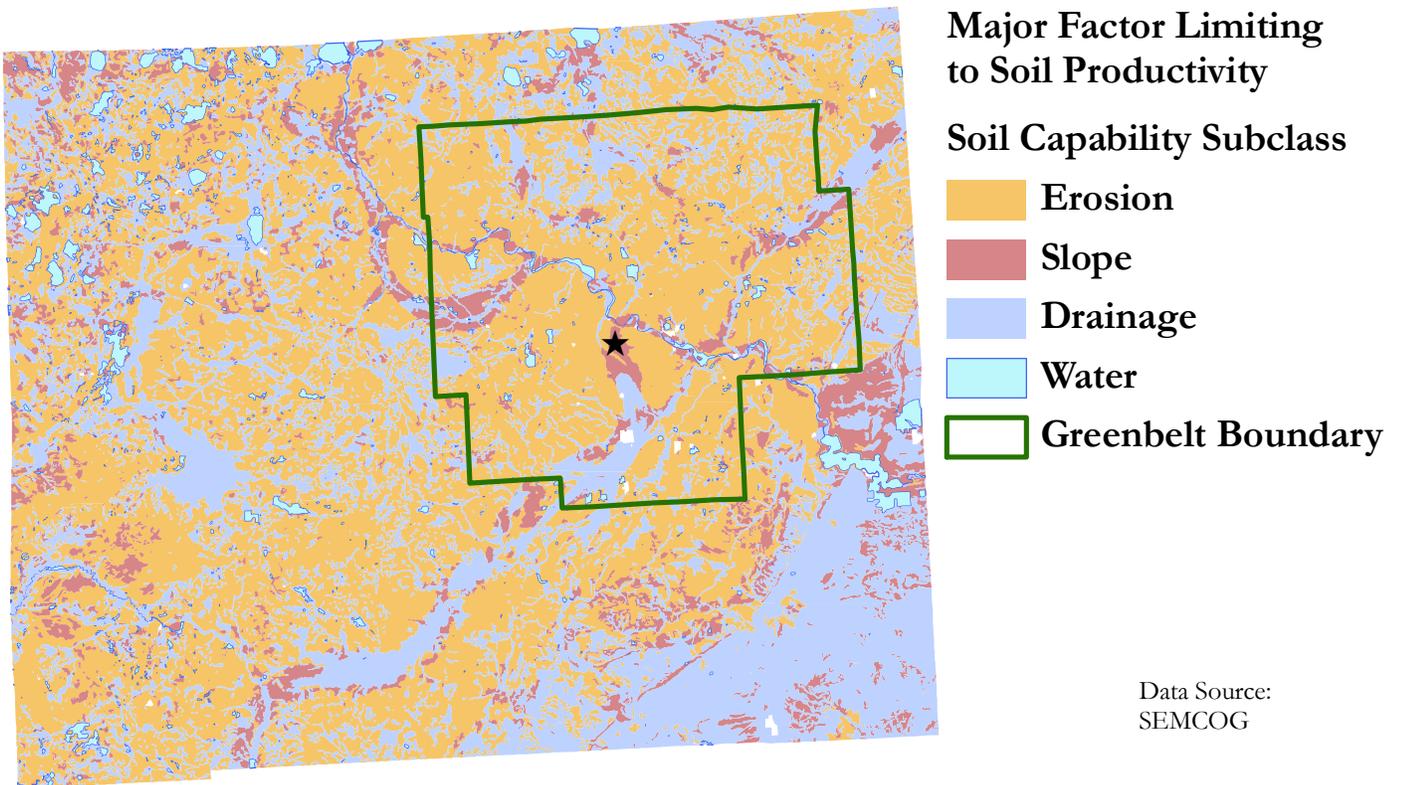
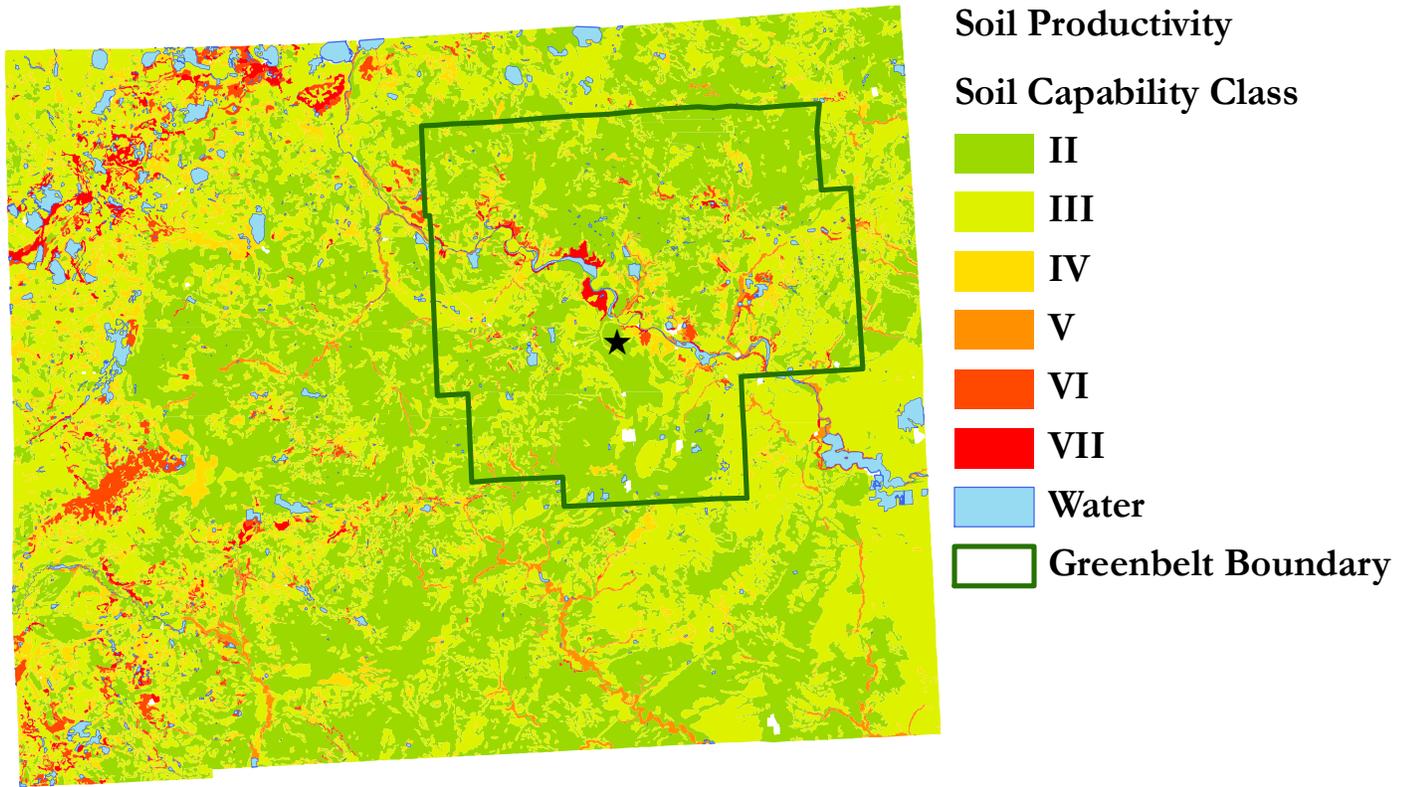
Figure A-1: Washtenaw County Cropland Use
 Even a cursory examination of patterns of land use within Washtenaw County reveals how imbalanced the dedication of land to production is. These figures are compiled from satellite data and show how commodity crops dominate our production landscape.
 In contrast, Jeavons (1995) recommends a 60-30-10 split of carbon-and-calorie crops, root diet crops, and assorted vegetables respectively.

Figure A-2: Washtenaw County: Land Use (2000) and Population Centers



Source data:
SEMCOG

Figure A-3: Washtenaw County Soils: Productivity and Productivity-Limiting Factors

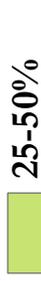


Data Source:
SEMCOG

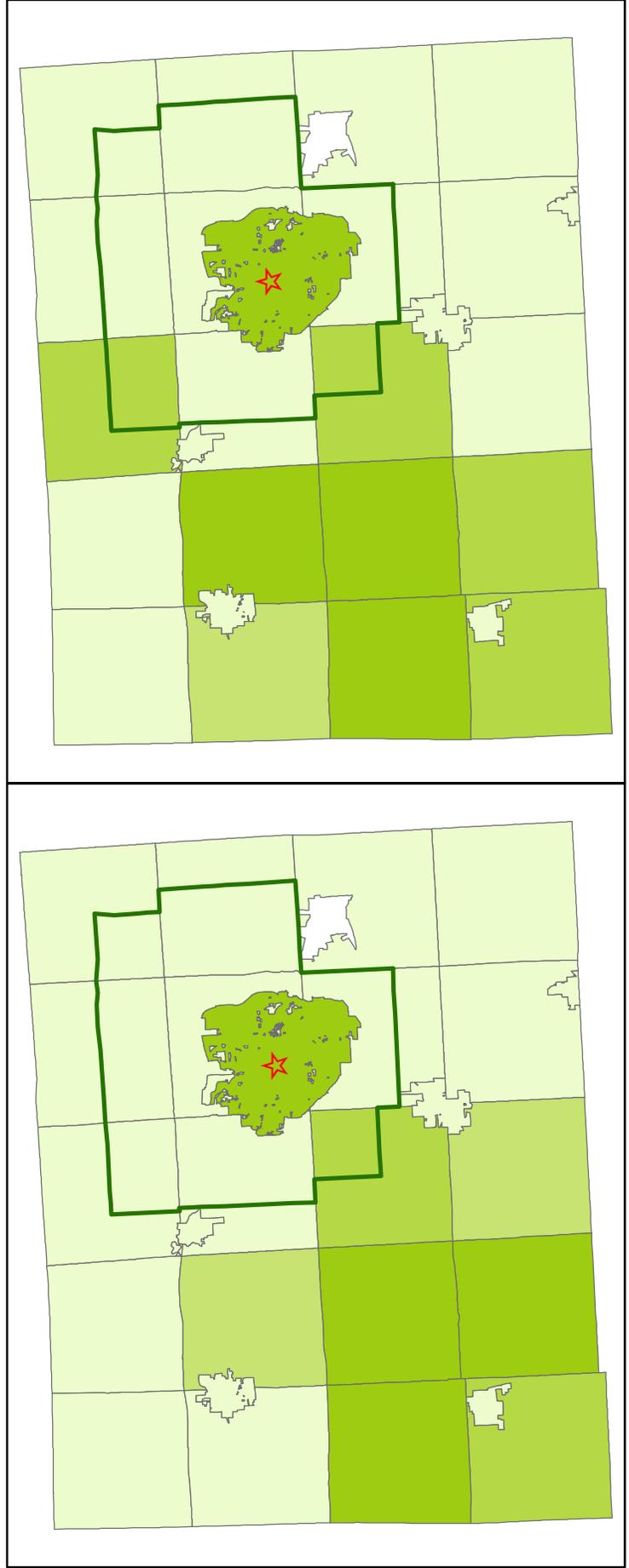
The 1977 Washtenaw County Soil Survey separated all of the soils underlying this county into six classes which reflect their potential agricultural productivity (II - VII, lower being better) and three subclasses which reflect the factors limiting productivity.

Figure A-4a: Ann Arbor's Potential Foodsheds (Vegetarian Scenario)

Legend

-  **Greenbelt Boundary**
-  **0%**
-  **0-25%**
-  **25-50%**
-  **50-75%**
-  **75-100%**

Using the methodology of (Peters et al., 2009) we modeled food transport directly from farmgate to table. Depth of color within each municipality shows the proportion of agricultural land consumed by Ann Arbor's foodshed. Ann Arbor marked with a star; Greenbelt boundaries in green. Only land currently used for agriculture considered for production. Assumed 0.625 acre land required per capita (vegetarian diet). Analysis extent including Detroit Metro area (left), restricted to Washtenaw County (right).





0 5 10 20 Miles

Legend

-  **Greenbelt Boundary**
-  **0%**
-  **0-25%**
-  **25-50%**
-  **50-75%**
-  **75-100%**

Using the methodology of (Peters et al., 2009) we modeled food transport directly from farmgate to table. Depth of color within each municipality shows the proportion of agricultural land consumed by Ann Arbor's foodshed. Ann Arbor marked with a star; Greenbelt boundaries in green. Only land currently used for agriculture considered for production. Assumed 1 acre land required per capita (meat-eating diet). Analysis extent including Detroit Metro area (left), restricted to Washtenaw County (right).

Figure A-4b: Ann Arbor's Potential Foodsheds (Meat-Eating Scenario)

How much food from the meat & beans group is needed daily?

The amount of food from the Meat and Beans Group you need to eat depends on age, sex, and level of physical activity. Most Americans eat enough food from this group, but need to make leaner and more varied selections of these foods. Recommended daily amounts are shown in the chart.

Daily recommendation*		
Children	2-3 years old	2 ounce equivalents**
	4-8 years old	3 – 4 ounce equivalents**
Girls	9-13 years old	5 ounce equivalents**
	14-18 years old	5 ounce equivalents**
Boys	9-13 years old	5 ounce equivalents**
	14-18 years old	6 ounce equivalents**
Women	19-30 years old	5 ½ ounce equivalents**
	31-50 years old	5 ounce equivalents**
	51+ years old	5 ounce equivalents**
Men	19-30 years old	6 ½ ounce equivalents**
	31-50 years old	6 ounce equivalents**
	51+ years old	5 ½ ounce equivalents**

How many grain foods are needed daily?

The amount of grains you need to eat depends on your age, sex, and level of physical activity. Recommended daily amounts are listed in the chart. Most Americans consume enough grains, but few are whole grains. At least ½ of all the grains eaten should be whole grains.

		Daily recommendation*	Daily minimum amount of whole grains
Children	2-3 years old	3 ounce equivalents**	1 ½ ounce equivalents**
	4-8 years old	4 – 5 ounce equivalents**	2 – 2 ½ ounce equivalents**
Girls	9-13 years old	5 ounce equivalents**	3 ounce equivalents**
	14-18 years old	6 ounce equivalents**	3 ounce equivalents**
Boys	9-13 years old	6 ounce equivalents**	3 ounce equivalents**
	14-18 years old	7 ounce equivalents**	3 ½ ounce equivalents**
Women	19-30 years old	6 ounce equivalents**	3 ounce equivalents**
	31-50 years old	6 ounce equivalents**	3 ounce equivalents**
	51+ years old	5 ounce equivalents**	3 ounce equivalents**
Men	19-30 years old	8 ounce equivalents**	4 ounce equivalents**
	31-50 years old	7 ounce equivalents**	3 ½ ounce equivalents**
	51+ years old	6 ounce equivalents**	3 ounce equivalents**

How much fruit is needed daily?

The amount of fruit you need to eat depends on age, sex, and level of physical activity. Recommended daily amounts are shown in the chart.

Recommended amounts are shown in the table below.

Daily recommendation*		
Children	2-3 years old	1 cup**
	4-8 years old	1 to 1 ½ cups**
Girls	9-13 years old	1 ½ cups**
	14-18 years old	1 ½ cups**
Boys	9-13 years old	1 ½ cups**
	14-18 years old	2 cups**
Women	19-30 years old	2 cups**
	31-50 years old	1 ½ cups**
	51+ years old	1 ½ cups**
Men	19-30 years old	2 cups**
	31-50 years old	2 cups**
	51+ years old	2 cups**

How many vegetables are needed daily or weekly?

Vegetable choices should be selected from among the vegetable subgroups. It is not necessary to eat vegetables from each subgroup daily. However, over a week, try to consume the amounts listed from each subgroup as a way to reach your daily intake recommendation.

The amount of vegetables you need to eat depends on your age, sex, and level of physical activity. Recommended total daily amounts are shown in the first chart. Recommended weekly amounts from each vegetable subgroup are shown in the second chart.

Daily recommendation*		
Children	2-3 years old	1 cup**
	4-8 years old	1 ½ cups**
Girls	9-13 years old	2 cups**
	14-18 years old	2 ½ cups**
Boys	9-13 years old	2 ½ cups**
	14-18 years old	3 cups**
Women	19-30 years old	2 ½ cups**
	31-50 years old	2 ½ cups**
	51+ years old	2 cups**
Men	19-30 years old	3 cups**
	31-50 years old	3 cups**
	51+ years old	2 ½ cups**

How much food from the milk group is needed daily?

The amount of food from the Milk Group you need to eat depends on age. Recommended daily amounts are shown in the chart.

Daily recommendation		
Children	2-3 years old	2 cups*
	4-8 years old	2 cups*
Girls	9-13 years old	3 cups*
	14-18 years old	3 cups*
Boys	9-13 years old	3 cups*
	14-18 years old	3 cups*
Women	19-30 years old	3 cups*
	31-50 years old	3 cups*
	51+ years old	3 cups*
Men	19-30 years old	3 cups*
	31-50 years old	3 cups*
	51+ years old	3 cups*

How much is my allowance for oils?

Most Americans consume enough oil in the foods they eat, such as:

- nuts
- fish
- cooking oil
- salad dressings

A person's allowance for oils depends on age, sex, and level of physical activity. Daily allowances are shown in the chart.

Daily allowance*		
Children	2-3 years old	3 teaspoons
	4-8 years old	4 teaspoons
Girls	9-13 years old	5 teaspoons
	14-18 years old	5 teaspoons
Boys	9-13 years old	5 teaspoons
	14-18 years old	6 teaspoons
Women	19-30 years old	6 teaspoons
	31-50 years old	5 teaspoons
	51+ years old	5 teaspoons
Men	19-30 years old	7 teaspoons
	31-50 years old	6 teaspoons
	51+ years old	6 teaspoons

How many discretionary calories can I have?

The discretionary calories allowance is based on estimated calorie needs by age/sex group. Physical activity increases calorie needs, so those who are more physically active need more total calories and have a larger discretionary calorie allowance. The discretionary calorie allowance is part of total estimated calorie needs, not in addition to total calorie needs. The chart gives a general guide.

Age and sex	Not physically active*		Physically active**	
	Estimated total calorie need	Estimated discretionary calorie allowance	Estimated total calorie need	Estimated discretionary calorie allowance
Children 2-3 years old	1000 calories	165***	1000-1400 calories	165 to 170
Children 4-8 years old	1200-1400 calories	170***	1400-1800 calories	170 to 195
Girls 9-13 years old	1600 calories	130	1600-2200 calories	130 to 290
Boys 9-13 years old	1800 calories	195	1800-2600 calories	195 to 410
Girls 14-18 years old	1800 calories	195	2000-2400 calories	265 to 360
Boys 14-18 years old	2200 calories	290	2400-3200 calories	360 to 650
Females 19-30 years old	2000 calories	265	2000-2400 calories	265 to 360
Males 19-30 years old	2400 calories	360	2600-3000 calories	410 to 510
Females 31-50 years old	1800 calories	195	2000-2200 calories	265 to 290
Males 31-50 years old	2200 calories	290	2400-3000 calories	360 to 510
Females 51+ years old	1600 calories	130	1800-2200 calories	195 to 290
Males 51+ years old	2000 calories	265	2200-2800 calories	290 to 425

Appendix C: Specification of the Transport Model in GNU MathProg

```
/*
===== The Transport Model =====
Created Thursday 20 January 2011

This model seeks to minimize food distance =
sum over destination zones ( sum over source zones ( transport to that zone * distance of transport ))
by varying amount of food shipped between source zones and destination zones.

Important things to know about this model file:

This model file relies on the presence of two supplementary files:
"ZonePopAgland.csv"; a csv file, delimited with commas, that contains three fields:
ZONES : contains names of populated production zones.
POP : the population of the Zone
AGLAND : the amount of land within the Zone

and

"SEMCOG_munis_distances.csv"; a .csv file , delimited with commas, that contains
InputID : contains the name of a source zone
TargetID : contains the name of a destination zone
Distance : the distance between the source point and the destination point.

These files must be located in the same directory as this model file when the model is run.

You need InputID and TargetID to be drawn from the same space as ZONES.

You can easily change the names of the files that are read by the model by changing the respective calls to the filenames, of course.
*/

/*HERE BEGINS THE ACTUAL CODE*/

set ZONES; /* Each Zone contains a population that needs to be fed, and may contain agricultural land as well; */
set ZONESsquared within ZONES cross ZONES; /* this is just to read the distances csv*/

/* constants */

param LandRequired; /*constant, in dimensions of land area/food, unit acres/ton*/
param FeedsHowMany; /*constant, in units of population/food, unit person/ton*/

param Distance {source in ZONES, dest in ZONES}, default 0;
/* the default is necessary because if you take it out there is no way to assign the Distance from a place to itself */

param AgLand {zone in ZONES}; /* represents how much agricultural land is available within each zone, in acres*/
param Population {zone in ZONES}; /* represents how many people live within the bounds of each zone */

table zonesdata IN "CSV" "ZonePopAgland.csv": ZONES <- [ZONE] , Population ~ POP, AgLand ~ AGLAND ;
/* imports the Zone data */

table distances IN "CSV" "SEMCOG_munis_distances.csv": ZONESsquared <- [InputID, TargetID] , Distance ~ Distance ;
/* imports the distances; the usual N^2 * 3 format generated by ArcGIS / Quantum GIS */

/* Decision variables */
var Quantity {source in ZONES, dest in ZONES} >= 0;
/* non-negativity constraint; cannot be omitted */

/* Objective function */
minimize FoodDistance: sum {source in ZONES, dest in ZONES} Distance[source, dest] * Quantity [source, dest] ;
maximize PeopleFed: sum {source in ZONES, dest in ZONES} Quantity[source, dest] * FeedsHowMany;

/* the entire goal: feed as many people while moving as little food as you can, in that order! */
/* Unfortunately, the GNU Mathprog programming language doesn't support
implementation of multiple objective functions;
if it did, one would invert the order of the above two objectives
and have it solve the first, then the second.
As it stands the only objective function that is actually being minimized/maximized is the first one in the list.*/

/* Constraints */
/* N.B. These are the constraints for the case in which the entire area has not enough agricultural land to support the population. */
s.t. WhichLandUsed {source in ZONES} : sum {dest in ZONES} Quantity[source, dest] * LandRequired = AgLand [source];
/* all land used */
s.t. WhichPeopleFed {dest in ZONES}: sum {source in ZONES} Quantity[source, dest] * FeedsHowMany <= Population [dest];
/* no populations overfed */
/* If the entire area actually does have enough land, just move the < from the second constraint to the first. */

solve;

/* This section of code outputs the computed food transport matrix to a .csv, in N^2 * 3 format.*/

table tab_csv {source in ZONES, dest in ZONES} OUT "CSV" "foodXport.csv" :
dest ~ TO, source ~ FROM Quantity[source, dest] ~ FoodShipped;

/* This section of code outputs the computed food transport matrix to a .dbf, in N^2 * 3 format. */
/* .dbf is better for ArcGIS integration. */

table tab_dbf {source in ZONES, dest in ZONES} OUT "xBASE" "SEMCOG_veg.dbf"
"C(30)C(30)N(15,5)" /* declares the type and precision of the fields */
;
dest ~ TO, source ~ FROM Quantity[source, dest] ~ SEMCOGveg;

data: /* THIS SECTION IS THE SECTION YOU CHANGE WHEN YOU WANT TO DO A SENSITIVITY ANALYSIS */

param LandRequired := 0.625; /*constant, in dimensions of land area/food, unit acres/"food ton"*/
param FeedsHowMany := 1; /*constant, in units of population/food, unit person/"food ton"*/

/* As the model is currently constructed, the quotient of these two parameters is the only thing that matters.
It is, however, useful for looking at different kinds of foodsheds (e.g., considering vegetable production only.)
The "food ton" is really loosely defined. It was intended to be relatable to Peters et al.'s concept of tons HNE,
"Human Nutritional Equivalent", but I never built a diet model so this approach doesn't work.*/

end;
```

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