From Rural Ground to Rural Grocery: Designing a local food value chain

by

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ABSTRACT

Present-day food systems in the U.S. are fraught with challenges that have spillover effects ranging from economic hardship of agricultural communities, inequitable access to nutritional foods, asymmetrical distribution of subsidies, and harsh environmental strains. Further contributing to a problematic system is the growing division between urban and rural settings, with the former receiving the majority of attention, planning, resources, and capital investment.

This thesis highlights the need to rethink the relationship between food and spatial planning. In response to more prevalent urban-focused queries that ask, "can food be produced where it is consumed," the author of this work asks, "can food be consumed where it is produced?" to acknowledge issues around food access, nutritional health, and living wages of farmers and food producers.

Through a proposed design-planning approach that integrates lived experience and data analysis, the author offers methodological strategies for food system planning in a rural context. She discusses the role of design at multiple scales, and its importance in participatory food system planning. Lastly, a case study of a Food Hub project in North Central Massachusetts is used to enact the design-planning approach and propose schematic designs.

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for reminding me of the important things.

Charlie's Redhouse Farm (Winchendon, MA). Photo by Author (2021)

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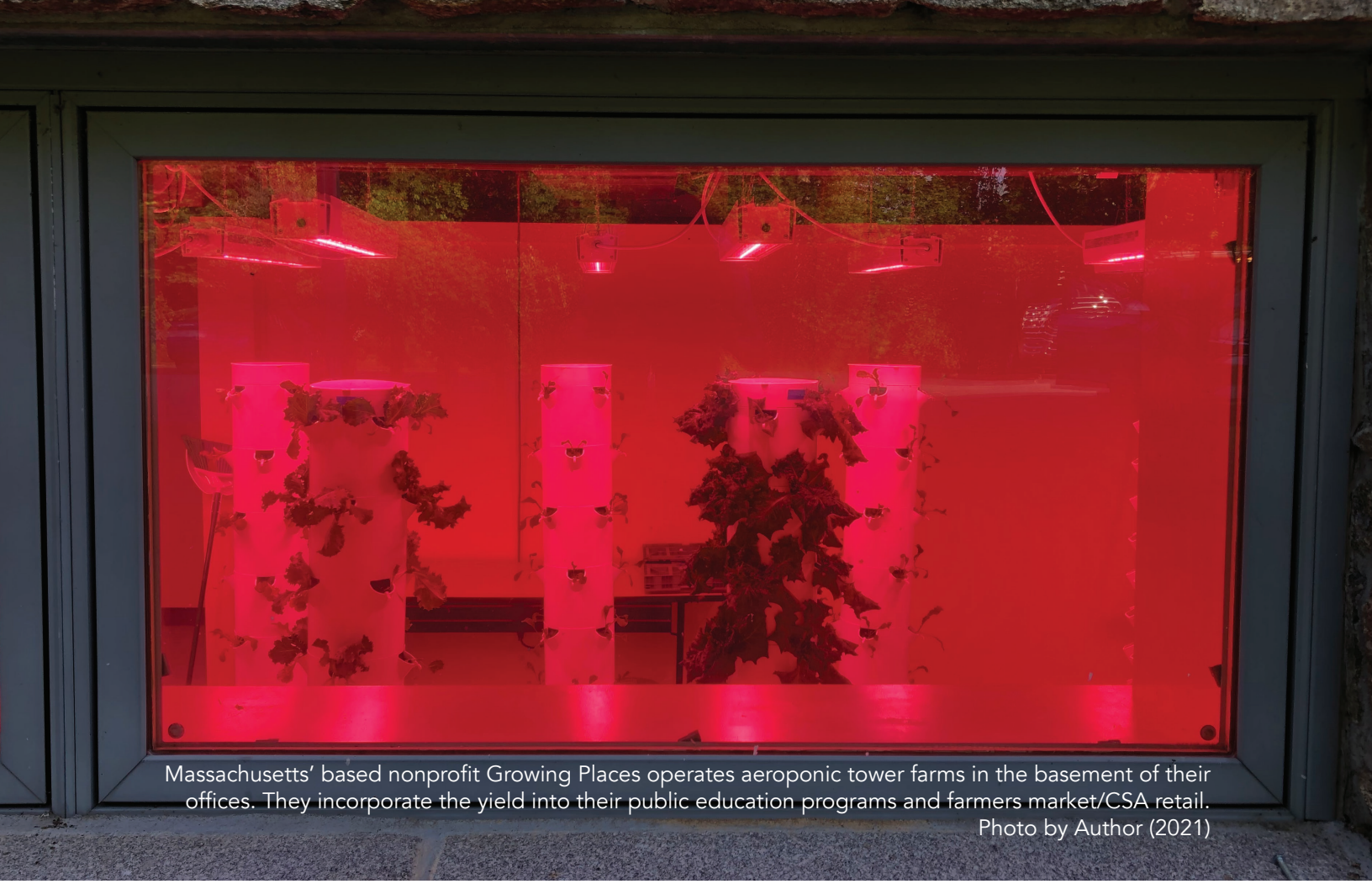


Massachusetts' based nonprofit Growing Places operates aeroponic tower farms in the basement of their offices. They incorporate the yield into their public education programs and farmers market/CSA retail. Photo by Author (2021)

Soil-grown garlic is cured to lengthen its storage time. Photo by Author (2021)

Introduction

In the year following the 2019 coronavirus outbreak, small towns across America saw a glimmer of opportunity. In certain rural regions, so accustomed to the one-directional outmigration of their residents to urban areas, city officials turned their attention to a wholly unexpected phenomenon unfolding across the country: remote work. Suddenly, the usual outmigration started flowing back, as high-skilled employed urban dwellers began moving to small towns and rural areas to escape congested city environments. Officials quickly realized the potential and scrambled to capitalize on their newfound aura, with the aim of not only attracting but retaining this incoming talent. As towns caught on to the economic potential, relocation schemes began offering competitive incentives to lure workers within their tax boundaries.

While each scheme was specific to the host town, the similarities in strategy tell a larger story of small town desperation amid today's patterns of population dispersal and economic development trends across the urban-rural divide in the United States. As reported by Brookings (2018), the top 2% of U.S. communities are consistently growing at rates higher than the rest of the country, and "by the present decade, a clear rank-ordered hierarchy of economic performance by community size [has] emerged."[1]

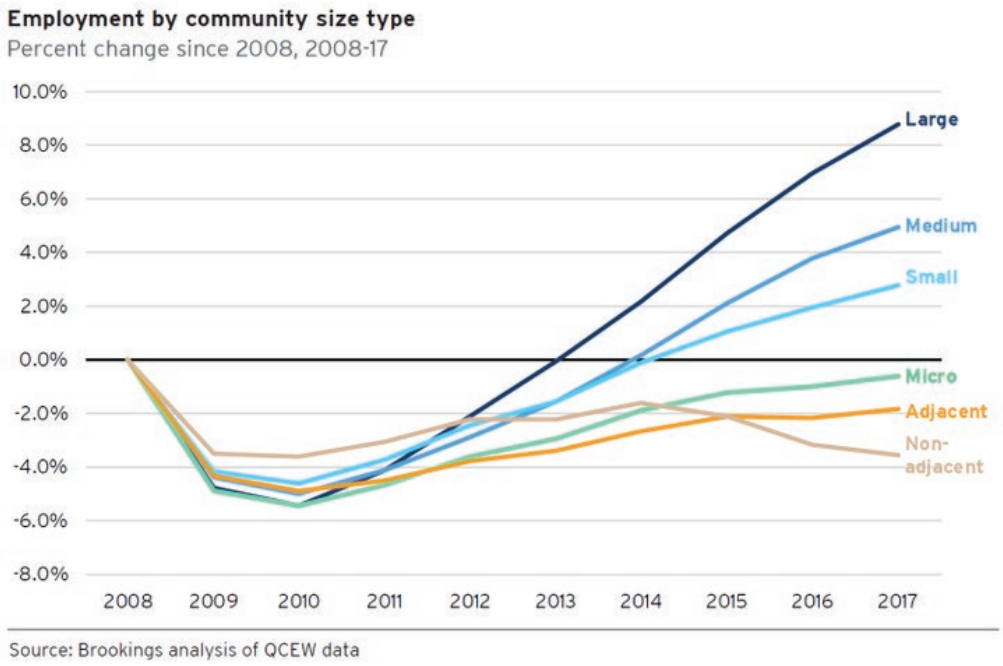


Figure 1. Employment rates increase at a higher rate in large communities than in smaller communities. [Source: Brookings, 2018]

1 Hendrickson, Clara, Mark Muro, and William A. Galston. 2018. "Countering the Geography of Discontent: Strategies for Left-behind Places." https://www.brookings.edu/research/countering-the-geography-of-discontent-strategies-for-left-behind-places/.

The geography of jobs reflects similar distribution patterns. Projecting to 2030, McKinsey predicts that urban areas will experience concentrated job growth, while rural counties are likely to remain stagnant or experience negative growth.[2] Venture capital, in many ways the lifeblood of innovation and job creation, is likewise concentrated with 77.6% of all investments funneled into the top 10 metro areas.[3]

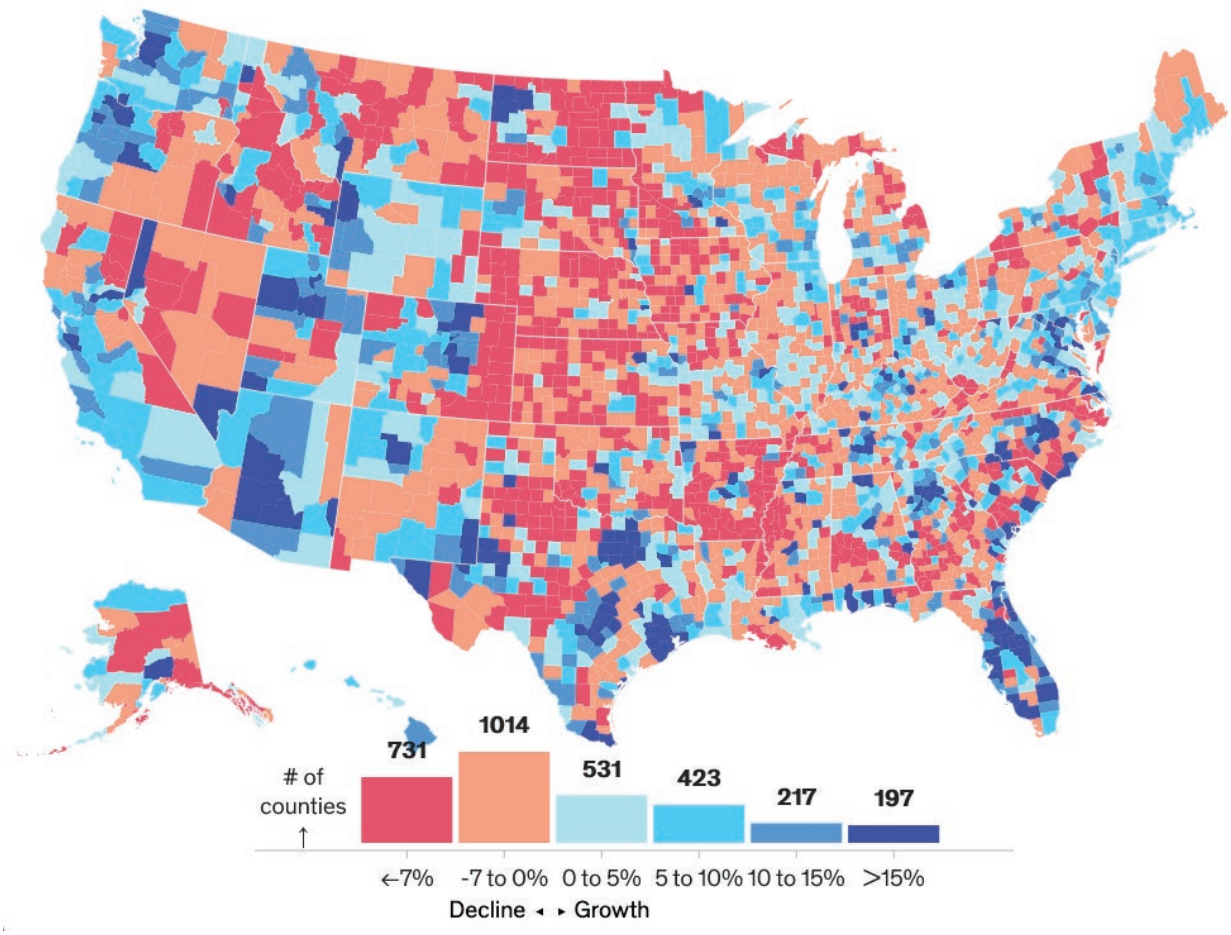


Figure 2. Net job growth is projected for urban cores, urban peripheries, niche cities, and mixed middle areas. Rural areas are overwhelmingly predicted to experience job stagnation or decline. [Source: McKinsey, 2017]

2 Lund, Susan, James Manyika, Liz Hilton Segel, Bryan Hancock, Scott Rutherford, and Brent Macon. 2019. "The Future of Work in America: People and Places, Today and Tomorrow." https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-in-america-people-and-places-today-and-tomorrow.

3 Florida, Richard. 2016. "A Closer Look at the Geography of Venture Capital in the U.S." Bloomberg CityLab, February 2016. https://www.bloomberg.com/news/articles/2016-02-23/the-geography-of-venture-capital-in-the-u-s.

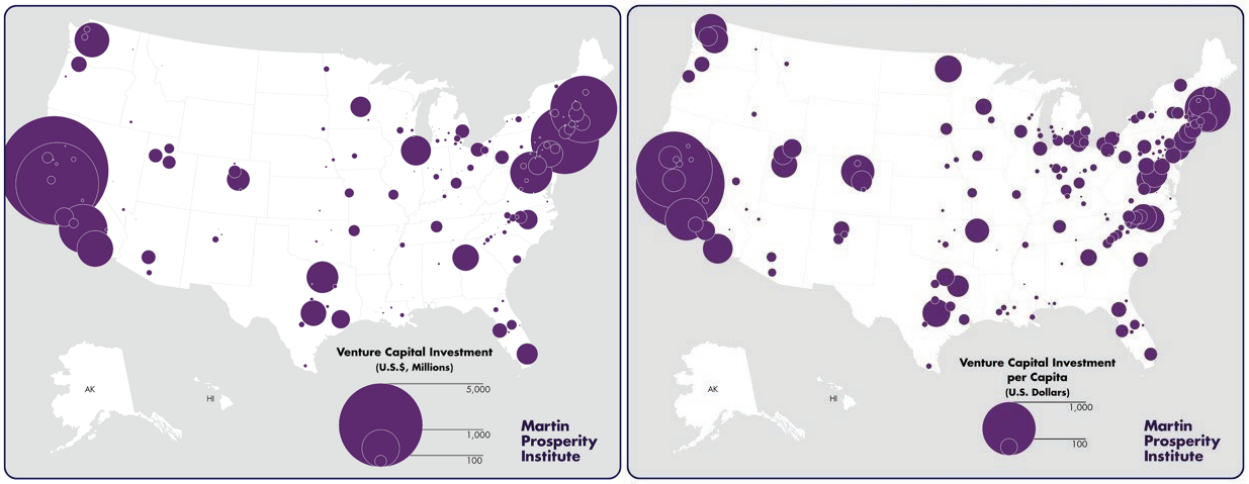


Figure 3. Distribution of VC investment across the U.S. by total amount (left) and amount normalized by population (right). Prepared by Isabel Ritchie of the Martin Prosperity Institute (2016). [Source: Bloomberg, 2016]

It is a story heard again and again in small towns and rural regions, and is a major cause of concern for residents and officials who see decreasing resources and the draining of talent. However, this stark disparity in geographical distribution of people, jobs, and capital, was not always the case in the U.S.

Throughout the 20th century, economic activity was spread relatively evenly between developed and less-developed regions. There were always pockets of poverty, but market forces and mobility limitations encouraged businesses that directly targeted, and were subsequently supported by, the local population. As journalist and author Alec MacGillis writes, "For decades, commerce and prosperity had extended across the country through the initiative of countless business-people staking out a venture in their own town or territory. Even as the more successful of these concerns had grown into regional forces, they had maintained some of their local roots and investments."[4] The dispersion had the effect of supporting small local businesses, as well as limiting the growth gaps between U.S. regions.

This state of relative balance shifted in the 1980s with the advent of digital technologies, and the rise of tech-focused job clusters housed in large metropolitan areas. Cluster economies started forming in places like Seattle and Boston, and location increasingly became a determinant of success. Reputable firms attract talent, which attracts more firms, and so the agglomeration builds until cities are bursting with population, capital, and growth. "By contrast," reports Hendrickson et al., "many of the nation's smaller cities, small towns, and rural areas have languished. As a result, few can now deny that the geography of America's

4 MacGillis, Alec. 2021. Fulfillment: Winning and Losing in One-Click America. Farrar, Straus and Giroux.

economic order has brought economic and social cleavages that have spawned frightening externalities: entrenched poverty, "deaths of despair," and deepening small-town resentment of coastal cosmopolitan elites."[5]

It is within the context of this urban-rural divide that we examine one structure in particular: the food system. Through this research, I argue that food is increasingly divorced from spatial planning, which has particularly troublesome consequences for non-urban environments where geography and distance greatly affect food supply chain operations. Furthermore, this paper contends that a major hurdle to developing a sustainable food system is a lack of holistic integration into place design. Policies and design solutions have commonly focused on piecemeal interventions, such as incentivizing supermarkets to locate in food deserts, providing subsidies for purchasing healthy groceries, or designing rooftop gardens for individual households. Yet, sustainable agriculture and equitable distribution requires a larger understanding of how food is produced, moved, stored, distributed, retailed, and consumed. Within this framework, the thesis argues that the food system must be seen as multi-scalar across rural, semi-rural, and urban settings, and cannot be compartmentalized into separate and unrelated activities.

In Part 1, this paper examines the state of U.S. food systems and how current misconceptions hinder effective food system planning. It then presents new momentum in the food space and how alternative food networks are emerging as design solutions to existing problems. In Part 2, the research proposes a design-method approach that combines lived experiences and spatial data, guided by overarching objectives. Part 3 applies this approach to a case study, where it offers suggestions for siting facilities, for efficient operations, and for programmatic supports that create a more equitable and self-sustaining system.

5 Hendrickson, Clara, Mark Muro, and William A. Galston. 2018. "Countering the Geography of Discontent: Strategies for Left-behind Places." https://www.brookings.edu/research/countering-the-geography-of-discontent-strategies-for-left-behind-places/.

Literature Review

This research attempts to string together various fields of study in order to highlight gaps and overlaps in those fields to facilitate better coordination and shared knowledge. The fields of study in question include: economic development, domestic agricultural production, urban-rural growth trends, community engagement, and planning and design. While all heavily researched in their own silos, they often don't align with each other thus weakening their ability to effect change on the ground for struggling communities.

The U.S. Department of Agriculture (USDA), charged with overseeing development related to farming, forestry and food, is also heavily involved with rural economic development. Data and national conditions are regularly reported via the USDA, often on a mass scale that gives overarching indicators of the health of rural America. Dating back to seminal reports such as, The People Left Behind (1967), the USDA Economic Research Services have been calling for more focused attention on rural development through infrastructure, investment and programming. In many ways, those early calls for attention were not addressed and many of the predictions made regarding growing chasms between urban and rural settings have been realized over the past five decades.

In addition to the USDA, media journals and research consultancies, such as Brookings, give a more nuanced and personalized narrative of the state of rural America, providing a different but complementary picture of agricultural communities and small towns across the nation.

Existing in a separate but related silo are the discussions regarding agricultural production and planning/design. In the late 20th century, the field of urban planning started to acknowledge its own oversight when it came to food and agriculture. Pothukuchi and Kaufman (2007) described this divergence in their paper, "The Food System: A Stranger to the Planning Field", which assessed how much attention planners and planning schools gave to food systems.

Since that major study, the links between planning and food have grown closer, however in piecemeal ways that tend to be heavily design-led (rooftop gardens, green walls) or policy-led (nutrition benefit programs, school lunch programs) but rarely address the food system holistically. They also tend to separate the rural and urban environments, where one is focused on production (rural) and one is focused on consumption (urban). Early planning work, such as that by Ebenezer Howard, proposed far more integrated food systems between urban and rural settings. Since Howard's proposal, other bodies such as the UN Food and Agriculture Organization (UN-FAO) and various localities around the world, have attempted to reinvigorate this more interconnected regional relationship through infrastructure and partnerships.

In addition to looking at the built environment, various federal and local public policies are examined to understand their role and impact within the larger food system. Major subsidy programs, such as those outlined in the U.S. farm bill, are discussed to highlight their contributions and impacts to the system.

Besides federal inputs into the food system in the forms of funding and programmatic supports, this research highlights emerging movements around food sovereignty and community choice. Organizations such as Via Campesina, as well as individuals like Natalie Baszile, Leah Penniman, and Karen Washington, are re-framing the value of agriculture (economically, socially, and culturally) in society and proposing alternatives for our future with food. Their focus is not only on what is consumed, but also how it is grown and by whom. Land, and a reconnection with productive land, is also underscored in this thesis as a platform for social and racial justice work.

Alternatives to current food systems are discussed, including food hubs and their various iterations. As relatively recent phenomena, food hubs have been documented by USDA on a national scale and are explored in more detail by the Economic Research Services and scholars such as Catherine Brinkley through her AFN model. Brinkley not only explores alternate organizational structures of a food system, but also emphasizes the reciprocal impact of these systems on the physical and social realm.

From this existing literature, the thesis proposes a design-planning approach that is formulated on the context of a rural environment. Most urban food system research asks the question, "**can food be produced where it is consumed?**" which drives proposals for infill projects like urban farms and community gardens. In contrast, this thesis asks the question, "**can food be consumed where it is produced?**" in response to issues of affordability, sustainability and access.

A hoophouse at Charlie's Redhouse Farm (Winchendon, MA). Photo by Author (2021)

Part 1. American Food Story

1.1 The Placelessness of U.S. Agriculture

1.2 Food as a Planning Concern

1.3 A Reconnection based on Sustainability, Equity and Engagement

1.4 The Role of Alternative Food Networks and Food Hubs

1.1 The Placelessness of U.S. Agriculture

The majority of Americans don't know where their food comes from. They don't know that ten companies own almost every large food and beverage brand in the world, thus controlling how and what we eat. They aren't aware that a handful of food distributors, such as Sysco and U.S. Foods, operates the majority of wholesale contracts with supermarkets, hospitals, restaurants, and universities. Few realize that 91% of all U.S. farms are considered "small", making less than $250,000 in gross cash farm income, but it is the remaining minority of "large" farms that account for 85% of the market value of agricultural production.[6]

Not many people comprehend the scale of domestic agricultural changes due to farmland consolidation, an aging agricultural workforce, and increasing financial difficulties for small-size farms. Since WWII, farm numbers have been on the steady decline, while farm size has been on the steady rise, indicating the consolidation of U.S. agricultural production. Alana Semeuls aptly describes the situation in an article for Time magazine (2019):

> *"In the American imagination, at least, the family farm still exists as it does on holiday greeting cards: as a picturesque, modestly prosperous expanse that wholesomely fills the space between the urban centers where most of us live. But it has been declining for generations, and the closing days of 2019 find small farms pummeled from every side: a trade war, severe weather associated with climate change, tanking commodity prices related to globalization, political polarization, and corporate farming defined not by a silo and a red barn but technology and the efficiencies of scale."*[7]

These metrics and national shifts are not strongly on the minds of American consumers. Food consumption and food production have been so divorced in people's imaginations, that it is difficult to make the connection of how changes to one side affect the other.

Yet, this disconnect is not only found amongst consumers, but is seen at much higher levels of policy, planning and education. In many cases, the plight of the rural American farmer is seen as irrelevant to the end consumer, be they urban or rural. As Pothukuchi and Kaufman (2007) highlighted through their late 1990s study of various planning agencies' agendas, agricultural production was considered "a rural topic", where food and urban agendas were developed

6 "Small Farms, Big Differences." 2021. USDA Research and Science. https://www.usda.gov/media/blog/2010/05/18/small-farms-big-differences.

7 Semuels, Alana. 2019. "'They're Trying to Wipe Us Off the Map.' Small American Farmers Are Nearing Extinction." Time Magazine, November 2019. https://time.com/5736789/small-american-farmers-debt-crisis-extinction/.

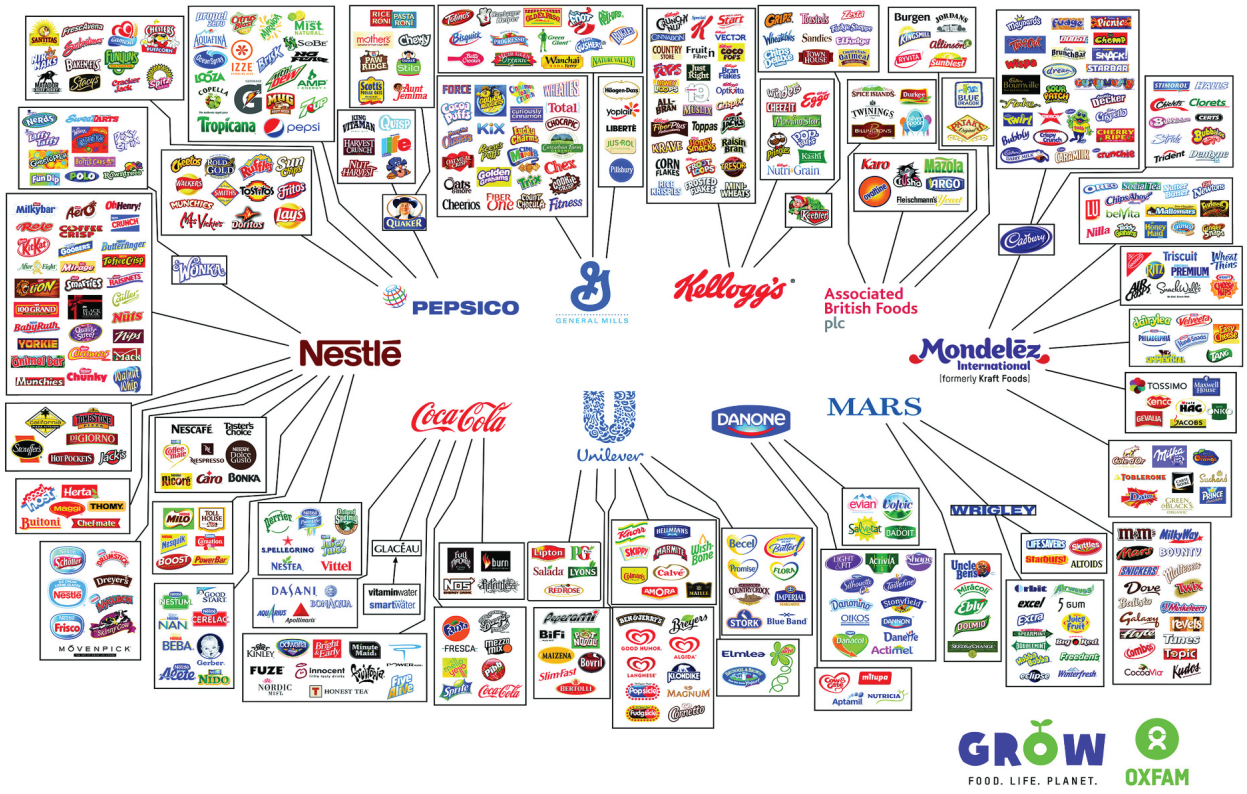


Figure 4. The ten largest food/beverage corporations in the world. [Source: Oxfam, 2014]

without reference to each other.[8] Assessing planning journals spanning the years 1987-1999, they found scant attention paid to food systems, and in the case of the major journals, found no article discussing community food system planning.[9] The educational system similarly reflected this divorce as well; Pothukuchi and Kaufman indicate that of the 93 planning schools in North America (as of 2007), none offered a food system specialization, and only 12% offered a rural planning specialization.

In the past decade, the field of planning has directed more attention to food, but typically through specific concerns such as food deserts, urban farming, and nutrition benefit programs, which rarely tackle the system holistically. By separating components of the food system and discussing them in isolation, planners don't address the root cause of these major challenges.

8 Pothukuchi, Kameshwari, and Jerome Kaufman. 2000. "The Food System: A Stranger to the Planning Field." Journal of the American Planning Association 66 (2): 113–24. https://doi.org/10.1080/01944360008976093.

9 Major journals at the time included: the Journal of the American Planning Association (JAPA), the Journal of Planning Education and Research (JPER), and the Journal of Planning Literature (JPL).

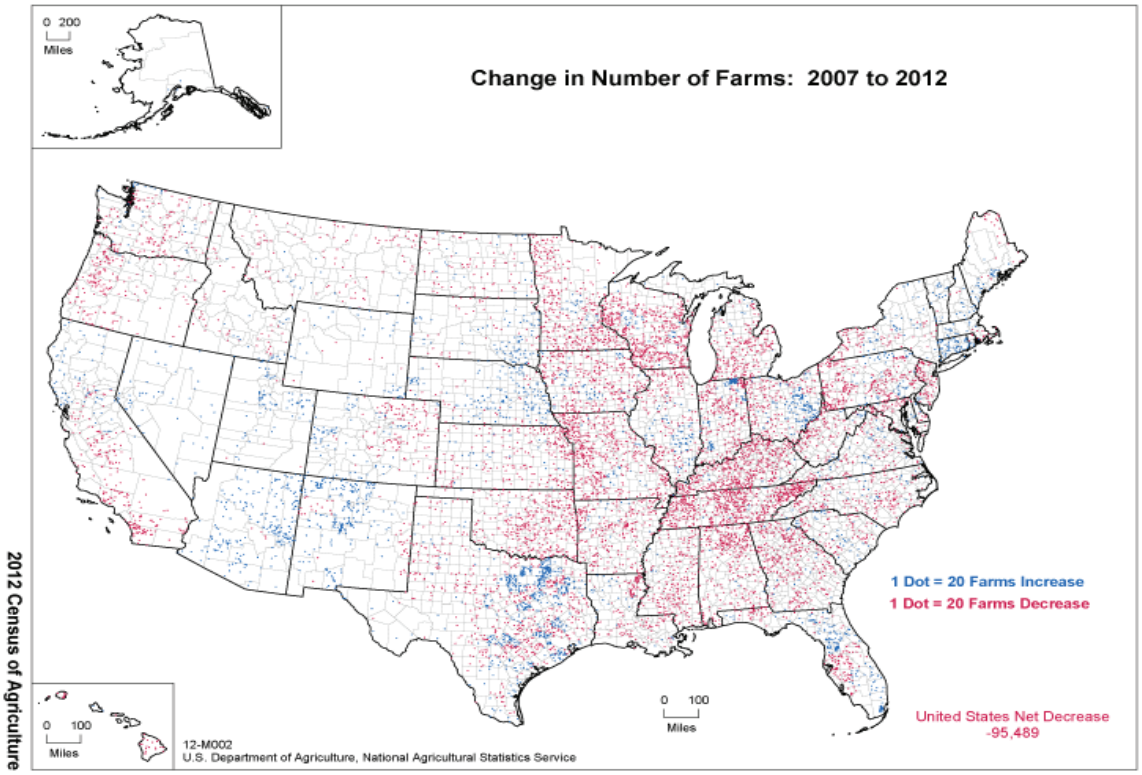


Figure 5. The loss of U.S. farms is over 95,000 in a 5-year span. [Source: USDA]

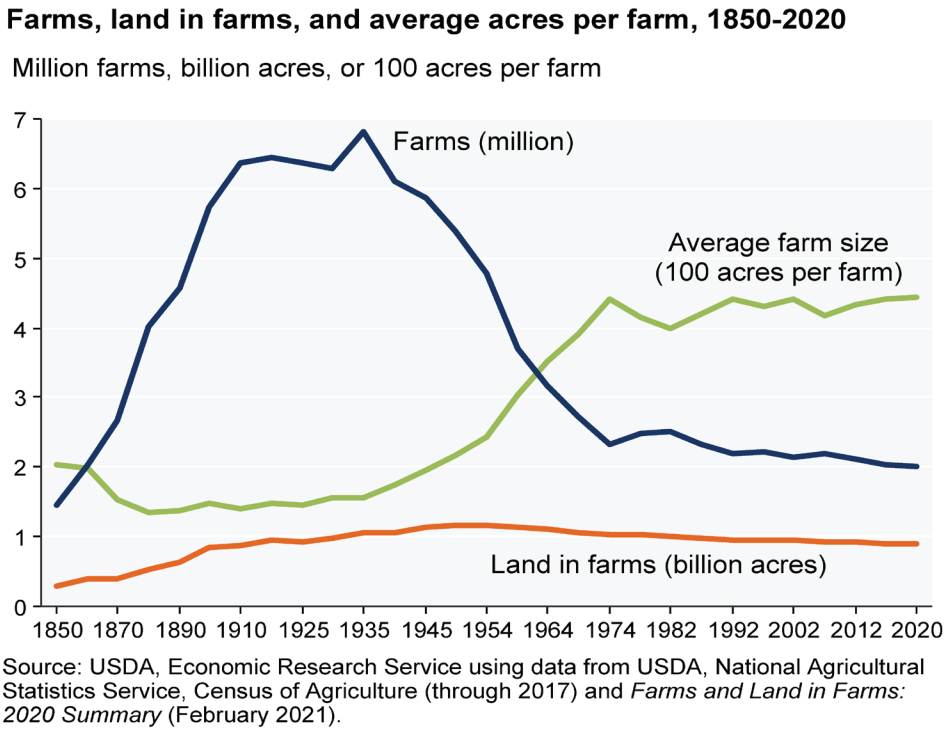


Figure 6. A decrease in number of farms accompanies an increase in average farm size. [Source: USDA]

1.2 Food as a Planning Concern

Since Pothukuchi and Kaufman's 1990s study, there have been forward steps in integrating food into the field of planning. In the 2005 American Planning Association (APA) Conference, a food planning specialization track was incorporated for the first time in APA history. In an APA report titled, *Policy Guide on Community and Regional Food Planning* (2007), it is acknowledged that, "planners have paid less attention to food issues when compared with long-standing planning topics such as economic development, transportation, the environment, and housing," and suggested three reasons as contributing to this oversight.[10] These misconceptions are explored below in more detail, in order to highlight how still-lingering perceptions about the relationship of food and planning continue to stall meaningful cooperation.

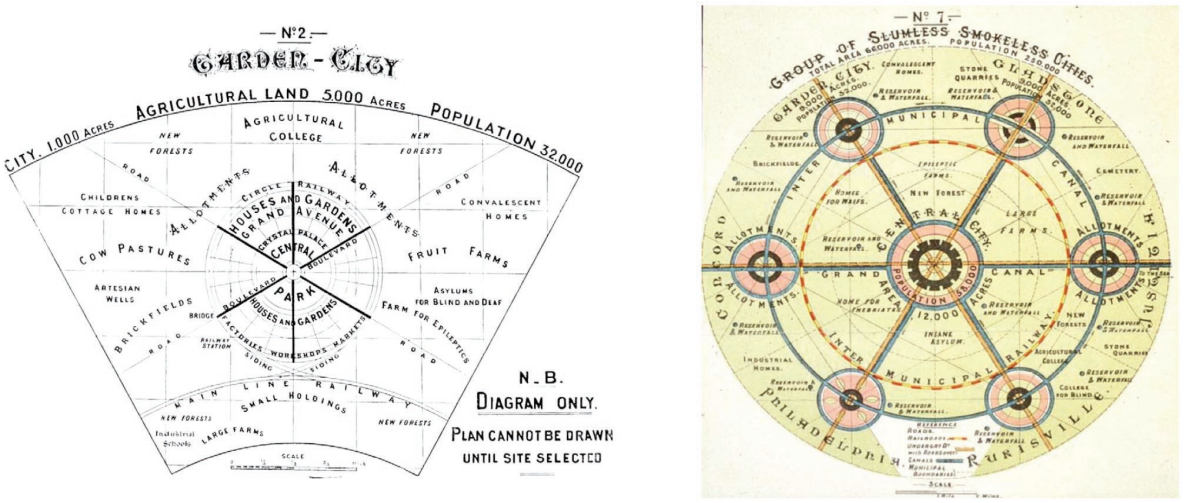
Misconception 1: The view that the food system - representing the flow of products from production, through processing, distribution, consumption, and the management of wastes, and associated processes - only indirectly touches on the built environment, a principle focus of planning's interest.

To this belief, one can refer to earlier examples of planned developments where food was more highly centered, the most notable of which was Ebenezer Howard's Garden City model. Howard's concept emerged in late 19th century England as a counter proposal to the dirty, polluted, and overcrowded conditions linked to the rise of industrial production.[11] Howard's model proposed designated agricultural space at various scales, to be integrated into the private and public realm. He also incorporated associated uses, such as community gardens, co-operative kitchens, and communal dining areas. His model encouraged small-scale farming and agricultural practices within the residential and social spaces, and at a larger scale, to be established along the peripheries of the towns. In this way, food was both accessible and understandable to people at different scales of operation.

Motivating this approach was Howard's intention to design a community that was locally self-sufficient, and he supported this by integrating various key food system components into the design of the spaces. Also notable was the transportation linkages between Garden Cities, indicating that while Howard designed for local self-sufficiency, he also recognized the importance of regional connections, and how goods and services must be easily transferred across different communities.

10 "APA Policy Guide on Community and Regional Food Planning." 2007. https://www.planning.org/policy/guides/adopted/food.htm.

11 Cabannes, Yves, and Philip Ross. 2018. "Food Planning in Garden Cities: The Letchworth Legacy, Pioneering Urban Agriculture and Food Integration into Urban Planning and Design." RUAF Occasional Papers Series. https://ruaf.org/assets/2019/11/Food-Planning-in-Garden-Cities.pdf.



Figures 7-8. Ebenezer Howard's early Garden City model designs with designated spatial integrations of housing, agriculture, transportation, health, and social living. [Source: Yves Cabannes and Philip Ross]

Unfortunately for Howard, his city typology was rarely fully implemented. A handful of places, such as Letchworth in England, Den-en-Chofu in Japan, and Jardim America in Brazil, would be inspired by Howard's model but often modifications to the design would alter the original intent. For example, Jardim America, built in 1917 in a suburb of São Paulo, Brazil, omitted the communal gardens. Still however, the benefits of city-country mixed designs would frequently carry over into other township layouts and suburban planned developments.[12] What did not carry over was Howard's emphasis on self-sustainability and shared access to productive land. Over time, agricultural production was increasingly separated from community life, and the ability and incentives of people producing food within their own communities likewise dwindled.

12 Vernet, Nicolas, and Anne Coste. 2017. "Garden Cities of the 21st Century: A Sustainable Path to Suburban Reform." Urban Planning 2 (4): 181–96. https://doi.org/10.17645/up.v2i4.1104.

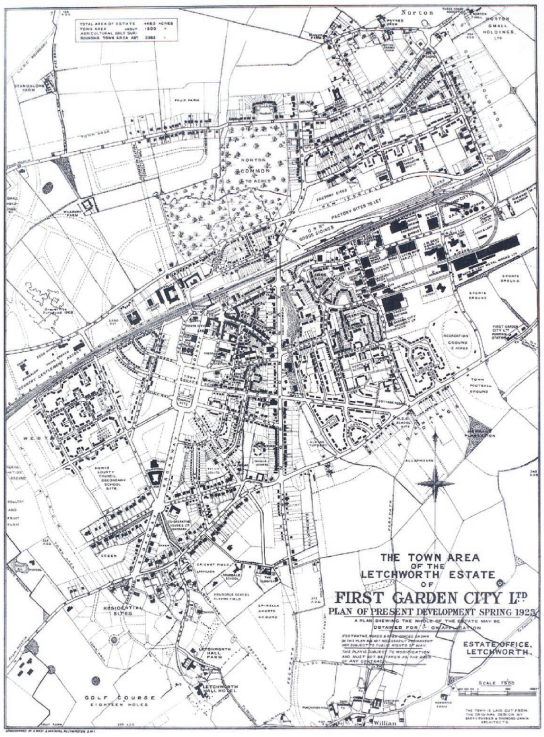


Figure 6. Letchworth Master Plan from 1925. Source: LGCHF, Letchworth Garden City Heritage Foundation

Figures 9-10. The Letchworth Garden City (England) has an axial layout with roads radiating out from a central square, interspersed with planned green spaces. (left) 1925 Master Plan by Barry Parker and Raymond Unwin [Source: Yves Cabannes and Philip Ross]; (right) Letchworth Garden City Heritage Foundation is founded in 1995. [Source: International Garden Cities Initiative]

Figure 11. Den-en-Chofu was developed on the outskirts of Tokyo in the 1920s as Japan's first Garden Suburb. [Source: International Garden Cities Initiative]

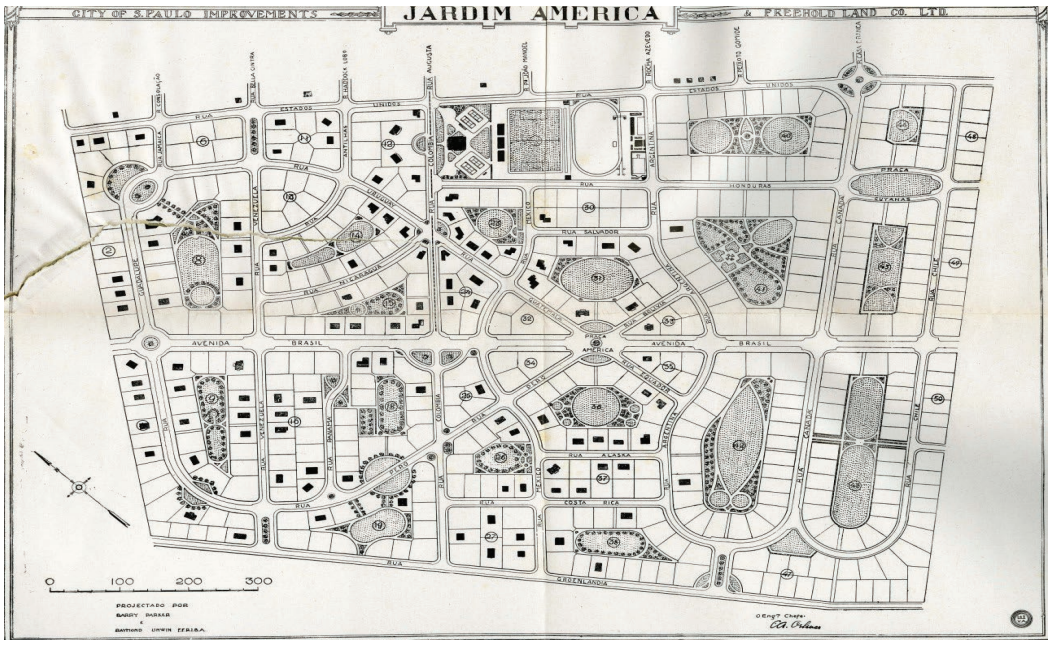


Figure 12. Jardim America in São Paulo, Brazil, was designed in 1917 by Barry Parker. [Source: International Garden Cities Initiative]

The concept of intentionally integrating agriculture into the community realm has reappeared in certain contexts. For example, the notion of City Region Food Systems (CRFS) encompasses "the complex network of actors, processes and relationships to do with food production, processing, marketing, and consumption on that exist in a given geographical region that includes a more or less concentrated urban center and its surrounding peri-urban and rural hinterland."[13] One tangible outcome from this theoretical approach is the Milan Urban Food Policy Pact, signed in 2015 by more than 100 city mayors pledging to better incorporate food sustainability through planned city-region linkages.[14] The Milan Policy advocates for a more integrated food system that relies on relationships between urban, peri-urban, and rural settings.

Another way that agriculture has made a resurgence in the built environment has been through urban-focused initiatives. Examples include rooftop farming, vertical gardens, urban food forests, and community gardens. These interventions have garnered significant attention in recent years, but have been heavily premised on dense urban contexts where access to greenspace is limited. In most of these cases, urban farming proposals are not intended to replace traditional food systems but to supplement them. They are also often proposed as tools for community-building, urban greening, education, leisure and health, and watershed management.

13 "City Region Food Systems Programme." n.d. UN FAO. https://www.fao.org/in-action/food-for-cities-programme/overview/crfs/en/.

14 "Milan Urban Food Policy Pact." n.d. https://www.milanurbanfoodpolicypact.org/the-milan-pact/.

Misconception 2: The perception that the food system meets neither of two important conditions under which planners act - i.e., dealing with public goods like air and water; and planning for services and facilities in which the private sector is unwilling to invest, such as public transit, sewers, highways, and parks.

The second reason identified by the APA asks two important questions: To what extent is the food system considered a "public good", and in what scenarios does it experience private market failures? These questions are useful in order to better understand where the supply chain faces congestion or inefficiencies, and how planners might design better alternatives.

In its current state, the U.S. food system generally operates within the private market except for two major nodes: the start and the end. At the start stands the farmers, who experience fluctuations in trade pricing and climate conditions. At the end stands the consumers, whose income may not allow for adequate healthy eating. Both of these nodes receive ample public funding to account for market failures and national development goals (i.e., stable agribusiness and a healthy population).

One major channel through which public subsidies are allocated is the U.S. farm bill. In 2018, the farm bill provided $428.3 billion to be spent over 5 years, with the majority going to farmers (23% total for "crop insurance", "commodities", and "conservation") and consumers with SNAP benefits (76% total for "nutrition").[15] In many cases, these public funds are a vital lifeline to both farmers and consumers, however, they are not without their faults.

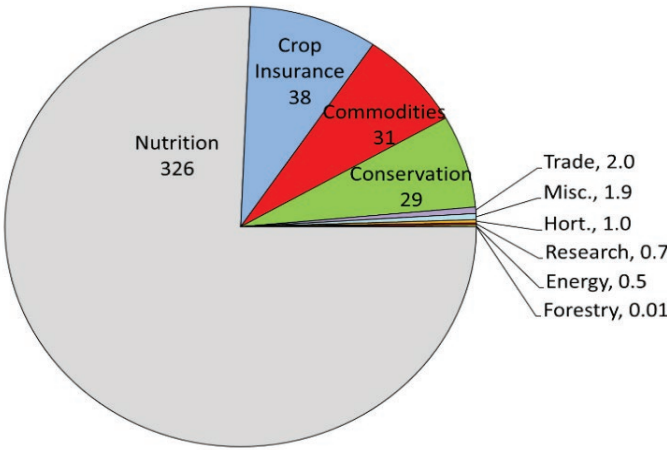


Figure 13. 2018 farm bill allocations.
[Source: Congressional Research Service, 2019. Compiled from the CBO Baseline by Title (unpublished, April 2018); and CBO cost estimate of the conference agreement for H.R. 2, December 11, 2018.]

15 The "Commodities" title provides assistance for dairy, sugar, and covered commodities - including major grain, oilseed, and pulse crops - as well as agricultural disaster assistance. The "Conservation" title provides assistance to agricultural producers regarding land retirement, conservation easements, working lands assistance, and partnership opportunities. The "Crop Insurance" title offers subsidized policies to farmers to protect against losses in yield, crop revenue, or whole farm revenue. The "Nutrition" title provides food assistance for low-income households through programs including SNAP and The Emergency Food Assistance Program. (Info source: https://sgp.fas.org/crs/misc/RS22131.pdf)

U.S. agricultural subsidies are allocated based on a farm's typical production levels. Large farms produce more, therefore they receive more funding. Seen in Figure 14, 89.6% of domestic farms are considered "small", yet it is the large farms that produce the majority of the agricultural output.[16] With growing consolidation of farming operations, this results in a handful of mega-farms receiving the bulk of the funding. For example, in 2020, only 1.3% of farms received more than $200,000 in coronavirus-relief payments whereas the other 98.7% received less than $200,000 in aid (Figure 15).[17] Proponents argue this a logical system that bases support on need; critics claim this system prioritizes big business and makes it harder for small farms to compete. Regardless of one's views on how funding is allocated, it is indisputable that U.S. agriculture is heavily influenced by public sector decisions.

On the other end of the subsidy spectrum are the consumers, namely those whose income level qualifies for food assistance. Because much of the food supply chain operates within the private sector (packaging, processing, distribution, retail), access to food is highly dependent on market conditions. For example, a supermarket may decline to locate in a low-density area due to fewer potential customers. Another example is a low-income household that cannot afford to eat regularly based on grocery store prices. To address issues such as these, a large amount of public subsidies are granted to improve access to nutritional foods for eligible households. As mentioned earlier, approximately 76% of 2018 farm bill funding ($326 billion) went to nutritional assistance alone.

The notion that food systems are separate from 'public good' issues is not only incorrect but dangerous. The enormous amount of public subsidies granted to farmers and consumers speaks to the problems and importance of the food system from an economic development and public health perspective. As New York University professor Marion Nestle argues, the farm bill "is crucial to practically everything about our food system: what crops get subsidized, how much food costs, how land is used, and whether low-income Americans have enough to eat. Whether you are rich or poor, much about your food choices is shaped by what's in this bill's 357 printed pages."[18]

16 "Small Farms, Big Differences." 2021. USDA Research and Science. https://www.usda.gov/media/blog/2010/05/18/small-farms-big-differences.

17 Newman, Jesse. 2020. "Federal Aid Mostly Goes to Bigger Farms." The Wall Street Journal, November 2020. https://www.wsj.com/articles/federal-aid-mostly-goes-to-bigger-farms-11604341709.

18 Nestle, Marion. 2016. "The Farm Bill Drove Me Insane." Politico, March 2016. https://www.politico.com/agenda/story/2016/03/farm-bill-congress-usda-food-policy-000070/.

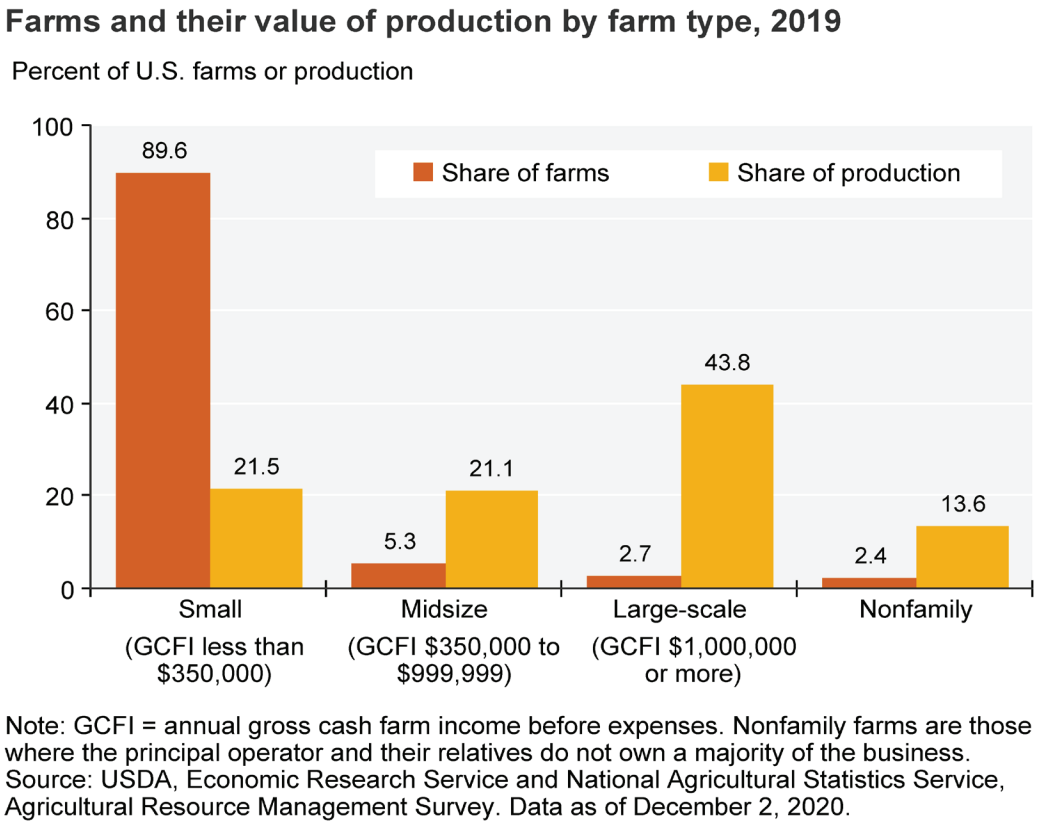


Figure 14. Small farms make up 90% of all U.S. farms, but only yield 21.5% of domestic production. [Source: USDA]

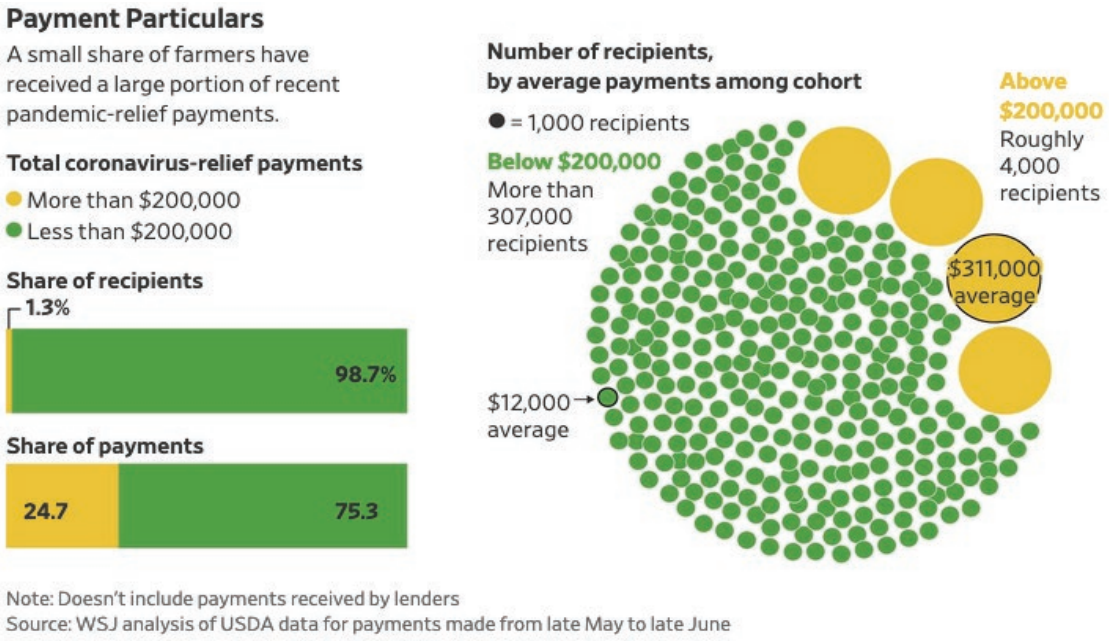


Figure 15. Federal aid mostly goes to bigger farms, with 1.3% of farms receiving an average of $311,000 and 98.7% of farms receiving an average of $12,000 of funding. [Source: Wall Street Journal, 2020]

Misconception 3: The sense that the food system isn't broken, so why fix it.

As of 2021, the U.S. has the largest economy in the world with a national GDP of $22.67 trillion, and ranks fifth in per capita GDP at $68,308.[19] It also has a massive wealth gap that is widening (Figure 16). As described earlier, this gap is not only growing numerically but spatially, indicating that geographical location is increasingly becoming a determinant of economic viability.

Despite the many riches in this country, over 1 in 10 U.S. residents live in poverty, or approximately 37.2 million people.[20] A similar rate of U.S. households, approximately 10.5%, are food-insecure, which includes both households having low food security and very low food security.[21]

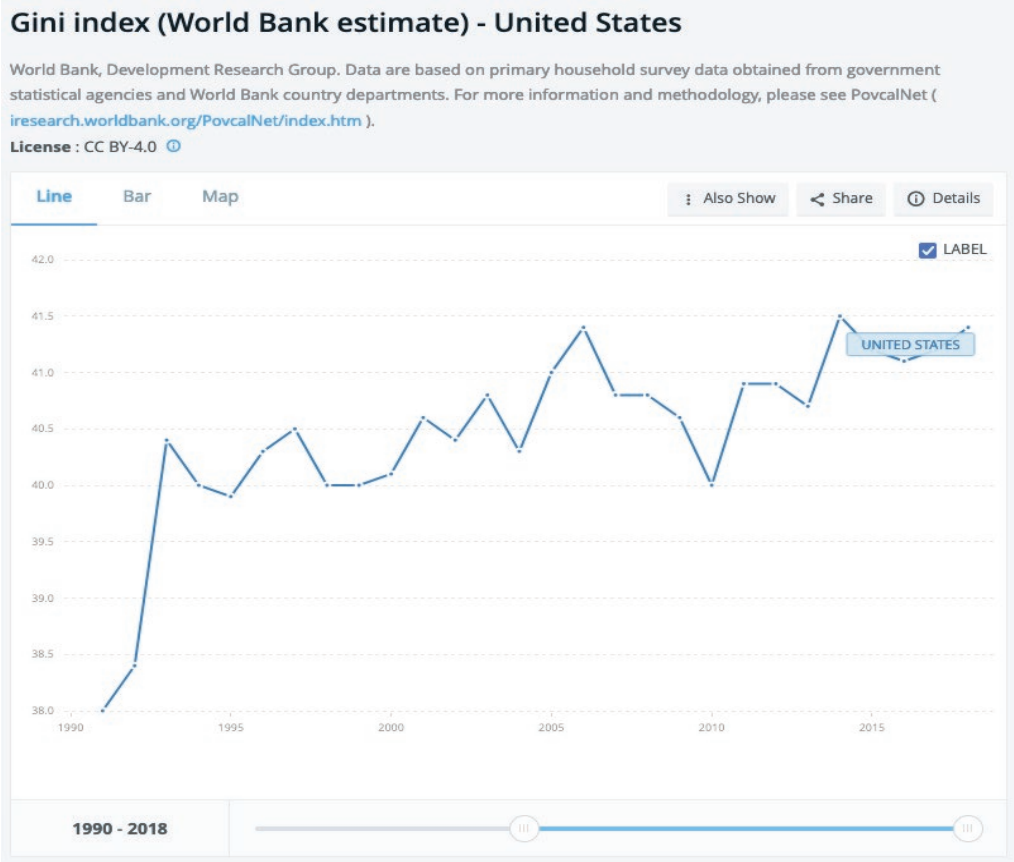


Figure 16. The U.S. Gini index is increasing. [Source: World Bank (data prior to 1990 is incomplete)]

19 "GDP per Capita, Current Prices." n.d. International Monetary Fund. https://www.imf.org/external/datamapper/NGDPDPC@WEO/OEMDC/ADVEC/WEOWORLD.

20 The 2020 rate of U.S. poverty was 11.4%, up 1 percentage point from 10.5% in 2019. (Census)

21 USDA Economic Research Service (Dec 2020).

Definitions:
(obtained from USDA ERS Food Security Status 2020)

Food insecure households: At times during the year, these households were uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money or other resources for food. Food-insecure households include those with low food security and very low food security.

- 10.5% (13.8 million) of U.S. households were food insecure at some time during 2020.
- Unchanged from 10.5% in 2019.

Low food security: These food-insecure households obtained enough food to avoid substantially disrupting their eating patterns or reducing food intake by using a variety of coping strategies, such as eating less varied diets, participating in federal food assistance programs, or getting food from community food pantries.

- 6.6% (8.6 million) of U.S. households had low food security in 2020.
- Essentially unchanged from 6.4% in 2019.

Very low food security: In these food-insecure households, normal eating patterns of one or more household members were disrupted and food intake was reduced at times during the year because they had insufficient money or other resources for food.

- 3.9% (5.1 million) of U.S. households had very low food security at some time during 2020.
- Essentially unchanged from 4.1% in 2019.

While hunger is spread across the country, it is particularly salient in rural America. The Food Research and Action Center points out a troubling reality, writing, "Paradoxically, in rural areas that grow most of our nation's food, households face considerably deeper struggles with hunger than those in metropolitan areas."[22] Not only do rural households face higher percentages of food insecurity (12.1%) compared to their metropolitan counterparts (10.3%), rural Americans tend to have higher risk for poor health outcomes, as well as lower access to positive-health resources such as medical facilities, recreational spaces and community amenities. While participation in food assistance programs such as SNAP is higher in rural (16%) and small town (15%) counties compared to metro counties (13%), a severe lack of information and communication is an additional barrier seen especially in rural areas. For example, it is not uncommon for SNAP information to be sparse and only provided in English, and therefore does not reach non-English speaking communities in need.

22 "Rural Hunger: Quick Facts." n.d. Food Research & Action Center. https://frac.org/hunger-poverty-america/rural-hunger.

Definitions:
SNAP (Supplemental Nutrition Assistance Program) is a federal nutrition program that provides monthly funding to eligible households for the purchase of healthy foods. SNAP dollars can only be spent at approved stores which fit certain requirements as determined by the Food and Nutrition Service of USDA.
WIC (Special Supplemental Nutrition Program for Women, Infancy, and Children) is a nationwide nutritional program in which individual states receive federal grants to improve access to supplemental healthy food, health care referrals, nutrition education and food access for low-income women, infants and children under age 5 who are determined to have nutritional risk.
Farmers' Market Nutrition Program ("Farmers' Market Coupons"): A limited number of coupons are offered to eligible seniors and families to purchase fresh fruits and vegetables at farmers markets. The USDA provides funding for this program with a required state match, and the coupons are allocated by the towns or a representative organization. There are two categories of coupons; one for eligible seniors, and another for WIC-enrolled households.

Besides enrollment challenges, there are also retailing limitations. While SNAP funds are "interoperable" between states, i.e., can be used across state borders, WIC funds often cannot be spent outside of one's residential state. This small detail has considerable consequences for people living in border towns, where their main grocery store is in an adjacent state, and especially so for rural areas where there are fewer WIC-eligible retailers and where residents are more likely to cross state borders for regular errands.

As highlighted by the Food and Research Action Center, much of the hunger felt in the U.S. is in communities where agriculture and farming are most prevalent. It is not uncommon for households with bare fridges to be neighbors of farms; in fact, those farming households face food insecurities themselves.

In some regions, such as Worcester County, Massachusetts, this paradox is gravely felt by residents. In 2017, Worcester Country was the third most economically productive farming county in the state, yielding over $65 million in agricultural sales, and hosting 1,568 registered farms across 95,000 acres of farmland.[23] That same year, 8.6% of county residents were food insecure and 68% were eligible for SNAP.[24]

A study produced by the Massachusetts Public Health Association found that food deserts (termed "grocery gaps") were prevalent in large swatches of the state, including many portions of Worcester County.[25] Discussions with farmers and residents in the region highlight that while an abundance of food (produce, meat, and dairy) is being produced in the region, most of it is being exported to higher-income markets in large metro areas such as Boston, and that very little of it is being sold in their own communities. Major reasons cited include lack of retail opportunities, a minimal consumer base, poor communication channels, cheap food competitors, and a low healthy food knowledge in the community.

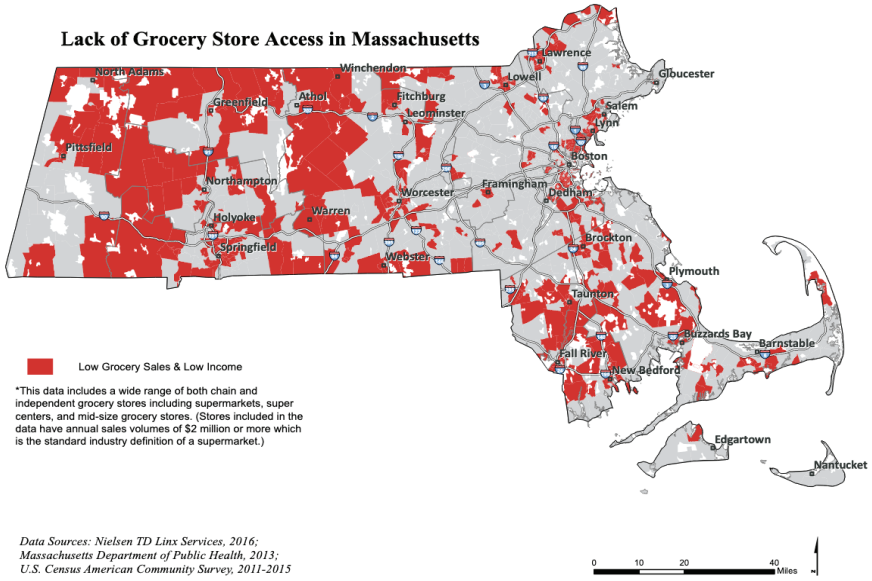


Figure 17. Grocery gaps based on data from The Food Trust. Grocery stores include chain and independent markets; low income areas based on the statewide per capita income level of $36,895. [Source: MA Public Health Association]

23 Inglis, Myron. 2017. "Agricultural Resources Facts and Statistics." Massachusetts Dept of Agricultural Resources. 2017. https://www.mass.gov/info-details/agricultural-resources-facts-and-statistics.

24 Eligibility in this case refers to below SNAP and other nutrition programs threshold of 200% poverty. https://map.feedingamerica.org/county/2017/overall/massachusetts/county/worcester

25 Measurements of "grocery gaps" were determined by markets with annual food sales of $2 million or more, low income areas based on incomes lower than the 2017 statewide per capita income level of $36,895, and percentage of residents living more than 1 mile from a grocery store. https://mapublichealth.org/priorities/access-to-healthy-affordable-food/ma-food-trust-program/

Just as in Worcester County, food access issues are linked to both affordability and reachability. Advocates and researchers continue to discuss how to combat the nation's food deserts, which are disproportionately growing in high-poverty and racial-minority areas. Sometimes also termed "food swamps", these areas not only have very limited access to healthy foods but are overrun with fast food eateries that contribute to public health issues. To paraphrase a resident of a rural Massachusetts town: "The abundance of cheap processed foods in my neighborhood is not a coincidence. These chain stores don't just happen to come here; they target us. They are not *serving* a population in need; they are *profiting* off a population in need and creating a larger problem."

Definitions:

Food Desert: Refers to a geographic area where residents have few to no convenient options for accessing affordable and healthy foods, such as fresh fruits and vegetables. These areas can be found around the U.S., in urban or rural settings, and generally share a few common characteristics, including smaller and/or less dense populations, residents with lower levels of income or employment, and higher rates of communities of color. The term "food desert" has often been used to illustrate public health concerns linked to dietary habits and nutritional food access.

In some cases, the term **food swamp** is used to more explicitly describe areas that host disproportionate amounts of unhealthy, processed foods that are typically more affordable than whole foods.

While designating certain areas as "food deserts" is useful in terms of policy-making and resource allocation, it is important to recognize that the notion of a "broken food system" is more comprehensive than food affordability and access. Duke University Professor Nobert Wilson explains that our current understanding "comes out of a very narrowly defined way that the USDA defines "food insecurity", [which is] talking about people answering a set of questions in a particular way to say whether or not they're food insecure. I think it can get muddled in terms of thinking, 'Is it hunger? Or are we talking about something else?'"[26]

26 Reiley, Laura, Norbert Wilson, Greg Watson, Jen Faigel, and Harry Selker. 2021. "Feeding Communities: Big Challenges, Local Actions (Recorded Zoom Panel)." Museum of Science, Boston. https://www.youtube.com/watch?v=b90WMTxYd5w.

If food insecurity is more than determined by income, proximity to markets, and fresh whole foods, then what else must be factored into an approach for improvement? Greg Watson, Director for Policy and Systems Design at the Schumacher Center for New Economics, explains that in the current arrangement, "what we find is that people who have not had access to fresh, nutritious food, locally, also have not had access to means of production, and being able to make decisions about not just having food but the types of food. And that may be cultural, but it may also be the quality, and where it comes from."[27] This approach is thus less about accessing food, but about having more control over one's food system overall.

Taking the view that the present-day food system is not broken dangerously overlooks injustices and harsh realities faced by large portions of the U.S. population. As it currently operates, the system:

- Creates unstable employment for small and medium size farmers;
- Prioritizes profit over people;
- Separates, rather than integrates, components of the system;
- Focuses on increasing yields rather than sustainable production;
- Subsidizes the start and end of the supply chain, but doesn't invest in long-term system change to support sustainable agriculture economies;
- Rewards consolidation and disincentivizes decentralized operations;
- Doesn't emphasize the value of food, including what role it plays in our health, communities, and ecosystem;
- Is at the frontline of climate change and supply chain disruptions, therefore is highly vulnerable;
- Offers little to no allowances for community input.

Exploring the three APA-defined misconceptions provides planners and designers a useful framework to rethink the relationship between food and planning. With a better understanding, they can more aptly use tools and techniques familiar to their industries in order to propose strategic improvements.

27 Reiley, Laura, Norbert Wilson, Greg Watson, Jen Faigel, and Harry Selker. 2021. "Feeding Communities: Big Challenges, Local Actions (Recorded Zoom Panel)." Museum of Science, Boston. https://www.youtube.com/watch?v=b90WMTxYd5w.

1.3 A Reconnection based on Sustainability, Equity and Engagement

To address the deeply entrenched problems of our food system, human rights groups have been calling for major reforms to how the world feeds itself. In 1993, La Via Campesina, an international movement, described what they termed "food sovereignty" as a community's right to choose how and what they eat. This term is heavily linked to policy reform, transparency, and community decision-making, and pushes back against purely neoliberal policies which they believe have, "increased the peoples' dependence on agricultural imports, and have strengthened the industrialization of agriculture, thus jeopardizing the genetic, cultural and environmental heritage of our planet, as well as our health."[28]

Definition:
(obtained from Via Campesina)

Food Sovereignty is a term that refers to the peoples' right to define their agricultural and food policies, including the prioritization of local agricultural production (and related actions such as land reforms, non-GMO, free access to seeds, and safeguarding water as a public good), the right of farmers to produce food, the right of consumers to decide what they consume and how and by whom it is produced, and the regulation of what is imported into the region and at what price.

In more recent years, the food justice movement has also strongly centered structural racism as a driver for needed change. In the U.S., people have been calling for more appreciation of BIPOC contributions to the agricultural landscape, to the food industry, and to the nourishment of the country as a whole. Author Natalie Baszile of We Are Each Other's Harvest reflects on the story of American farming, saying, "When I think about the images that I grew up with… the narrative around who is farming in this country, who is involved in agriculture, who are the land stewards - it's shocking to think how Black and Brown people have been left out of that conversation. They've been left out that narrative."[29]

Simultaneously, people have been demanding attention on how racism and colonization forced people *to* productive lands for others' gain, or *from* productive lands on which they were self-sustaining. Leah Penniman, author of Farming While Black and founder of Soul Fire Farm, writes how "racism is built into the DNA of the U.S. food system. Beginning with the genocidal land theft from Indigenous people, continuing with the kidnapping of our ancestors from the

28 "Food Sovereignty." 2003. La Via Campesina. 2003. https://viacampesina.org/en/food-sovereignty/.

29 Baszile, Natalie, and Karen Washington. 2021. "Authors in Conversation | We Are Each Other's Harvest." Museum of the African Diaspora. https://www.youtube.com/watch?v=XnH7pDUIE9k.

A rural farmhouse in Ashby, MA. Photo by Author (2021)

shores of West Africa for forced agricultural labor, morphing into convict leasing, expanding to the migrant guestworker program, and maturing into its current state where farm management is among the whitest professions, farm labor is predominately Brown and exploited, and people of color disproportionately live in food apartheid neighborhoods and suffer from diet-related illness, this system is built on stolen land and stolen labor, and needs a redesign."[30]

In some cases, the limitations of farmland ownership played out similarly to the redlining of residential properties, when government-backed private banks created unjust appraisal conditions for loan eligibility based on race. The 1999 Pigford Case is one such example of a class action discrimination lawsuit between the USDA and Black farmers, and is recognized as one of the largest civil rights settlements in U.S. history.[31] John Boyd, President of the Black Farmers Association, advocates for more young Black Americans to embrace agriculture as a form of liberation while acknowledging a history of oppression, saying, "We came from slaves, from slaves to sharecroppers, from sharecroppers to landowners, to supposedly, free agricultural farmers. But the same government that was supposed to be giving us a hand-up, was the same government that was giving us a hand-down by taking our land and denying us loans."[32]

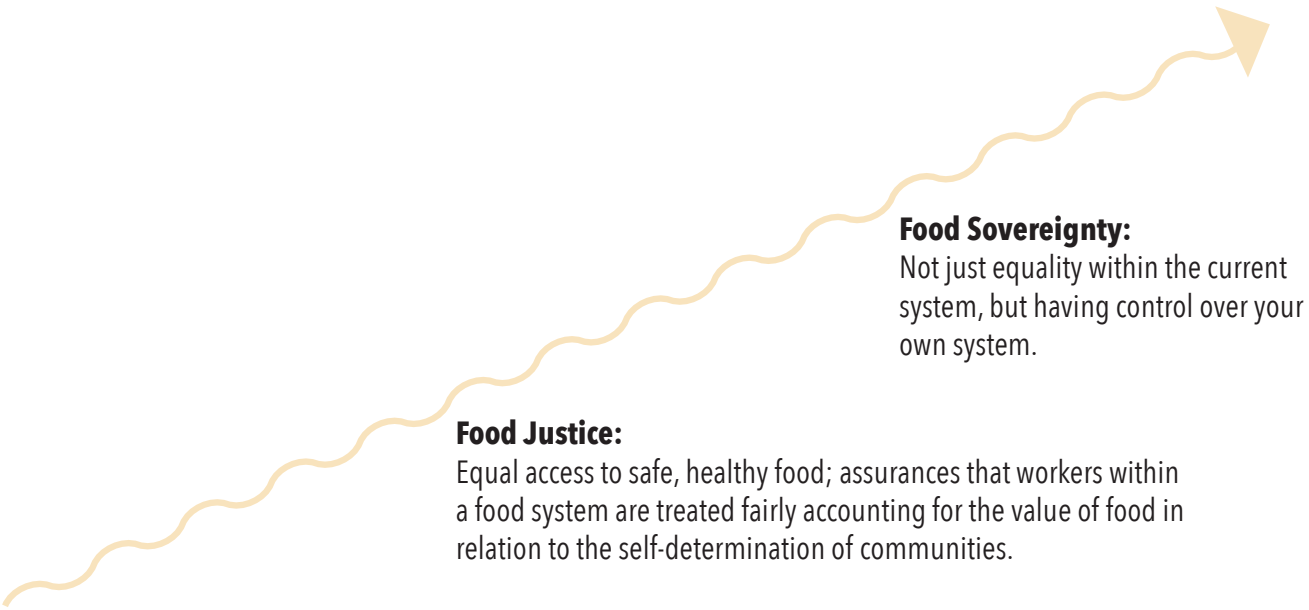
30 Penniman, Leah. 2018. Farming While Black: Soul Fire Farm's Practical Guide to Liberation on the Land. Chelsea Green Publishing.

31 Boyd, John. 2014. "Black Farmer's Association: Pigford Lawsuit." PBS. https://www.pbs.org/video/nc-now-john-boyd-black-farmers-association-pigford-lawsuit/.

32 ibid

Climate change and a reconnection with the environment is also affecting how people view farming and agriculture. There is a palpable change in mindset from land ownership to land stewardship, and this shift is translating into the built environment in the form of co-ownership models, such as community land trusts and land tenure-focused assistance organizations such as Land For Good, based in New England.[33] "[Young people] are starting to understand the power of putting their hands in the soil, the power of controlling your own food. When you talk about food justice and food sovereignty, it's about self-governance, it's about being self-reliant, self-sufficient," says farmer and activist Karen Washington.[34] Under this mindset, the act of growing food for oneself and one's community is increasingly seen as a method of claiming agency for the future.

What is emphasized in the justice-focused work is that the problem is deeply entwined with larger historical, spatial, and structural inequities, not the individual components of the food system. Food sovereignty is about much more than access to food. In discussing indigenous food systems and how they were dismantled through colonialism, Dr. Elizabeth Hoover of UC Berkeley succinctly states, "If you weaken people's food systems, you weaken their political power."[35]



33 "Land For Good." n.d. https://landforgood.org/.
34 Baszile, Natalie, and Karen Washington. 2021. "Authors in Conversation | We Are Each Other's Harvest." Museum of the African Diaspora. https://www.youtube.com/watch?v=XnH7pDUIE9k.
35 Hoover, Elizabeth. 2021. "Defining and Enacting Food Sovereignty in Native American Community Gardening, Culinary Work & Land Defense." Tufts University. https://tischcollege.tufts.edu/content/food-sovereignty.

1.4 The Role of Alternative Food Networks and Food Hubs

As people develop a stronger consciousness about the connection between food, economy, culture, community, and health, there has been a surge in alternative food networks, such as food hubs, to replace the standard supply chain. The USDA defines a food hub as a:

> *"business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand. Food hubs play an important role in the food system by meeting the needs of small and "ag-of-the-middle" farmers who lack the capacity to meet the specific volume, quality, and consistency requirements of larger scale buyers, such as retailers, wholesale distributors, and institutions."*[36]

Food hubs also improve access to healthy, diverse, and local food for consumers, including underserved populations. By aggregating products from many small farms, they act similarly to a standard consolidation point, however what differentiates them from corporate retailers is that their mission and operating plan is guided by community needs, accountability to the local stakeholders, and transparent decision-making and/or co-ownership models.

Since the early 2000s, food hubs have proliferated across the U.S. with various scales and success. As food hubs have increased, so too has the research and reflection on them. Planners are taking more notice of their role regarding zoning, land use, and transportation. Policymakers are crafting new protections around productive land and incentivizing "buy local" initiatives. Town officials are reconsidering how agriculture can be a driver of economic development, in the form of agrotourism, food manufacturing, and new food business ventures. Urban designers are strategizing how best to co-locate features, such as green rooftops and community farms at transit stops.

However, since food hubs are highly localized to address specific needs of the context in which they operate, there is no one-size-fits-all business model. In 2017, USDA researchers Sasha Feldstein and James Barham produced a report titled *Running a Food Hub*, detailing lessons from food hub closures to better understand major impediments to successful operation. Encouragingly, their findings indicate a very high survival rate, however, among the shuttered ones they identify common pitfalls and challenges, such as inadequate attention to management and consistently thin margins. Describing the fragile nature of food hub operations, they write, "if one piece fails, the whole operation can fail. Additionally, food hubs must constantly balance financial viability with other positive economic, social, and/or environmental impacts within their communities, and maintaining that balance often leaves little room for error."[37]

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36 Feldstein, Sasha, and James Barham. 2017. "Running a Food Hub: Learning from Food Hub Closures." USDA Rural Development 4 (77): 1–70. https://www.rd.usda.gov/files/publications/SR77_FoodHubs_Vol4_0.pdf.

37 ibid

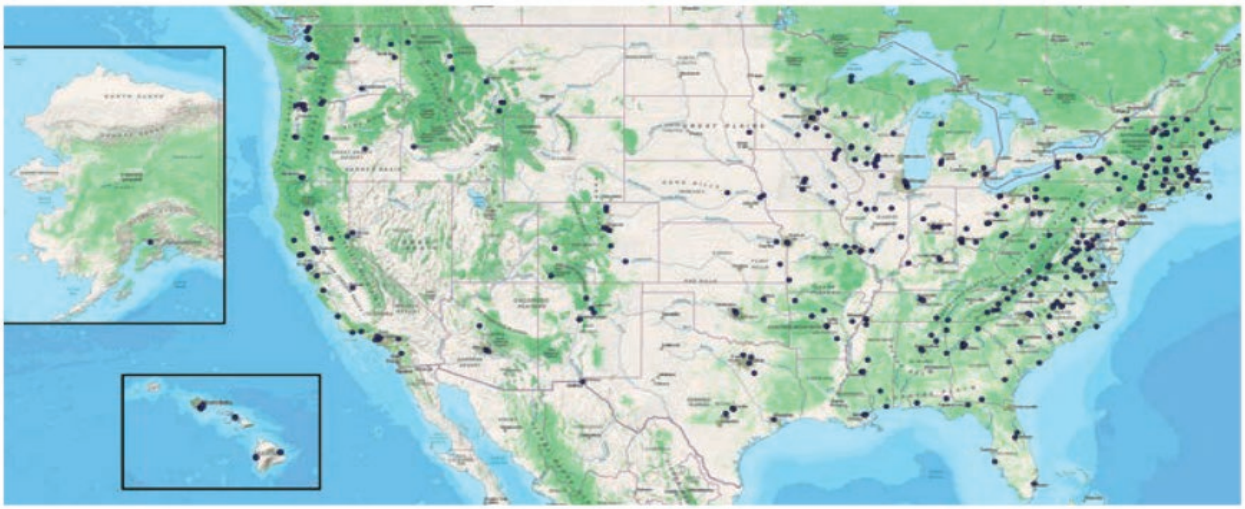


Figure 18. Locations of U.S. Food Hubs (as of 2017). Data compiled by USDA Rural Development in collaboration with the Wallace Center at Winrock International. [Source: USDA]

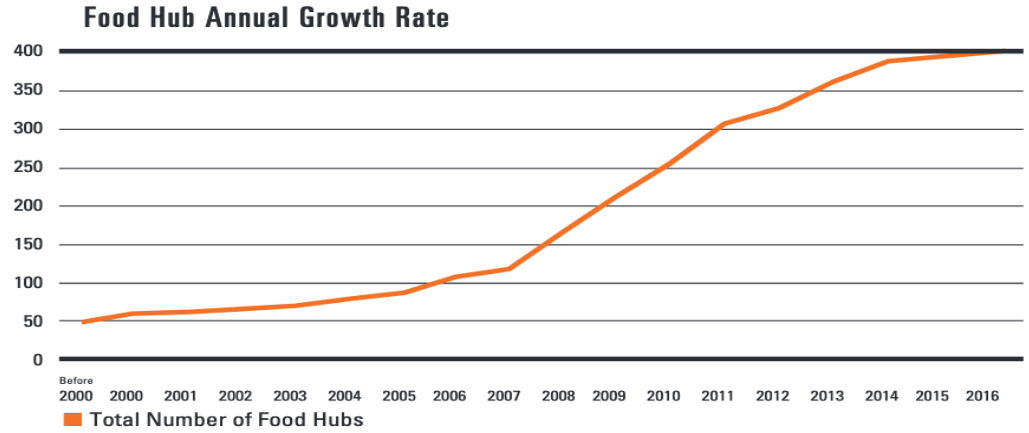


Figure 19. Increase of U.S. Food Hubs (as of 2017). Data compiled by USDA Rural Development in collaboration with the Wallace Center at Winrock International. [Source: USDA]

Incorporating co-benefits into a localized food system requires a different way of thinking about the operating model. UC Davis Professor Catherine Brinkley writes about Alternative Food Networks (AFNs), explaining that, "the food system is often conceptualized as a network of nodes represented by producers, processors, distributors, and consumers. Connections between the nodes are referred to as 'edges'. ...In AFNs, transparent edges between producers and consumers are emphasized as important to tighten feedback loops between diets, consumer demand, land management, and economic investment in sustainable practices, as trust is re-discovered between producers and consumers."[38]

38 Brinkley, Catherine. 2018. "The Small World of the Alternative Food Network." Sustainability 10 (8): 2921. https://doi.org/10.3390/su10082921.

Brinkley visualizes the AFN operating structure differently than a traditional supply chain operating structure, with more edges amongst different players in the system.

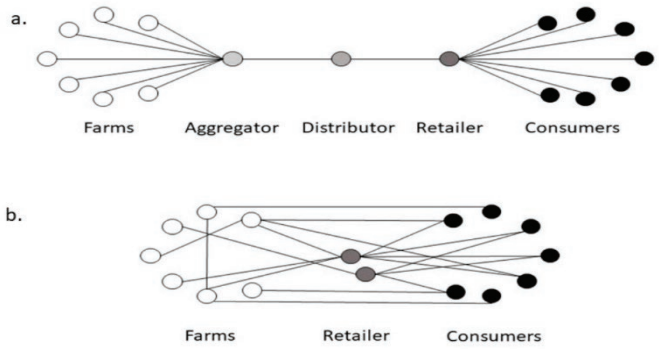


Figure 20. Brinkley archetypes for a global supply chain centralized network (a) and an alternative food network (b) . [Source: Brinkley, 2018]

As illustrated by Brinkley, the decentralized AFN structure includes more interaction between farms, retailers, and consumers, which as she argues, facilitates higher levels of trust and feedback within the food system. Brinkley points out that local AFNs, which she also refers to as "small-world network structures", mimic collective-action-oriented social movements composed of semi-independent actors motivated by joint objectives typically focused on a larger social good that extends beyond the personal gain of the actors at play.

One particularly notable moment in Brinkley's work is the mention of how food systems affect the physical landscape (through land use) and social values (through economics and community cohesion). She provides the below equation to illustrate this relationship:

Food Systems ⟵ (reciprocal) ⟶ Land-Use Planning + Social Networks

Through this arrangement, Brinkley shows the reciprocal impact on each component. She continues to discuss the spatial influence, writing, "likely, geography governs how various network nodes, edges, and clusters are spatially and socially oriented, an area of inquiry in this research and one that is not yet well understood in broader network studies."

When exploring the role of food hubs - including their impact potential, their physical and managerial organization, their operating model, and the options for co-benefits - we can use Brinkley's investigation of spatial determinants to ask, what are specific considerations for planning and implementing a food hub in a rural region? How does the context affect the operation of the food system? How do non-urban economics, resources, and demographics impact decision-making? Can we take Brinkley's AFN model as-is, or must we modify certain parts in order to develop a sustainable version for our particular context? These are the types of questions to be considered in more detail in the following sections, which propose a design-method approach for food systems in rural contexts, and then applies it to a case study in North Central Massachusetts.

Local shops in downtown Sterling, MA. Photo by Author (2021)

Part 2. A Design-Method Approach

2.1 Design / Planning Objectives

2.2 Incorporating Lived Experiences: Ground-truthing & Rural Challenges

2.3 Incorporating Data: GIS-based Spatial Analysis

2.1 Design / Planning Objectives

Outlined here is a design-method approach for developing an alternative food system in a rural context. As an important note, the term "rural" in this section may differ from the U.S. Census or Office of Management and Budget (OMB) designations. These official designations are based on a handful of metrics, but as a quick-glance can be summarized as:[39]

- Metropolitan areas (non-rural) include central cores with 50,000 or more people;
- Micropolitan areas (rural) include clusters of 10,000-49,999 people;
- All remaining counties (rural) which are outside of "core-based" metro or micro areas.

The use of the term "rural" in this research is employed to indicate particular differences with urban contexts, namely those related to density, population, spatial distances between nodes, economics and resources, investment, and proximity to larger markets. Acknowledging the multidimensional nature of urban and rural contexts, it is intended that the "rural" term highlights particular challenges faced in non-urban environments, and argues that an urban-focused food system approach cannot be readily applied to a rural context.

The proposed approach aims to address the overarching problems of the current food system as detailed in Part 1, as well as incorporate considerations specific to rural and small-town environments. For reference, the identified problems are again included below:

Today's food system: (reiterated from Part 1)

- Creates unstable employment for small and medium size farmers;
- Prioritizes profit over people;
- Separates, rather than integrates, components of the system;
- Focuses on increasing yields rather than sustainable production;
- Subsidizes the start and end of the supply chain, but doesn't invest in long-term system change to support sustainable agriculture economies;
- Rewards consolidation and disincentivizes decentralized operations;
- Doesn't emphasize the value of food, including what role it plays in our health, communities, and ecosystem;
- Is at the frontline of climate change and supply chain disruptions, therefore is highly vulnerable;
- Offers little to no allowances for community input.

As described earlier, food systems and planning have had a tenuous past relationship. As these two realms reconnect under emerging food sovereignty movements, there is a risk that too much attention is paid on *urban* food systems, thus overlooking the different needs of *rural* food systems. While the overall goals may align, such as improving nutritional health,

39 Definitions based on the Office of Management and Budget (OMB), 2013.

educating the population on true agricultural value, promoting environmental conservation, and supporting food value chains, the strategies should differ given the variation in contexts.

Rural and small-town settings face specific challenges linked to lack of investment and resources, declining job opportunities, inadequate public infrastructure, poor communication and coordination across a large geographical footprint, and individualist mindsets that have the tendency to promote competition rather than cooperation. In these settings, it is more ideal to strategically redesign a holistic system based on existing assets and actors. For example, various "food for free" programs tackle food waste and hunger, thus addressing major broken elements of the current system. However, such rescue programs do not contribute to farmer livelihoods, and in some cases, promote a parallel food system that maintains the broken state of the original. A solution to one problematic component cannot come at the cost of another. In rural settings, this is especially pronounced given the scale of problems and the lack of resources.

Thus, this paper presents design / planning objectives that serve to guide food system planning in non-urban contexts. While some of these may be relevant and useful in urban settings, I argue that they are increasingly important in rural areas and have a higher potential for impactful change in such settings.

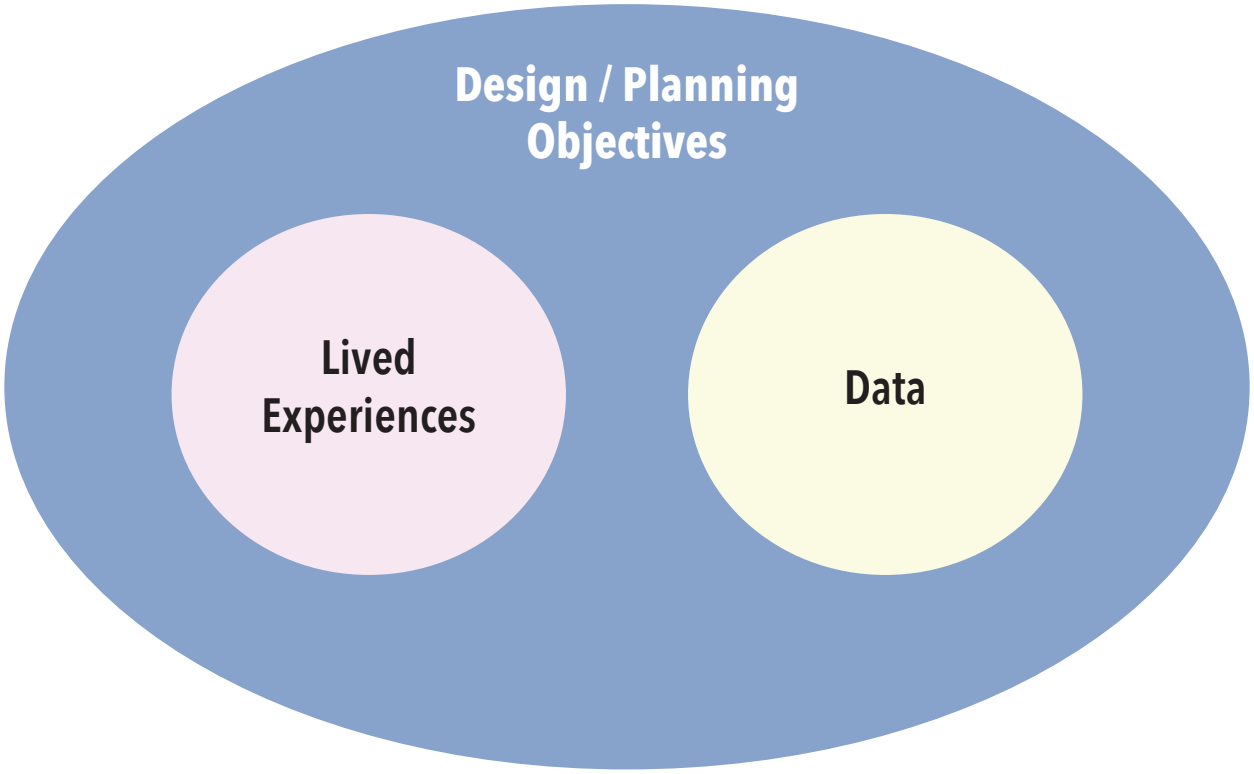
Vacant lots along a main street in downtown Fitchburg, MA. Photo by Author (2021)

Design / Planning Objectives		
1. Promote economic development, in order to improve opportunities for advancement.	2. Establish a food network that supports social equity, education, environmental safeguarding, community cohesion, and improved quality of life for all residents.	3. Invest public funds in infrastructural provisions and upgrades, such that spending is directed towards long-term and sustainable programs instead of piecemeal corrective policies.
4. Develop methodology for strategic siting of food system components, in consideration of key input factors like population, transportation, environment, etc.	5. Optimize impact by designing multiple outcomes from one intervention. Consider partnerships, co-benefits, and multiple users of a single space.	6. Creatively use existing assets rather than inject wholly new features into the system, where possible.
7. Balance financial goals so that the success of one group doesn't come at a cost to another.	8. Integrate community engagement, stakeholder input, and operational transparency in all aspects of the system. Create platforms for stakeholders to lend their expertise and communicate with each other.	9. Operate on a large scale; work on a small scale. The food system must operate on a regional (and beyond) scale to ensure economic sustainability, but individual components should remain on a smaller scale to ensure community trust, feedback, and a manageable capacity.

With these objectives in mind, we can approach food system planning using two main information channels: lived experiences and collected data.

The lived experience offers vital information about what is taking place on the ground within the community. Due to the complex nature of a food system, this experiential input must be sourced from all actors: the producers, the distributors, the buyers, the consumers, the residents, etc.

The other information channel is through data, collected by federal, state, or local entities. This is necessary in order to understand bigger trends, spatial gaps, vulnerable populations, and other large-scale concerns. It is also useful in developing an effective operation model to address the design / planning objectives, such as determining the optimal location for siting food system components.



2.2 Incorporating Lived Experiences: Ground-truthing & Rural Challenges

While lived experiences will vary according to the project context and community, included below are some commonly discussed challenges in rural areas. This sample of identified problems have been sourced from farmers, buyers, community members, and organizations working in the food and agricultural industries. These challenges are highlighted due to their prevalence and scale of problem in rural regions. It is recommended to consider these when planning for a food system redesign or intervention.

Small Farm Production

Small farms, which make up almost 90% of the farms in the U.S., are heavily reliant on off-farm income. This is seen across the U.S. as documented by the USDA. Many small farmers in the U.S. northeast indicated in interviews that they have second jobs, and/or depend on spousal income. The low farming profits are linked to a variety of reasons, including extremely high input costs (machinery and equipment, infrastructure, utilities), and low retail options.

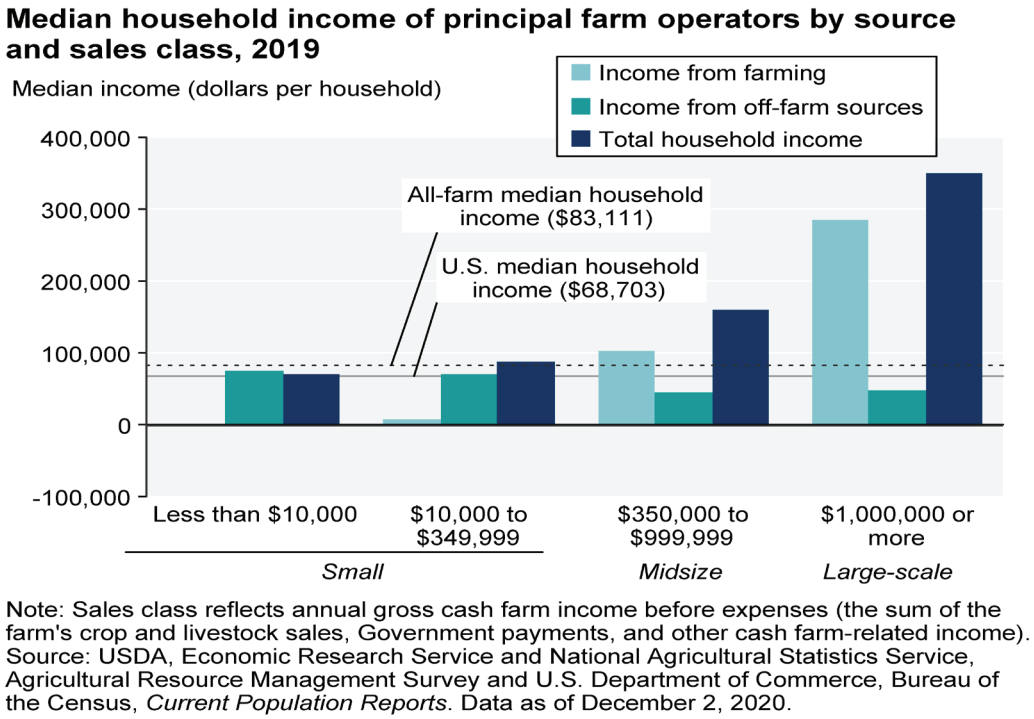


Figure 21. Small farms are significantly dependent on off-farm income, making relatively little in actual farming income by comparison. [Source: USDA]

The small farmer is the hardest to incorporate into a food system because of the lack of scale and the variability in their product. Without reliability in product amount, size, and delivery, buyers are less inclined to purchase from them. For example, a restaurant may require a guarantee that 100 eggs can be delivered on time; if not, their own operations are put at risk.

Small farmers face hurdles with unexpected crop loss due to weather and disease. ML Altobelli, a horticulturalist based in Westminster, MA, is running trials on tomato plants after significant loss from unpredictable weather patterns seen over the last few summers. She explained that climate patterns are changing and that many farmers aren't prepared; that the techniques used for past decades do not always work in current climate conditions, and losing an entire crop to excessive rains is a devastating profit loss for farmers already living on thin margins. It's important to observe, experiment and bring new information and techniques to the job of growing healthy food crops.

B2C Retail

Business-to-Consumer retail, or direct-to-consumer retail, is the main market channel for most small farmers and producers. This is mostly done through farmers markets, on-site farm stands, and community supported agriculture (CSA) programs in which customers subscribe upfront to a farm's harvest for the season. As described in interviews, these channels are used mainly because farmers simply lack the time and skills to organize other retail options like online sales or larger business-to-business contracts. Some farms maintain websites; most use Facebook or word-of-mouth to connect with consumers. Visibility is important; in some cases, customers are invited to visit the farms to understand the process and value the product more.

A major inefficiency stated by farmers and producers is retail options. During the growing season, farming is a 7-day operation. The only time a farmer is away from the farm is for retail, such as vending at a farmers market or making produce deliveries. For small farmers, losing a half day of farm work to attend a market is a serious time allocation. Many farmers report not wanting to drive far to a retail site because they cannot afford being away from the farm for long stretches of time. Even if more profitable markets are located at further distances, they choose a closer retail option to prioritize farm work. Drive time is especially relevant in rural settings, where towns are spread more distantly. This is also important to consumers, especially in acknowledgment of populations who do not own cars or who cannot drive themselves.

Furthermore, whereas urban farmers markets generally have a large customer volume, small town and rural markets rarely have enough customers to make the vending lucrative. In some cases, only a handful of customers visit the market. Many vendors indicate that, in these settings, participation in a farmers market is more about visibility and community connections, rather than profit. In fact, it is at times a financial loss to participate in farmers markets.

Retail in these settings is much more dependent on what's available, rather than what's optimal. There is little strategy in siting retail locations or marketing products. There are few co-benefits or incentives that draw customers to the spaces. On both the producer and consumer side, travel to retail sites is inefficient.

The Westminster Farmers Market is one of the busiest in the north central Massachusetts region. Photo by Author (2021)

The Leominster Farmers Market is sited on a busy road, a suboptimal location for both vendors and consumers. Photo by Author (2021)

B2B Retail and Institutional Buyers

Business-to-Business retail and institutional buyers have different needs than individual customers. B2B buyers demand larger purchase scales at a wholesale price. They also demand higher reliability, because their business operation is also at risk. For example, many schools contract with large food procurement services such as Sysco because of its scale and reliability of product. Large buyers don't want to contract with multiple small farms if they can contract with one entity.

Communication is key. In many under-resourced rural regions, the communication channels tend to be fragmented, outdated, and incomplete. This disarray pushes buyers towards more straightforward contract options which may not be local procurement. Interviews with restaurants revealed that many would like to purchase more local produce but are not familiar with the local farm options.

Community

Under-resourced communities, in some cases designated as food deserts, are not unaware of their challenges. They need help in the form of support and funding, but they do not need lack expertise. They have more knowledge about the breakages in their food system than any outside expert, and a system redesign must be driven by this existing community knowledge.

Many of these communities are experiencing "survey fatigue," having been the subject of countless studies, reports, and failed initiatives. Most of these surveys are extractive, taking information out and not returning any action. It is not uncommon for residents to have distrust or feel hesitant to embrace a newly proposed solution, as failed initiatives have harsher effects on residents than the people implementing the program. "We are not a petri dish," one local food advocate remarked, arguing that action must accompany study reports.

At the same time, it is important to recognize that successful system change moves slowly, especially in rural regions. Urban systems tend to be more quickly adaptable: residents are more transient, resources are plentiful, change is familiar. Rural areas and small towns are slower to adapt: residents tend to be deeper rooted, resources are limited, change is infrequent, and there may be a bigger culture of mistrust towards large system shifts. Small, forward steps with visible change and regular readjustments can be a more effective method of project implementation in rural settings.

Main Takeaways:

1. Off-farm income is a common way small farms scrape by. High input costs and low profits are the main cause of this struggle.

2. Small farms, especially organic farms, do not have the same scale and reliability as larger farms. Creative solutions, such as aggregation or partnership, is needed to secure bigger purchase contracts.

3. Independent farmers are unprepared for climate change and the effects it will have on their crop production. Information sharing, including new methods and techniques, will be vital for the survival of small farms.

4. B2C retail is time consuming and inefficient, but farmer visibility is important.

5. Drive times and distances matter greatly, for both producers and consumers.

6. Retail channel options are based on what's available, rather than what's optimal.

7. Large purchasers prioritize reliability and dependability over "buy local," for the sake of their own business operations. Food system actors must be aware of this.

8. Communication in rural regions is a barrier to partnerships.

9. There is ample knowledge within the community about how to address their current food system.

10. Studies and surveys in rural and small-town regions are often extractive, and produce very little action within the community itself.

11. An approach for systems change in rural settings may look different than an approach in urban settings.

Murdock Farm in Winchendon, MA sells their ice cream at a seasonal on-site dairy stand.
Photo by Author (2021)

2.3 Incorporating Data: GIS-based Spatial Analysis

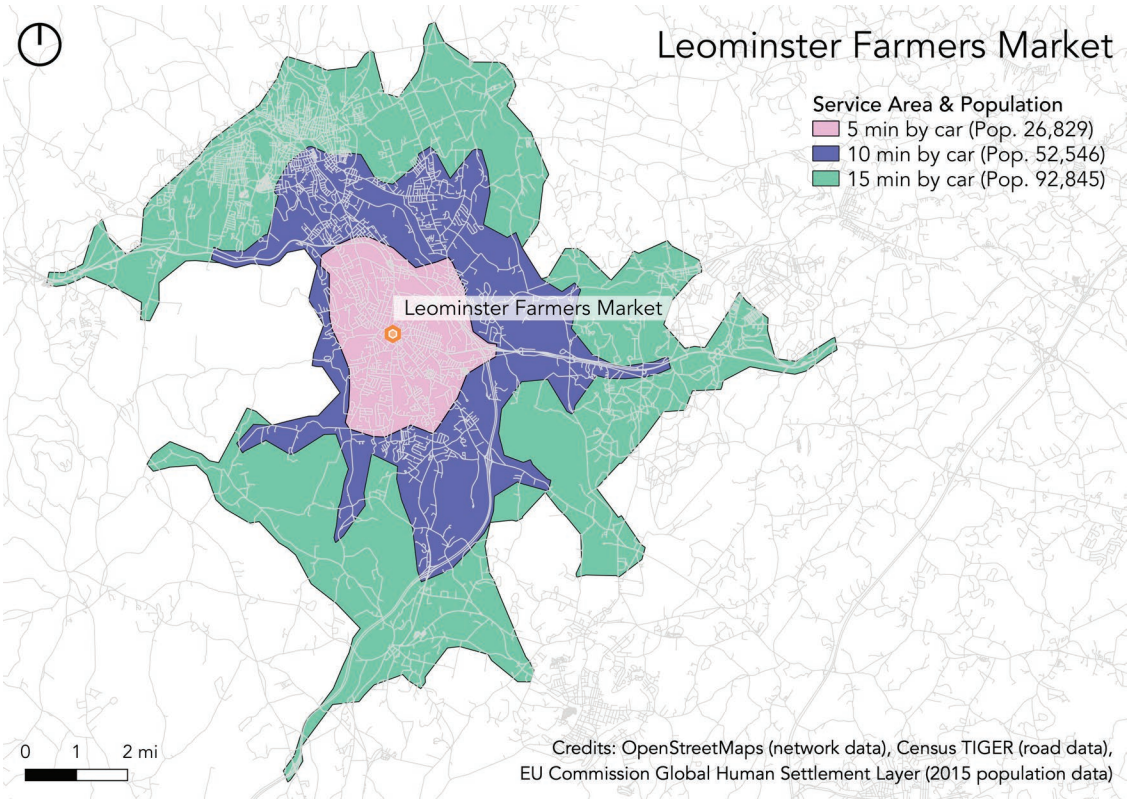
To accompany lived experiences, it is useful to also examine regional data to strategize and model ideal outcomes of any proposed intervention. Data collected by local, regional, and federal entities can direct where to allocate resources in order to reach target populations, fill infrastructural gaps, and address inequities in food access. In the case of rural regions, it is especially helpful to consider the below inputs:

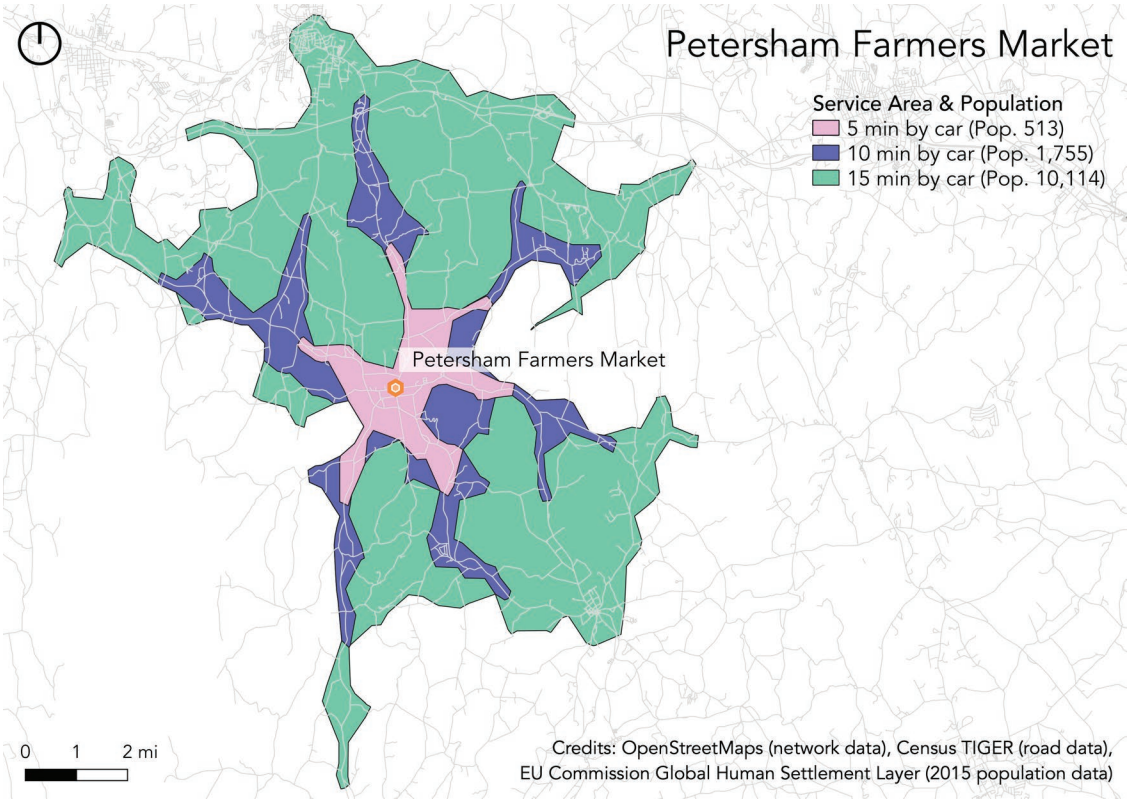
- Population density
- Income levels
- Demographic information
- Road networks
- Public transportation
- Prevalence of vehicle ownership
- Location of existing food retail outlets
- Location of farms and production sites
- Location of community amenities, such as churches, hospitals, town squares, etc.
- Location of existing food assistance outlets, such as SNAP-accepting stores
- In some cases, governments prepare datasets specifically indicative of food deserts or environmental justice populations

A network analysis can be conducted in order to determine service areas of a proposed retail location based on a predetermined drive-time and/or walk-time. Service areas can indicate the geographic reachability (based on road network) and the potential customer reachability (based on population density). Depending on the project objective and parameters, it might be optimal to select the retail location with the largest service area.

For example, as shown in Figures 22-23, two farmers markets' service areas can be compared. Presented at the same scale, their geographic reach varies due to the road network, and their population reach varies due to proximal residential density. A 5-min driving area around the Leominster Farmers Market (on top) encapsulates 26,829 people, whereas the same drive time around the Petersham Farmers Market (on bottom) reaches 513 people.

This type of quantitative and geographic analyses only contributes a portion of the insight needed for food system planning. A low service area doesn't mean that a town such as Petersham should be overlooked, but that a different strategy might be needed for lower density areas.





Figures 22-23. A comparison of current farmers markets' service areas, based on geographic reach and population reach. [Source: Author, via QNEAT3 plugin for QGIS]

In addition to calculating farmers markets' service areas to estimate nearby customer populations, we could also evaluate the markets' convenience to farms. Farmers repeatedly indicate travel to market as a major time allocation, thus drive time between farm and market should be considered. To evaluate this, we can use an origin-destination (OD) cost matrix to determine proximate farms. The OD cost matrix calculates all the travel distances (termed "costs") from an origin point to a destination point. The GIS algorithm produces both a mapped network (Figure 24) as well as a matrix table with calculated "costs", i.e. drive times. From this matrix, one can see which farms fall within a certain distance of each farmers markets.

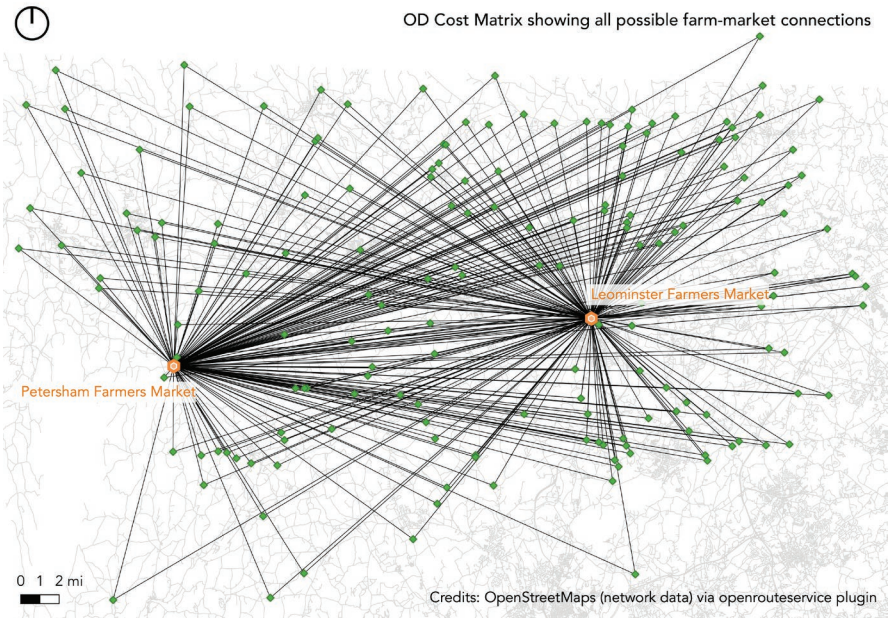
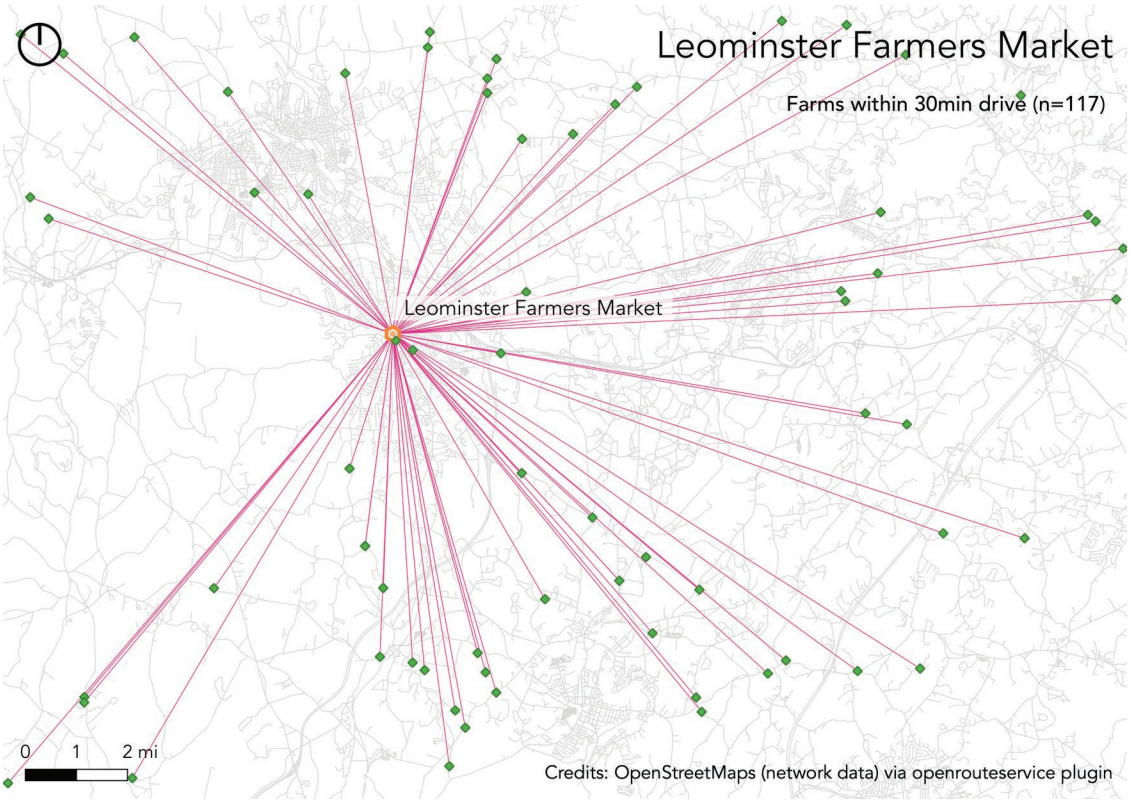


Figure 24.
OD matrix output with network routes (shown) and drive times (not shown). [Source: Author]

This is useful for siting a new retail outlet, or comparing locational benefits of retail options. If we are again comparing the benefits between the Leominster and the Petersham farmers markets, we can calculate how many farms fall within a 30-min drive time using this OD cost matrix. These tools, all of which can be accessed in both ArcGIS and QGIS, provide quick analysis for more strategic operation planning.

As a note, conducting spatial analysis in rural regions may require more manual collecting and cleaning than in urban-focused analyses. Business information is not always updated, and social media is more common than websites. In certain states, such as Massachusetts, anyone can sell products grown or raised by themselves or their households without obtaining a license.[40] While these small producers should be included in the larger food system, their information such as farm location, may be more difficult to obtain. Similarly, cottage food laws allow certain processed foods to be made in one's home and sold at markets. It is important to keep in mind the blurred lines between "business" and "home" in these cases, especially regarding privacy and personal data. Lastly, it is recommended to reference community input to determine how best to conduct the spatial analysis, including which data points to include and exclude, which criteria influences suitability, tolerance levels for drive times, and how best to communicate the findings to the wider population.

40 Under Massachusetts General Law Chapter 101, Section 15, farmers are allowed to sell their fruits, vegetables or other farm products raised or produced by them or their family at farmers markets without obtaining a hawkers' or peddlers' license.



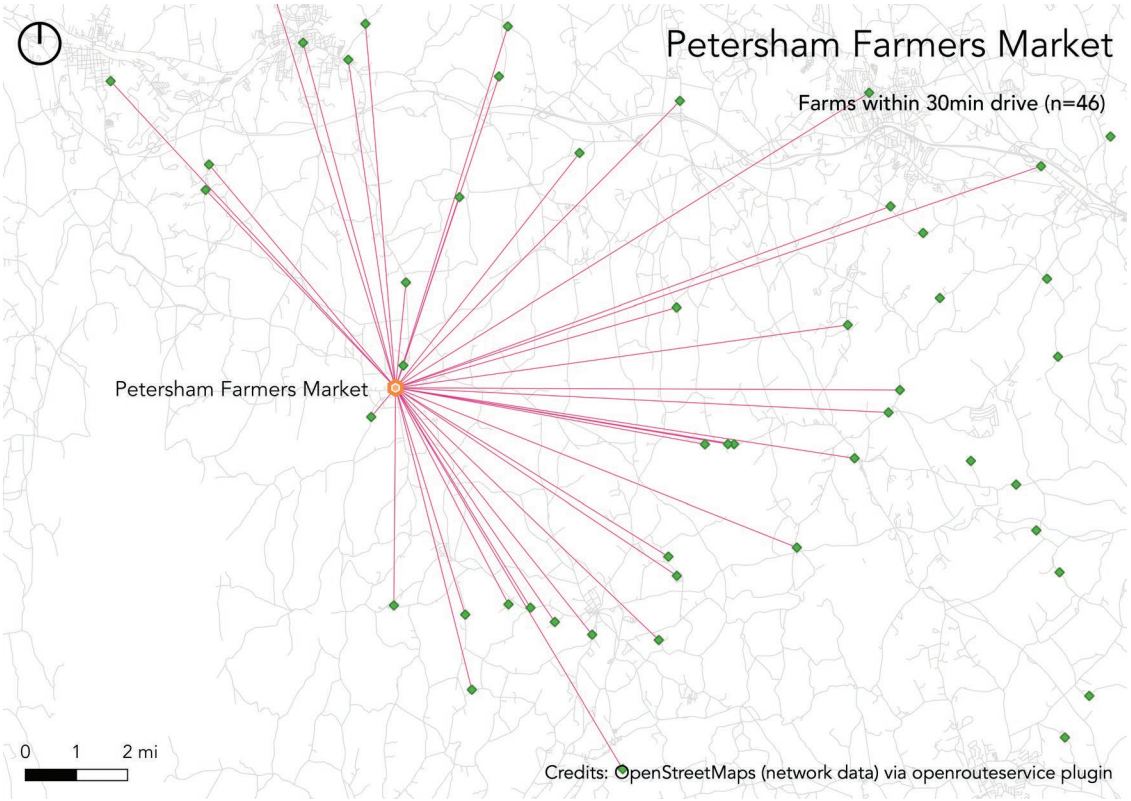


Figure 25-26. Filtered drive times (<= 30 minutes) indicate that Leominster Farmers Market is convenient for 117 out of 187 farms (top), and Petersham Farmers Market is convenient for 46 out of 187 farms (bottom). [Source: Author, via openrouteservice plugin for QGIS]

Local products - including duck eggs, cranberries, huskebrries, squash, peppers, apples, dryer balls, and more - are featured in a raffle gift basket at the Local Food Works public engagement event. Photo by Author (2021)

Part 3. Case Study: Local Food Works

3.1 Introduction

In 2019, a group of concerned citizens in North Central Massachusetts came together to discuss the problems in their current food system. The group, later named Local Food Works, represents various sectors, from agricultural production, to retail, to healthcare. With regular meetings and information sharing, they discuss the potential of a food system that better serves its people – economically, socially, and nutritionally. In November 2021, they conducted their first public engagement event in order to bring their internal conversations outward to the larger community, such that the future visioning is truly co-created and responsive to the many different needs of local stakeholders.

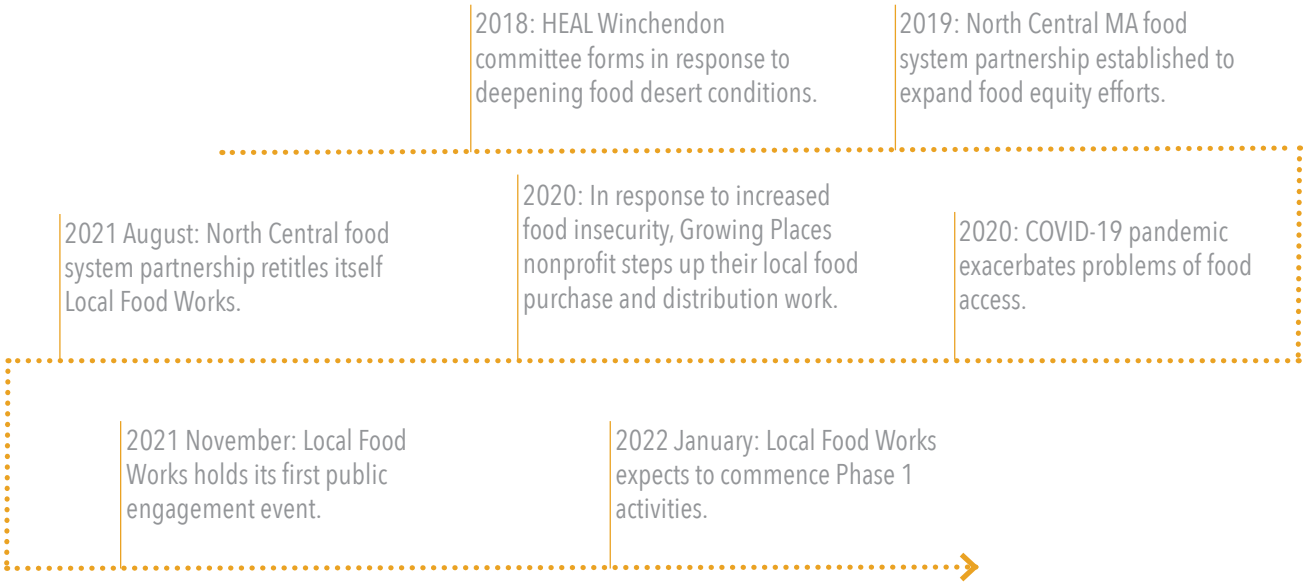


Figure 27. An abbreviated timeline of Local Food Works' development. [Source: Author]

From February 2021 to January 2022, the author of this research participated in the Local Food Works initiative, in which she attended meetings, interviewed stakeholders, worked on farms, assisted at farmers markets, visited local downtowns and retail sites, and met with relevant officials and funders. A great deal of time was spent in the company of the local residents, hearing stories, sharing food, observing operational processes, and understanding major challenges. The region, lush with natural and farmed lands, is also visibly struggling. Downtown areas are dotted with vacant storefronts, sidewalks are ill-maintained or non-existent, broadband is unreliable, and retail is limited. Transportation is almost entirely via private car, and those without car access are reliant on family and friends to run daily errands.

Within this context, and from the experience working alongside Local Food Works, the author applies the design-method approach and offers schematic designs to visualize operational potentials for a north central MA Food Hub network. The operational plan and the hub-and-spoke components are informed by the project team, and are incorporated into the designs.

3.2 Context and Conditions

The Region

North Central Massachusetts is a non-delineated region that roughly overlaps with parts of three counties (Franklin, Worcester, and Middlesex) with the New Hampshire state line as its topmost border. While opinion differs as to the extent of the region's footprint, the main core generally consists of 26 communities spread across more than 800 square miles.[41] The region is a mix between medium towns, small towns, and rural landscapes, and is located on the distant periphery of larger metro areas such as Boston and Worcester. Some residents refer to their towns as "bedroom communities", indicating a primarily residential area with little industry or commerce, from which residents commute to other locations for work or are already retired. A few major highways serve as main thoroughfares to move goods and people. The Fitchburg commuter rail connects to metro Boston, with 6 commuter train stops located within the region. Overall, there is minimum public transportation options, with the concentration of bus lines limited to the more densely populated areas such as Fitchburg, Leominster, and Gardner.

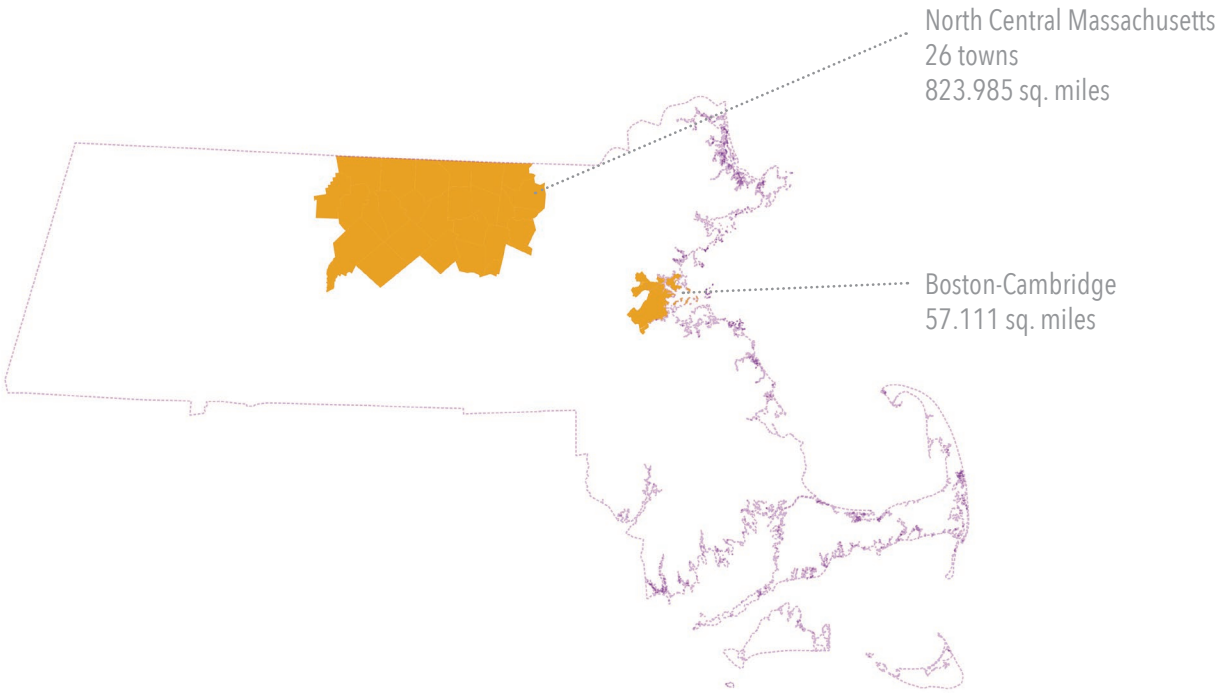


Figure 28. A comparison of North Central MA with the Boston-Cambridge area. [Source: Author]

41 The North Central MA footprint will vary depending on the source but for purposes of this thesis, 26 towns were chosen including: Ashburnham, Ashby, Athol, Ayer, Barre, Clinton, Fitchburg, Gardner, Groton, Harvard, Hubbardston, Lancaster, Leominster, Lunenburg, Orange, Pepperell, Petersham, Phillipston, Princeton, Royalston, Shirley, Sterling, Templeton, Townsend, Westminster, and Winchendon.

Overall, the region houses approximately 275,000 residents, with the population slowly increasing but at a rate below the state- and national-level. Similar to other parts of the country, small towns in North Central Massachusetts are experiencing aging populations, with projections of older age segments increasing in comparison to younger age segments.

As detailed in the UMass Donahue Institute's 2020 Economic Profile of the region, these population estimates have potential economic and social implications, including decreases in projected family formations, births, and people enrolled in schools, all of which affect regional spending on education and school expenses.[42]

In their earlier industrial days, towns throughout the region capitalized on the natural resources of the area, such as wood and water power. Producing both the machinery and products, the region was known for its prolific output of shingles, wooden-ware products, furniture, toys, and textiles. However, the decline of industry in the late 20th century also witnessed the outmigration of people and jobs. Slowly, towns transformed from hubs of manufacturing to bedroom communities, with many residents commuting to larger metro ares such as nearby Boston or Springfield.

This transformation has had a visible effect on the financial resources of the small towns, with many downtowns facing challenges such as vacant storefronts, dilapidated sidewalks, and few public transit options. In some towns, however, there are signs of revitalization and renewal. New restaurants, many of which feature local food, are cropping up in Leominster. Construction of new buildings and adaptively-reused warehouses are becoming additional housing units in downtown Fitchburg. In 2020, Winchendon released a new Master Plan (with volume 2 currently being drafted) that prioritizes new mixed-use development, open space, environmental protections, and developing economic infrastructure including rebuilding the downtown as a business center.[43]

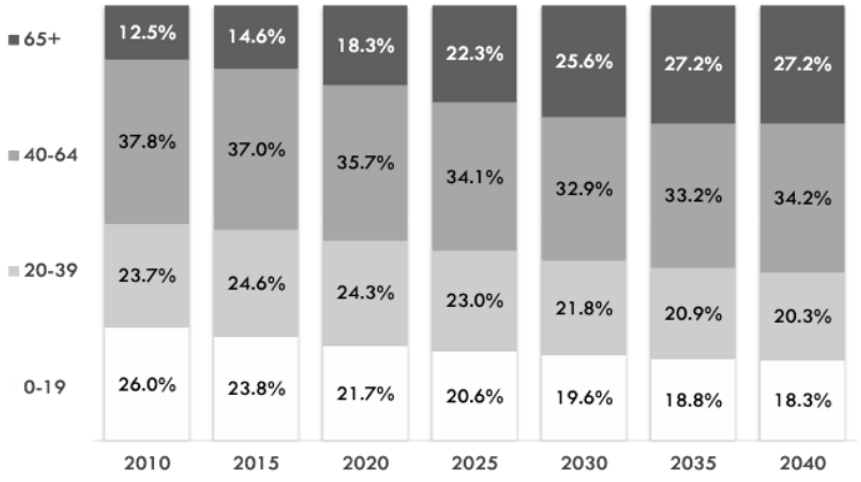


Figure 29. Age projections 2010-2040 for the North Central MA region. [Source: UMass Donahue]

42 Stewart, Branner, Andrew Hall, Abigail Raisz, Eli Briskin, and Ian Dinnie. 2020. "North Central Massachusetts: An Economic Profile." https://www.northcentralmass.com/wp-content/uploads/2020/01/Final-North-Central-Economic-Profile-Report.pdf.

43 Town of Winchendon, MA. 2020. "Community Master Plan." https://www.townofwinchendon.com/sites/g/files/vyhlif4051/f/uploads/mp_final.pptx.pdf.

A vacant storefront along a main street in Fitchburg, MA. Photo by Author (2021)

A slew of properties, despite being located in downtown cores, face financial hardships. Photo by Author (2021)

Figure 30. The locations of the 26 towns in the region, as defined in this thesis. [Source: Author]

The economic profile of the region varies across the townships, with an overall per capita income average of $34,800 (2017).[44] Higher income towns include Pepperell, Townsend, Ayer, Lunenburg, Westminter, Sterling, Harvard, Groton and Princeton. Lower income towns include Royalston, Athol, Phillipston, Winchendon, Ashburnham, Gardner, Shirley, Barre, Fitchburg, and Leominster.

The racial composition of the region reflects a predominately white (86%) population that is higher than the state average (73%).[45] The biggest change in racial demographic is the increase in Hispanic population from 2010 (8%) to 2017 (10%).

Across the state of Massachusetts, farmer demographics are almost entirely white (96.7%), followed by Black (1.8%) and Asian American (0.6%).[46] This does not reflect seasonal labor, which is both domestic and migrant. There are also some initiatives such as Tufts New Entry Program and World Farmers which focus on uplifting a new generation of farmers including immigrants, new transplants, and people of color.

Transportation is limited within the region, and predominately reliant on personal car. The Massachusetts Bay Transportation Authority (MBTA) Commuter Rail Fitchburg Line partially connects the region to the greater Boston metro area, however it inadequately serves the region as a whole.

44 Town of Winchendon, MA. 2020. "Community Master Plan." https://www.townofwinchendon.com/sites/g/files/vyhlif4051/f/uploads/mp_final.pptx.pdf.
45 2017 U.S. Census Bureau, American Community Survey
46 Fitzsimmons, J. 2019. "Massachusetts Agricultural Census Data, 2017."

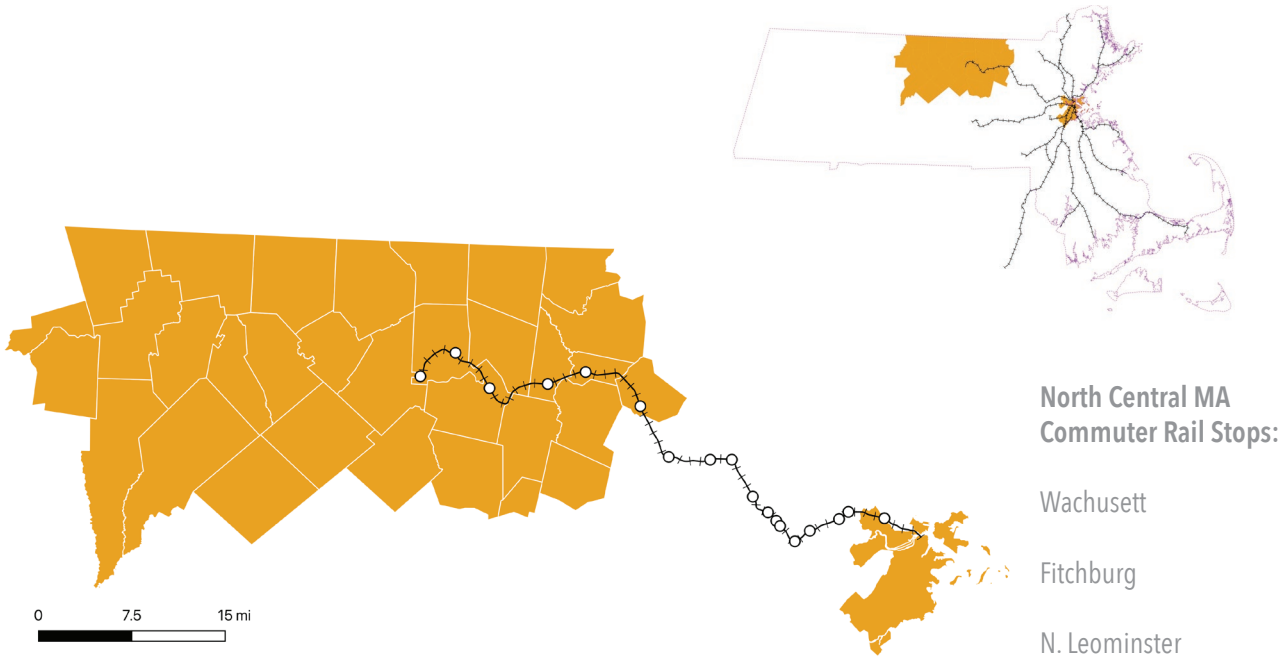


Figure 31. The MBTA Commuter Rail provides limited transit within the region. [Source: Author]

The MBTA Commuter Rail line services the Fitchburg stop hourly. Photo by Author (2021)

The northeast U.S. has a long history of agricultural production coupled with environmental conservation. With nutrient-rich soils, ample access to water, and mountainous landscapes, resident communities are traditionally well-connected to their foods and their local farmers, however this relationship has devolved over the past decades to it's current disconnected state.

Massachusetts is home to 7,241 farms on 491,653 acres of land. A whopping 94% of these are "small farms", with almost 80% operating as family- or individually-owned farms.[47]

Figure 32 shows the prevalence of prime and important farmland soils for the state of Massachusetts. Prime farmland, generally, is determined from specific physical and chemical characteristics including available water capacity, pH levels, flooding frequency, soil permeability rates, density of rock fragments in upper soil, percentage of bedrock exposure, amongst other criteria. Farmland of statewide importance is one class lower than prime farmland, however it is still valuable as sites of food production.[48]

The criteria on which this rating is based does, of course, change with environmental shifts. For example, climate change has affected rainfall patterns, prevalence of flooding, and drought occurrence. Overuse of fertilizers have boosted weed growth along riverways, resulting in clogged tributaries and increased flooding. Small-scale farmers are intimately tied to the land on which they labor, and the changing environments are affecting them differently every year.

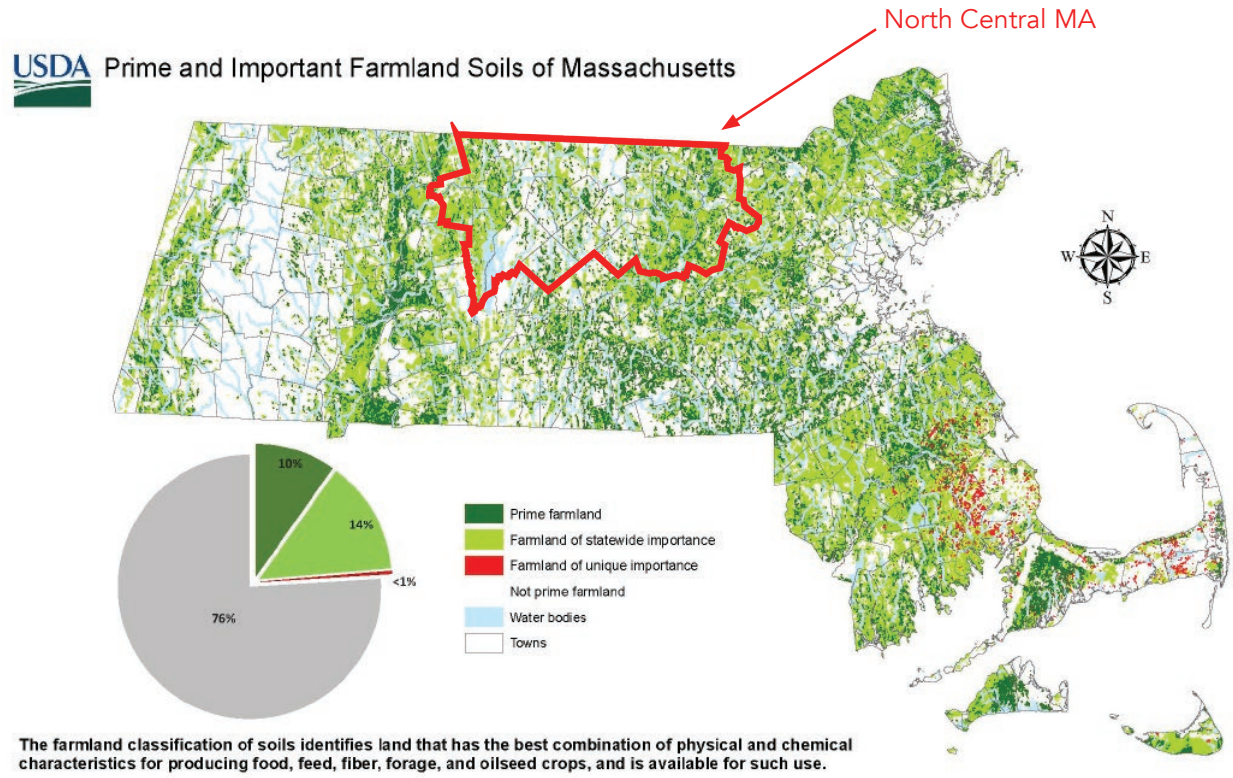


Figure 32. Farmland designations based on soil types and conditions. [Source: USDA 2020.]

47 2017 USDA Census of Agriculture; U.S. Census Bureau via MDAR.

48 For more informaton on soil surveys: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ma/soils/?cid=nrcseprd1371099

Pineo Family Farm with a hoophouse being constructed. Photo by Author (2021)

Cultural Cues

As in any design / planning approach, the local culture should not be undervalued. Cultural characteristics can catalyze a project if integrated correctly, or stall a project if ignored. While local culture is ever-changing and nuanced among different regional groups, there are often certain values that structure how the community views itself, how things operate, how people interact, and how residents envision their future. Sometimes these values conflict with one another. Sometimes they don't reflect contemporary times. In some cases, there are harmful or exclusionary motivations behind certain values.

All of these are the realities that planners and designers must be aware of, and strategic with, when incorporating local cultural values into future planning.

In the case of North Central Massachusetts, one strong cultural value is that of independence. This is reflected on many scales, from the self-governing townships to the libertarian politics to the pull-yourself-up-by-the-bootstraps freethinking individuals. Journalist and historian Colin Woodward attributes this characteristic to the region's Puritan roots, writing, "The Puritan emigrants were led not by highborn nobles or gentlemen…but by an elite distinguished by education. [They] believed every community of the chosen should govern itself without interference from bishops, archbishops, or kings; every congregation was to be completely self-governing. Every town was to be a little republic unto itself."[49] This regional characteristic influences not only how residents interact, but also how businesses operate, how towns organize, and how public infrastructure and programs are used.

49 Woodard, Colin. 2012. American Nations: A History of the Eleven Rival Regional Cultures of North America. Penguin Books.

Figure 33. Residents' self-described regional characteristics. [Source: USA Labs Report 2021]

This independent spirit also translates into a "get it done" attitude, strong civic leadership, and deep roots and ties to history. As a predominately rural region, many of the towns have right-to-farm bylaws, which encourage the pursuit of agriculture and agriculture-based income by allowing farming and related activities on private properties by-right. Within such right-to-farm communities, the sights/sounds/smells associated with agricultural activities cannot be penalized as a disturbance to abutters. As of 2017, there were 140 towns (out of 351 total) in the state of Massachusetts that have local right-to-farm bylaws.[50] This prevalence speaks to the trait of local self-sufficiency and independence in the region.

However, there are challenging consequences as a result of this particular characteristic as well. Both towns and businesses are often siloed, with little communication and cooperation. This leads to redundancies, competition and inefficiency in already under-resourced areas. Despite residents being strong-willed, the general population isn't highly engaged in communal matters, outside of a handful of vocal civic actors. Private life is prioritized over public life, and there are minimal public spaces for convening in downtown areas. There is a strong aversion to government-led programs or schemes. This translates into heavy stigmas against participating in certain assistance programs, such as SNAP.

Lastly, while history gives people a sense of belonging and place, it can narrow perceptions as to "who belongs" by prioritizing certain populations over others. It can also skew visions of future planning under the false assumption that "what worked in the past can work in the future", which doesn't acknowledge the change or action needed to make forward progress.

50 "About AgComs: MA AgComs." n.d. Massachusetts Association of Agricultural Commissions. https://www.massagcom.org/AgComs.php.

A farmhouse kitchen window overlooks the property outside of Winchendon, MA. Photo by Author (2021)

The Food Landscape

The north central MA region is host to upwards of 187 farms, including produce and orchards, livestock and dairy, apiaries, and greenhouses and nurseries. The majority of farms in the region are small in terms of income and footprint. They range in size, with the smaller ones between 1-10 acres and the larger ones hovering around 60 acres.

Most are family-run, and often main operations are carried out by one household member with uncompensated assistance from a spouse, family members, etc. Some of the larger farms have seasonal hires. While the peak of production occurs during the summer months (May - Oct), farmers do typically work year-round. As estimated half of the farmers (including both meat/dairy and fruit/veg) produce year-round, albeit at a decreased rate. Some of the more established farmers have purchased or constructed winterproofing or season-extending infrastructure such as hoophouses, root cellars, and on-site freezers, however these large capital investments is not easily accessed for most farmers.

A handful of farms do value-added processing, such as making apple cider from harvested apples, making yarn skeins from sheared sheep wool, making pickles from cucumbers, etc., but the majority of farms grow and sell unprocessed produce.

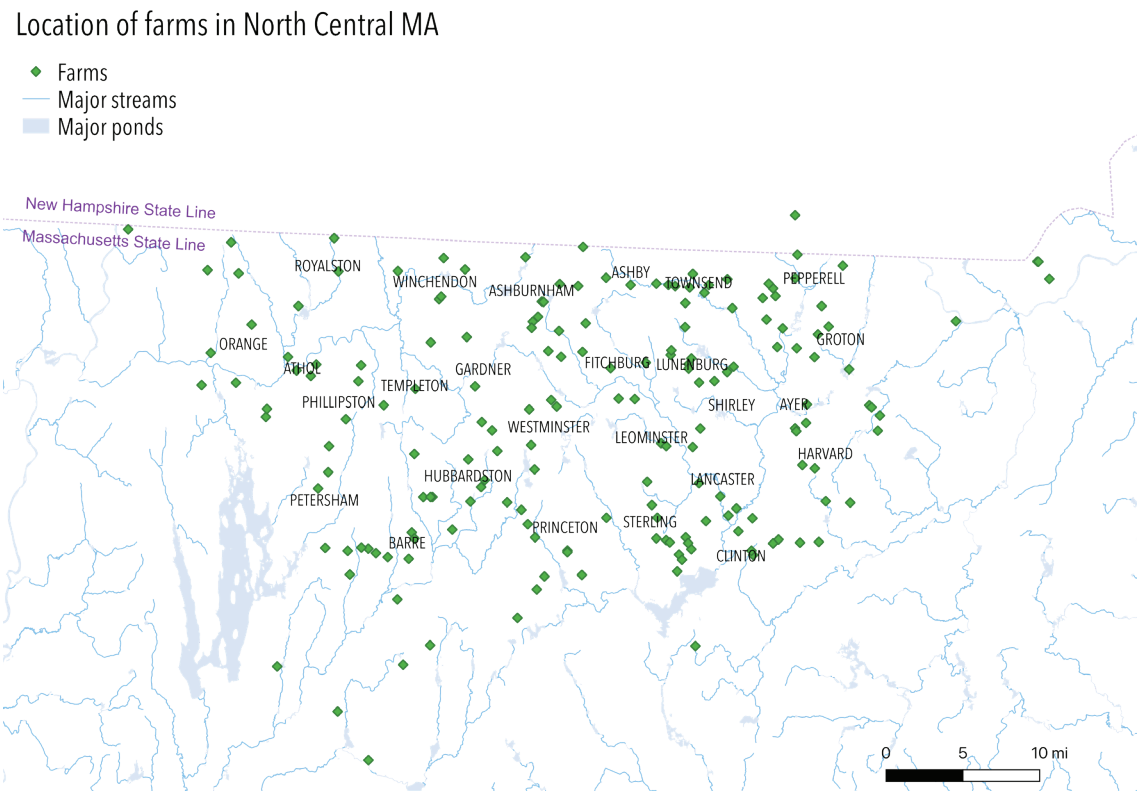


Figure 34. Location of farms in North Central MA. [Source: Author]

According to a producer survey conducted by Local Food Works in Fall 2021, the top barriers to meeting goals amongst the farmer community include:

- Availability / Cost of labor
- Lack of adequate slaughter and meat processing facilities
- Challenges from weather and climate
- Access to capital
- Knowledge of government grants and programs
- Time and effort required for meeting food safety standards, including FSMA and GAP certification
- Production equipment (tilling, planting, weeding, harvesting)
- Lack of processing capacity

Additional challenges mentioned include distribution, logistics, and pricing.

Retail channels are limited for local farms. Most farms sell via farmers markets, on-site farm stands, and community supported agriculture (CSA) subscription programs. A few have relationships with local restaurants or schools for purchasing. Some of the larger farms are able to distribute outside of the region to bigger markets such as in Boston or Brookline. Looking at the retail options available to local farmers, it becomes very evident that scale matters. The small farms struggle within limited retail channels and low consumer densities. The larger farms are more easily able to access additional market channels with higher consumer densities and more opportunities for profit.

As is common in rural areas, consumers face narrowing food access options. In 2017, the town of Winchendon lost its only supermarket when the IGA grocery store closed abruptly, citing financial losses. For some residents, this was an inconvenience; yet for those without a car or the ability to drive themselves, it was major setback to accessing fresh groceries. In a quick effort to address this gap, the town began running a free shuttle service for Winchendon residents to the Market Basket store across the state border in Ringe, New Hampshire.

Figure 35. The Town of Winchendon offered free shuttle service to the Market Basket in Ringe, NH. [Source: Town of Winchendon, 2017]

Free meals are provided at the town church in Sterling, MA to address local food insecurity. Photo by Author (2021)

The supermarket closure, while unfortunate, was not particularly surprising for those working in the public health and nutritional fields. Ayn Yeagle, Executive Director of Growing Places nonprofit, argues that the arrival of the Winchendon Family Dollar store and Cumberland Farms siphoned just enough customer revenue from the IGA supermarket to shut it down, and that this sequence was happening in many other communities. "Small towns are all starting to look the same," she remarked, pointing out the slow dominance of cheap discount and convenient stores in rural and small-town America.

Yeagle's observation is on par with reports of similar occurrences around the county. In another instance, Bloomberg journalist Tanvi Misra reported, "when a dollar store opened up in Haven, Kansas – subsidized through tax breaks by the local government – sales at the nearby Foodliner grocery store dropped by 30 percent… [it is surmised] that 'the difference in margins is just enough that the local stores are not able to stay in business when there are so few options and there is an undercutting of prices.'"[51]

While the debate over the discount store's perceived harm or benefit to the community jumps from healthy food options, to wage levels, to price undercutting, it is centered on one important facet prevalent in rural areas: the lack of alternatives. As reported by Sharon Terlep in the Wall Street Journal, "critics say Dollar General's strategies harm local communities, by not providing healthy food options and potentially hurting the local small business economy. Dollar General says that they are not a grocery store, and that they are serving customers that otherwise would not have access to an affordable retail option. Ultimately, the low prices and the convenience for rural customers is what keeps people coming back."[52] Terlep further emphasizes that the Dollar General retail locations are not random but are strategically sited, often on a 2-lane road, on the periphery of town, near farmlands or low-income communities, near to a post office or church, in areas with limited shopping options. "Three quarters of Dollar General stores serve communities of 20,000 people or less, according to the company," Terlep reports, and they are growing at a rate of 2.5 stores per day.

As evidenced, choice is heavily influenced by options – a calculation familiar to Dollar General. While general merchandising and convenience stores may seem disconnected from the food landscape, in many places they are a significant channel for how people access food. In a 2018-19 study conducted by the Community Health Network (CHNA9) for the north central MA region, 15% of residents indicated a convenience store or "dollar store" as their primary food source.[53] Another 8% of residents indicated their main source of household groceries was the local food pantry. These survey results alarmed local public health experts who saw overlaps in areas of low-income populations, food deserts, and high rates of diet-related chronic diseases. To many in the region, familiar with the local context and daily challenges, the numbers reflected a reality already known to them: their food system was broken.

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51 Misra, Tanvi. 2018. "The Dollar Store Backlash Has Begun." Bloomberg CityLab, December 2018. https://www.bloomberg.com/news/articles/2018-12-20/when-the-closest-grocery-store-is-a-dollar-store.

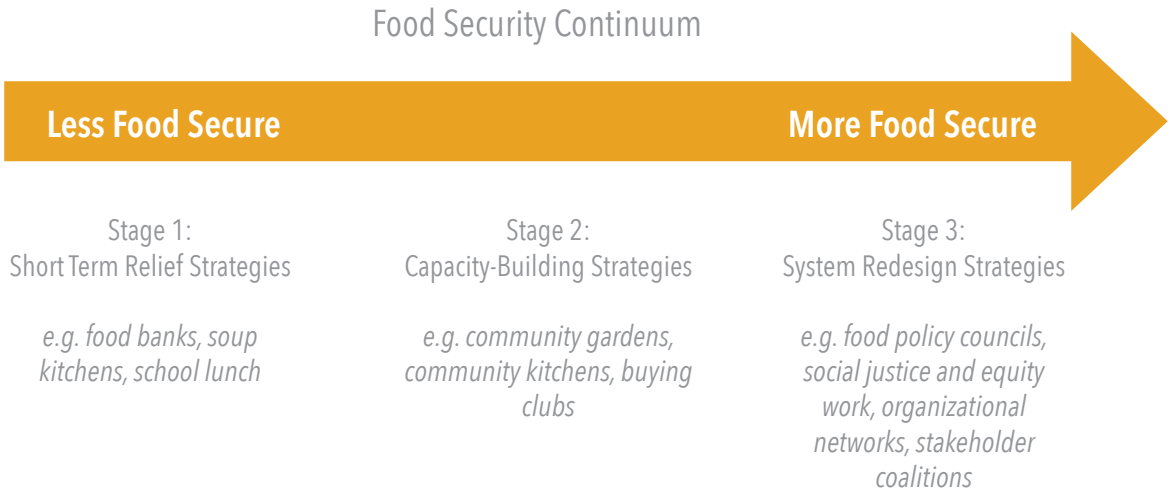
52 "Behind Dollar General's Strategy to Dominate Rural America." 2021. The Wall Street Journal. https://www.wsj.com/video/series/the-economics-of/behind-dollar-general-strategy-to-dominate-rural-america/9CDC6D44-2A99-4187-AAF9-72818CD6CDA1.

53 Benes, Deborah. 2019. "North Central Massachusetts Community Food Assessment 2019."

Local Food Works

Local Food Works formed in early 2020 as an action-oriented planning group focused on addressing problems linked to an inadequate and unsupported local food system. The convening was led by two organizations: Growing Places, focused on food equity, and Central Mass Grown, the regional "Buy Local" organization.[54] While the group was newly formed, the topic was not new in the area. In fact, several complementary efforts were already underway and a handful of relevant studies had been conducted in recent years by entities such as HEAL Winchendon, Heywood Hospital, regional planning commissions, and the Community Health Network of North Central Massachusetts (CHNA9).[55]

Early studies had focused on public health, investigating the relationship between levels of health-related chronic diseases, consumption patterns among the local population, and the availability of fresh foods. Yet, as the research evolved, attention expanded to recognize that the health concerns were symptoms of a much larger socio-economic problem in the region. As explained by Ayn Yeagle, food security is not a simple have/have-not binary, but is a continuum along which people move depending on their current situation. At one end are the least food-secure individuals, who require immediate relief (i.e., "food in their bellies"). Actions taken here are usually short-term, quickly rolled out, and directly applied. The middle stage includes more food-secure individuals, but requires capacity-building and organizational support. Community gardens, educational programs, and mobile markets might be part of this middle stage work. The furthest stage along the continuum, closest to being entirely food secure, is a much deeper dive into system redesign. This is where policy, data, infrastructure, investments, and large-scale programming are enacted. They are long-term actions, often indirectly applied, and take considerable time and resources to develop.



54 Massachusetts state has 10 designated regional agriculture "Buy Local" organizations that serve to connect farmers to their surrounding communities. The organizational efforts began in 1993 under the Community Involved in Sustaining Agriculture (CISA) initiative. More info: https://www.mass.gov/service-details/buy-local-groups

55 The CHNA9 was renamed the "Health Equity Partnership of North Central Massachusetts".

The group acknowledged that the early and middle stage work was already being done in the region. Food pantries were servicing immediate needs, community gardens were established in various locations, farmers markets were distributed throughout the towns, and a handful of agricultural commissions convened regional farmers. The components were there, but the food security was still low.

Gaps and breakages between components meant that flows – of capital, of resources, and of knowledge – weren't smoothly moving between them. A system redesign was needed; one that better connected and supported existing assets, and that was community-led. The notion of a local Food Hub surfaced.

In theory, a Food Hub acts as a middleman between many small producers and different buyers, ranging from individual consumers, to restaurants, to institutions. At its most basic, a Food Hub provides essential services - such as washing, sorting, packaging, food safety, transportation, contract facilitation, and billing - to scale up existing local production. In grander iterations, it might provide further economic development opportunities around food/ag-based businesses, with commercial kitchens, processing equipment, entrepreneurial supports, and connections to non-local wholesale buyers. Besides providing infrastructure, it also functions as a network, facilitating communication, partnerships, and balancing the needs of the different actors within the system.

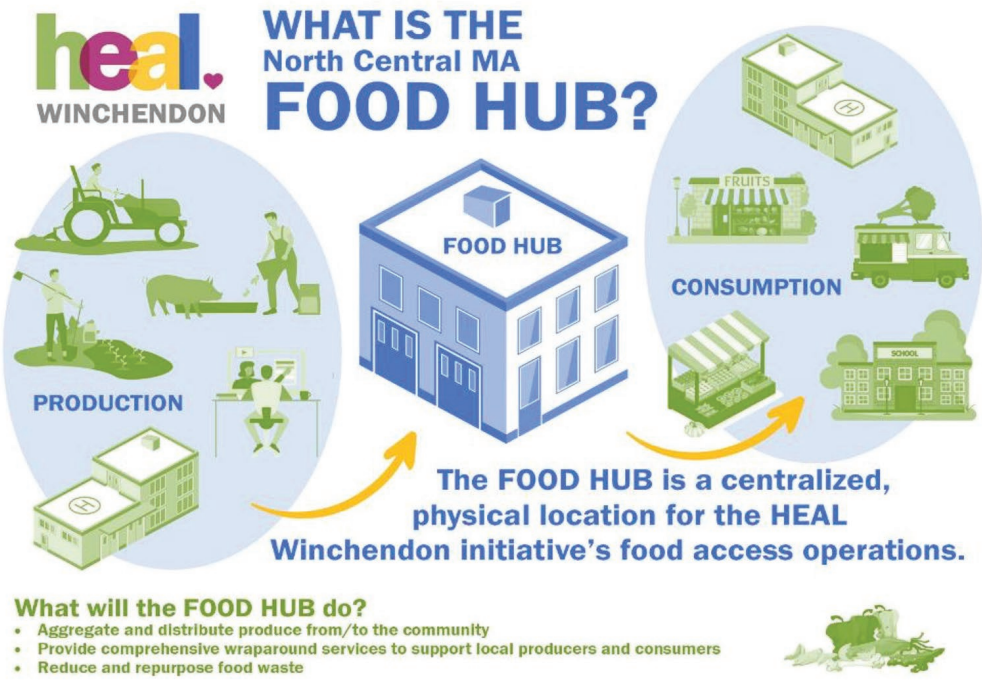


Figure 36. Visions of a North Central MA food hub. [Source: HEAL Winchendon / Growing Places]

However, for the north central MA context, a standard centralized Food Hub wouldn't suffice. The rurality of the area - including its large geography and low density - demanded a more decentralized spatial arrangement, as one central node wouldn't justly serve a dispersed population. Within this context, the team proposed a variation: a hub-and-spoke model.

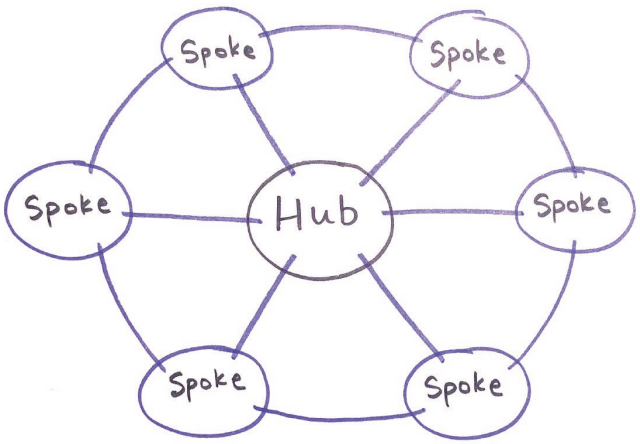


Figure 37. The hub-and-spoke concept. [Source: Author]

The hub-and-spoke model helped clarify to the group and the community what a new vision might look like. The model represented both physical and programmatric interventions. A central hub would be a main aggregator and nexus for essential operations. Spokes, radiating outward from the center, would serve as community access points and additional services. Flows of product and people would move bi-directionally throughout the network. But this was only the starting point; the model told a story but did not provide an action-plan. It did not specify the "where, what, and how."

To move from theory to implementation, it was vital to identify the major gaps and inefficiencies in order to prioritize actionable next steps. Through months of volunteered time, the group embarked on a series of initiatives including outreach surveys, targeted interviews, needs assessments of particular organizations, and a public engagement event that convened people across sectors and towns. The major findings and feedback would inform the operation and business plan for Local Food Works.

Surveys and interviews revealed stated preferences, concerns, challenges, and goals. Producers indicated high interest in selling to a Food Hub, as well as a willingness to scale up their production if demand and resources allowed. Buyers in the region also expressed considerable interest in purchasing from a Food Hub in order to support the local agricultural economy. Both sides have concerns about pricing (producers want high prices; buyers want low prices), but this is an expected conversation that a Food Hub would be poised to facilitate.

Other select takeaways from the Fall 2021 surveys, interviews and public event include:

- There is interest in having a shared flexible space for gathering, events, training, etc.
- Transportation, of people and goods, is problematic in its current state.
- Local food businesses are relatively immature in formation and requested incubator-type support services.
- Some food entrepreneurs already use commercial kitchens or contract food manufacturing facilities, but travel as far as Worcester or Malden to access facilities.
- Collective purchasing, such as for packaging materials, would significantly help costs.
- All parties are concerned with location of Food Hub services/outlets, given the scale of the region.
- There is need for both cold and dry storage, as well as other season-extending infrastructure.
- There is demand from the producers for meat processing, such as a chicken slaughterhouse. In the past, this request gets pushback from residents.
- Education around food production, procurement, and processing would help the public develop a deeper understanding of the value of food and farmers.
- Existing assets must be leveraged, not made redundant.
- Labor is a constant challenge.
- Consideration of "what is local" should be included in system planning.

As identified through the surveys and public engagement, there are gaps and complications sprinkled throughout the existing system. At the same time, there is energy and motivation to redesign a local food economy that better serves the whole region. The vision is slowly evolving into a plan; however, it is important to keep in mind the context of the plan's implementation. This is a community that, for many decades, has been losing control of their food system. It is a region that has experienced declining industry, under-investment, and shuttering downtowns. Residents have been surveyed, assessed, and labeled with deep red indications of poor health and low incomes. Trust is weak; collaborations are few. Political, cultural, and financial situations have more frequently placed people in opposition rather than in partnership. As Yeagle reiterates, this is slow democracy, and requires long-term and personal engagement with the issues and the actors. Some aspects of the north central MA food system can be improved with straightforward infrastructural investments; other aspects require nuanced cultural reflection and behavioral changes that take time and empathy.

A major catalyst that differentiates this moment from previous initiatives is a large federal Cares Act Community Development Block Grant (CDBG) to aid populations impacted by COVID-19. The federal grant, allocated via the Community Foundation of North Central MA, provides $1,630,499 earmarked for advancing food security and addressing hunger within the region. Part of the funding is focused on immediate relief, targeting the Stage 1 portion of the food insecurity continuum such as free meal distribution. Yet the other part is focused on Stage 2 and 3, aiming to support sustainable and impactful change through long-term infrastructural investments and operational improvements. As opposed to "plugging a leak", this funding offers the chance to "rebuild the roof", and in doing so, to address systemic and pervasive inequities with strategic redesign.

Local Food Works Public Engagement Event, held on November 05, 2021.
Photos by Mackenzie May and Allison Lee.


= Institutions, Hospitals, Schools
= Artisans, Restaurants, Makers, Chefs
= Governmental, Politicians
= Producers Farms
= Organizations, Non-profits
= Residents

3.3 Schematic Design

As a final step, the author uses the proposed design-method approach, detailed in Part 2, to present one iteration of a schematic design. The contribution of this research is not intended as a prescriptive design proposal for the north central MA Food Hub, but instead as a methodological approach to be enacted by the project team (such as Local Food Works). This is an important differentiation that the author stresses, in order to maintain flexibility in project design and to put the power of design analysis in the hands of the project team.

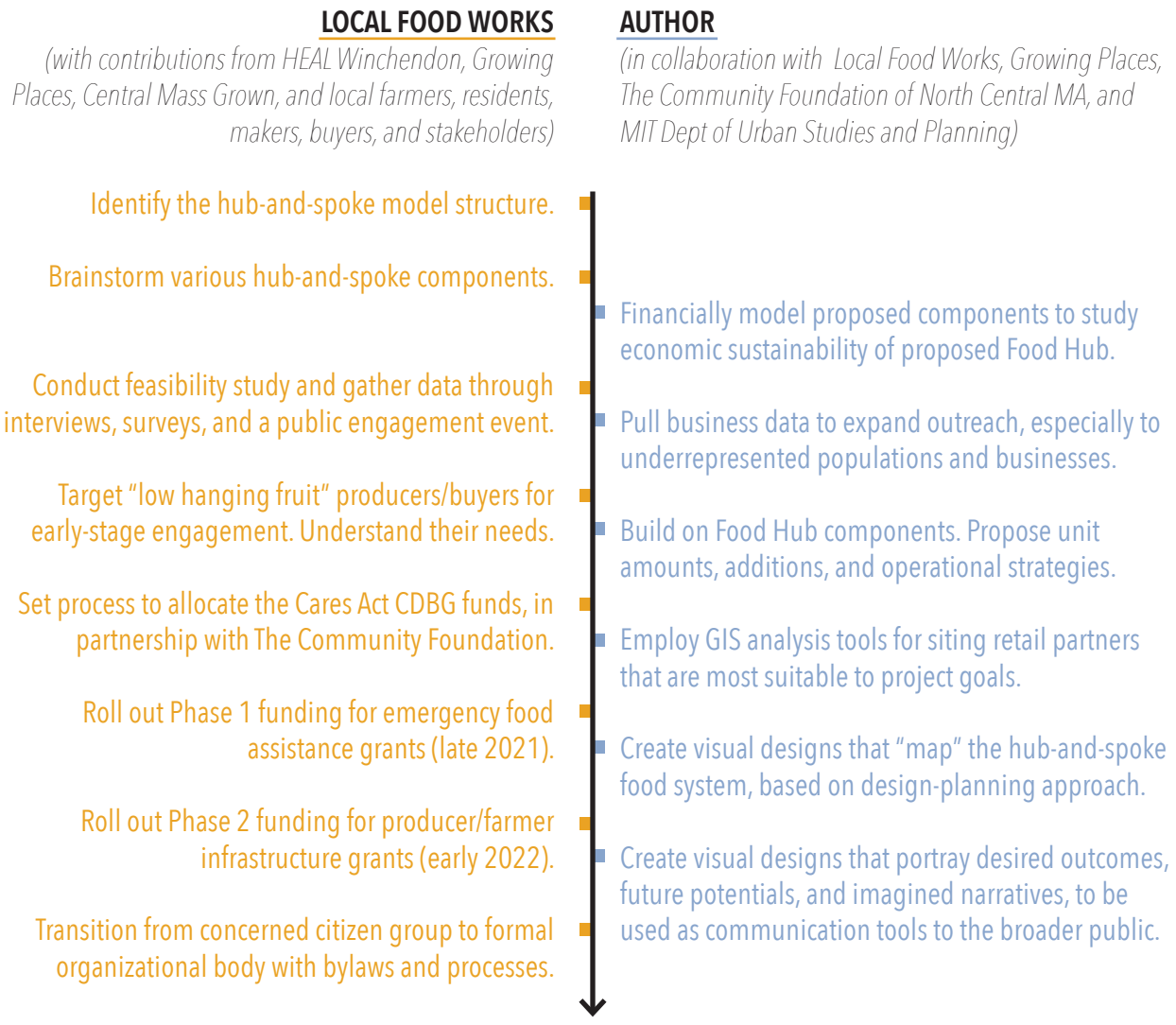
For example, in this iteration, the decision to include or omit certain inputs were informed by the project team and local context but chosen by the author. All analysis and siting recommendations for the below design are thus based on the author's decisions. However, it is intended that this methodology could be easily replicated with different inputs or alternative thresholds chosen by the project team. It is also intended that this approach be iterated many times over the duration of project implementation, to provide flexibility and maneuverability in redesign as needed.

Design / Planning Objectives *(reprinted from section 2.1)*
1. Promote economic development, in order to improve opportunities for advancement.
2. Establish a food network that supports social equity, education, environmental safeguarding, community cohesion, and improved quality of life for all residents.
3. Invest public funds in infrastructural provisions and upgrades, such that spending is directed towards long-term and sustainable programs instead of piecemeal corrective policies.
4. Develop methodology for strategic siting of food system components, in consideration of key input factors like population, transportation, environment, etc.
5. Optimize impact by designing multiple outcomes from one intervention. Consider partnerships, co-benefits, and multiple users of a single space.
6. Creatively use existing assets rather than inject wholly new features into the system, where possible.
7. Balance financial goals so that the success of one group doesn't come at a cost to another.
8. Integrate community engagement, stakeholder input, and operational transparency in all aspects of the system. Create platforms for stakeholders to lend their expertise and communicate with each other.
9. Operate on a large scale; work on a small scale. The food system must operate on a regional (and beyond) scale to ensure economic sustainability, but individual components should remain on a smaller scale to ensure community trust, feedback, and a manageable capacity.

The following section on schematic design is the author's contribution to the Local Food Works project. It is meant as an academic and design study, and it was developed in parallel to the actual project. Portions of the designs, therefore, will directly reflect objectives of the project team; other portions of the designs are newly introduced features from the author, and may or may not be feasible or desirable in actuality. Thus, this section aims to do the following:

1. **Reflect** existing discussions and translate them into more visually-communicative graphics, with the hope that such visuals can help portray complex ideas to the public, to funders, and to potential partners;
2. **Propose** additional features and operational strategies that respond to existing discussions and current conditions; and
3. **Inspire** Local Food Works and the north central community to continue in their visioning of future possibilities for a better food system.

A timeline is included below to clarify the parallel development (past and future) of the Local Food Works project and the thesis research/designs:



A MULTI-SCALAR STRATEGY FOR ECONOMIC VIABILITY

Part 1 of this thesis discussed the need for a multi-scalar strategy to food system planning, and positioned urban and rural environments not as discrete, but as overlapping, places of food operations. For example, the objective of approaches such as City Region Food Systems - which integrates urban, peri-urban, and rural areas in a holistic food supply chain - is to acknowledge the strengths and weaknesses of each setting to develop a balance such that one doesn't thrive at the expense of the other. There is a growing understanding that, in order to create a sustainable food system that supports a healthy planet and population, we must redesign a better balance of food system inputs.

While Local Food Works aims to place local products in the foreground, it does not intend nor advocate for creating a completely-closed regional food system. Nutritionally, certain staple items, such a wheat flour, are not produced in the region. Culturally, certain foods are not readily accessible. Financially, to separate fully from traditional global supply chains would not prove lucrative or useful. Geographically, peripheral areas including major metros like Springfield or Boston, offer potential for Local Food Works to expand into larger markets and should not be excluded from future planning.

> For example, one proposal for a later stage is to partner with the Massachusetts Port Authority (Massport) which owns and operates three airports - Logan International Airport, Hanscom Field, and Worcester Regional Airport - to incorporate North Central MA products within their concessions portfolio. Exploratory conversations with Massport revealed that their concessions strategy had been veering in the direction of "local" over the past years, incorporating more Boston-identified restaurants such as Lucca (located in Back Bay), Monica's sandwiches (located in North End), Shojo (located in Chinatown), and Legal Seafoods (founded in Cambridge). In 2014, a grab-and-go food retail space called Berkshire Farms Market was added to the Massport concession portfolio to vend local products mainly from Western Massachusetts. Preliminary conversations with Massport indicated potential interest in a partnership with an organization such as Local Food Works which aggregated and oversaw local products from the north central region. While too early to plan for this type of expansion, it is useful for Local Food Works to consider various scales of reach beyond their immediate regional "borders".

Thus, it is recognized by Local Food Works and the author of this thesis that there is a necessary balance of local and non-local that must be incorporated into a regional food system to ensure the financial, cultural, and nutritional health of the population. Partnerships with small local stores must occur alongside partnerships with large institutional buyers. More profitable retail channels must offset less profitable retail channels. Reaching high-income dense consumer markets in populated towns like Fitchburg must co-operate with reaching low-income sparse consumer markets in rural areas like Petersham. Local products should be foregrounded, but in a manner that's realistic and suitable for consumer desires. Established supply chains need not be entirely cut, but instead finessed to better serve local needs by rethinking and redesigning the flows of products into and out of the region.

At the center of this project is the question:

"How can we create a food system that is both *equitable* and *financially sustainable*?"

This aim, while attractive in theory, becomes much more challenging in actuality. Within current capital markets, "equity" and "financial sustainability" are often placed in opposition to each other. Equitable access may mean lowering prices at farmers markets to make vegetables more affordable; it might mean incentivizing a grocery store chain carrying global bulk products to locate in food desert areas. However, both of these options may hurt local farmers. Financial sustainability of local agriculture might mean increasing vegetable prices at retail sites, or narrowing the grocery options to force more local purchasing. However, this would hurt low-income populations and further add to perceptions of local food as a luxury item for the wealthy.

The challenge of balancing actions is the central guiding task of the project, and one that, in all honesty, is not a guaranteed success. Through its initiative, Local Food Works is essentially attempting to *build and sustain* an alternative structure in a market system that is unfriendly to such alternatives. With strategic interventions (both infrastructural and operational), Local Food Works proposes to create economies of scale through a coalition of farmers, to craft safety nets and financial supports through responsive business plans, and to facilitate inclusivity through targeted and intentional actions.

There are many ways to operate a traditional profitable system at the expense of the consumers or the producers. But building an equitable and sustainable food system for diverse populations requires a careful balance of various food system components and operations, which will be discussed in the following sections.

A sustainable local food economy involves more than just local food. Photo by Mackenzie May.

THE ROLE OF DESIGN

For a project with such a large geographical footprint, with so many moving parts, the role of design can seem murkey. Financial modeling, survey and data analysis, operations and logistics - all of these tools are clearly applicable and useful to developing a Food Hub for the region.

But what is the role of design in food system planning?

This question repeatedly surfaced over the course of the author's involvement in the project. Yet, over months of participating in Local Food Works - organizing public charrettes, writing summary reports, reviewing grant applications, presenting plans to funders, and brainstorming operation strategies - it became clearer that design could have a remarkable impact to this project.

Design can augment the imagination to explore possibilities of the future. Through imagined spaces and scenes, it communicates potential while still reflecting the local environment. In its ideal form, it brings a newness and familiarity to the audience it seeks to reach, and sparks not only hope but further ideas from the local population as to what the project can be.

Besides uplifting the imagination to new possibilities, it also grounds the project in real life context and conditions. It helps to translate grant application text and hours of brainstorming sessions into visuals that lean closer to tangible action. Renderings, while themselves imagined moments, can feel more akin to reality through their mixture of detail and abstraction.

Within the complexity of food systems, design can also reflect multiple scales of intervention by portraying scenes of the built environment, of programmatic activities, and of individual narratives. Generally, food system planning takes a high-level perspective that facilitates flows and processes across large distances and populations. Yet, as this project has emphasized, food systems are not only about the big picture but also about the individual - the small farmer whose livelihood is determined by a summer's rainfall; the local ice cream maker whose income is dependent on whether the farmers market at which she vends is sited in a convenient location for customers; the elderly resident who relies on a neighbor to drive him across the state border since the recent closure of his neighborhood market. This is where design can speak loudest; where it can respond to context and conditions through imagination, sentiment, and visioning.

What follows in this section are designs at a multitude of scales - from regional operations to bulk preparation culinary classes to salsa recipes made with local vegetables. It is hoped that these designs respectfully exist within the sweet spot of imagination and reality, and that they reflect Local Food Works' plans and inspire new ideas for the future Food Hub.

COMPONENTS

Based on the design / planning objectives, the following components have been identified to include within the Food Hub network in order to operate an inclusive and financially-sustainable local food system. Some of these components may be operated by Local Food Works, but others should be independently run, with support by the network.

CENTRAL WAREHOUSE

A **central warehouse** is the heart of the Food Hub network, providing operational and logistical support to the surrounding "spoke" nodes.

The warehouse intakes produce from surrounding small regional farms. Using commercial-grade equipment, on-site staff clean, sort, package, and store produce to then be redistributed outwards to various retailers (including retail partner sites, institutional purchasers, mobile market, and CSA orders). This in-house processing takes a burden off of small farmers, and allows Local Food Works greater control over sanitation, quality, tracking, and order fulfillment.

INSTITUTIONAL BUYERS

Institutional buyers are vital to the system, as they provide the bulk of stable income from large-scale purchases. Institutional buyers might be schools, hospitals, senior centers, and other major purchasers.

These buyers may have specific needs, such as HACCP certification, traceability records, and seasonal consistency, thus will require unique strategies for successful partnership.

Increasing transactions between local producers and institutional buyers requires navigating complex systems (safety, contractual, bureaucratic) as well as negotiating prices and relationships. Local Food Works would be poised as an intermediary to assist both sides in creating such partnerships.

COMMERCIAL KITCHEN

A **commercial kitchen** offers a shared space for food entrepreneurs, small businesses, and local processors to increase their food production levels and grow their ventures while supporting local farmers and the Food Hub network.

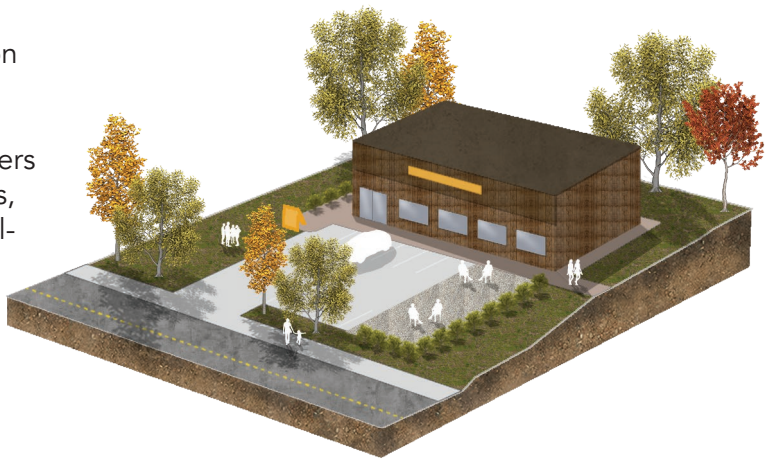
Currently local makers either use substandard community kitchens, their own homes, or distant commercial kitchens in neighboring towns/counties. A proposed food/ag-focused makerspace located within the region allows more convenient access to needed equipment and facilities, as well as provides the opportunity to increase and/or incubate food businesses.

It is recommended to partner with existing business incubators.

RETAIL PARTNERS

The **retail partners** are existing businesses spread around the region who have entered into partnership with Local Food Works to act as wholesale buyers of produce. Partners might be grocery stores, restaurants, convenience stores, and other small-scale retailers.

Purchase orders are facilitated through an online system, and distributed from the central warehouse to the retail partners via refrigerated vans. Retail partners are not only buyers, but are supported by the larger Local Food Works system in the form of needed infrastructure (refrigerators, shelving, signage, etc.).



DEMONSTRATION FARM

Community Gardens / Community Farms, while cherished assets in urban settings, do not have the same demand in rural areas where land and natural green space are more plentiful. North central MA hosts a handful of communal gardens, and these should continue to operate as they provide benefits such as healthy food, community cohesion, education, and leisure.

However, it would be strategic to treat these **demonstration farm** spaces less as sites of production, and more as sites of education and visible regional identity. They could be used as welcome sites for agrotourism, to promote the region as one that celebrates and respects its agricultural character. It is recommended to site them in highly visible places, such as the MBTA commuter rail stops.

Low-maintenance plantings, attractive and informative signage, public seating and rest zones, and winter-proofing strategies are recommended.

MOBILE MARKET

With a scarcity of healthy food options as well as a dearth of public transportation in the region, a handful of existing **mobile markets** target underserved areas and communities in need.

Many local retail stores do not accept SNAP/HIP dollars due to qualifying criteria, application hassle, or processing time. However, mobile markets run by eligible organizations (such as Growing Places/Local Food Works) do have the ability to accept SNAP/HIP benefits. Thus, the mobile market not only improves convenience for low-access communities, but also addresses food equity for low-income communities.

While mobile markets may not replace the reliability and long-term benefits of brick-and-mortar stores, they provide a needed service in rural settings by strategically covering a large geographic area and connecting disparate communities.

REFRIGERATED LOCKERS

Refrigerated lockers provide another access point for underserved communities to obtain healthy local foods. Individual produce orders, such as CSA shares, can be made to Local Food Works and then distributed to refrigerated lockers on specified days for pick-up by the consumer. Delivered produce is stored in a temperature-controlled environment to ensure safety and compliance.

One benefit is that orders placed to Local Food Works are eligible for SNAP/HIP. Another benefit is that many orders can be dropped and delivered at once, without needing to coordinate with each individual customer.

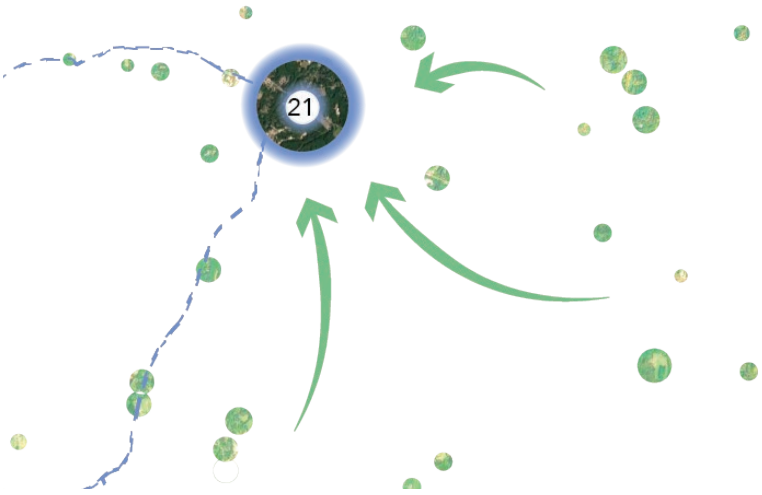
It is recommended to site these lockers at major community anchor points, such as hospitals, churches, schools and downtown areas.

[OPERATION] PIGGYBACKING

To address farmers' stated inefficiencies with transporting produce around the large region, it is proposed to use the retail partners as intermediary aggregation points to serve as harvest drop-off locations for farmers. This **piggybacking system** offers farmers a closer distance to offload their harvested produce, which then gets picked up by the Local Food Works van upon order delivery to the retail outlet.

This system allows a bi-directional flow of goods that utilizes existing retail sites to reduce drive times for farmers and for Food Hub staff.

More details can be found in the *Operations* section.



FREIGHT FARM

A **freight farm**, also known as a container farm, is a highly productive grow system supported by hydroponics within a controlled indoor environment. Typically, its variety is limited to leafy greens, cherry tomatoes, herbs, and other shallow-rooted plants.

The freight farm is not intended to replace or compete with existing agricultural activities in the region, but instead to supplement inventory at a significantly lower price point, as well as grow during winter months, thus providing an additional income source to the Food Hub.

The proposed siting of the freight farm is Montachusett Regional Vocational Technical School ("Monty Tech"), which would act as partner in the operation and maintenance. This partnership offers ideal educational links between local students, health and nutrition, and the agricultural community of the region.

OPERATIONS

Having established which components should be included, we now focus on how best to link them. There are two major aspects for consideration: operations and siting. Both aspects should be informed by lived experiences and data.

In terms of operations, if we reconsider Brinkley's alternative food network (AFN) model and adapt her notion of "nodes and edges" to the North Central MA region, we come to an interesting conclusion. While Brinkley focuses on the benefits of AFN models, such as increased trust between producers and consumers, healthy diets, and more efficient land use management,[56] she omits the risk that results from too many "edges" in a food system model. Arguably, the current North Central MA food system is just that - a hyper-decentralized model with so many independent connections between individual actors that the system is inefficient and fragmented.

The current system is visualized in Figure 38, where farms (in green) sell via direct-to-consumer channels (in red) or sell to other businesses (in blue). While this facilitates short supply chains, as Brinkley's AFN model praises, the onus of retail work rests heavily on the farmer. Processes such as cleaning, transportation, and marketing are repeatedly mentioned by producers as major time and money burdens. Furthermore, in the current system, retail options are slim and their scale is low. Larger purchases in the region, such as schools and hospitals, are not integrated well into the system and often don't purchase from local producers.

A proposed structure, which exists somewhat between Brinkley's traditional model and her AFN model, is proposed in Figure 39. In this version, the Food Hub (in yellow) plays a prominent role in the system by aggregating farm produce for redistribution to buyers. It is akin to a traditional food system through its central aggregation, but it still echoes an AFN structure in its short supply chain distance and its ability to facilitate tighter feedback loops and better trust. Main benefits of this model include:

1. the facilitation of contracts with larger buyers that increase purchase scales from local farms,
2. a strategic balance of higher revenue streams with lower revenue streams such that low income populations can access fresh healthy produce while supporting living wages for farmers; and
3. the Food Hub absorbs some of the processing tasks and costs (such as cleaning and packaging) which relieves the farmer from such duties.

This also gives the Food Hub more control over uniformity, tracking, sanitation and food safety. As mentioned by local institutional buyers, a major concern with any food aggregation system is chain of custody and traceability to ensure food safety and minimize risk.

56 Brinkley, Catherine. 2018. "The Small World of the Alternative Food Network." Sustainability 10 (8): 2921. https://doi.org/10.3390/su10082921.

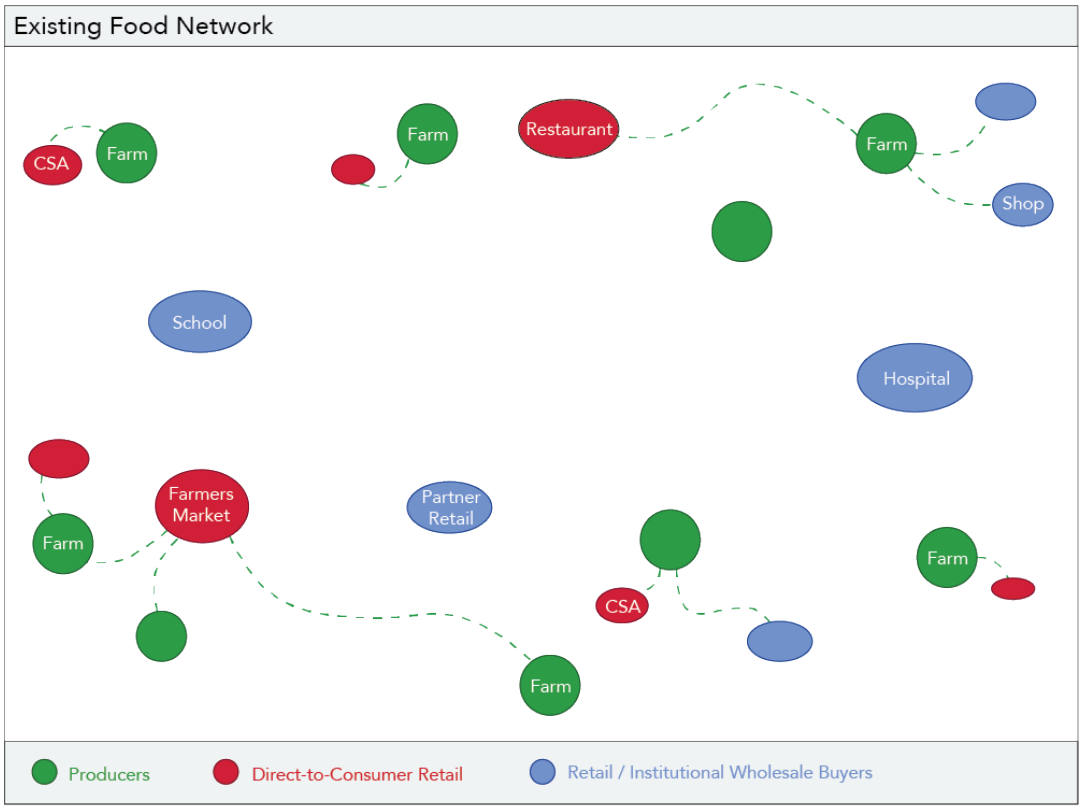


Figure 38. The existing node-and-edge network model includes many resources but missed connections and limited partnerships. [Source: Author]

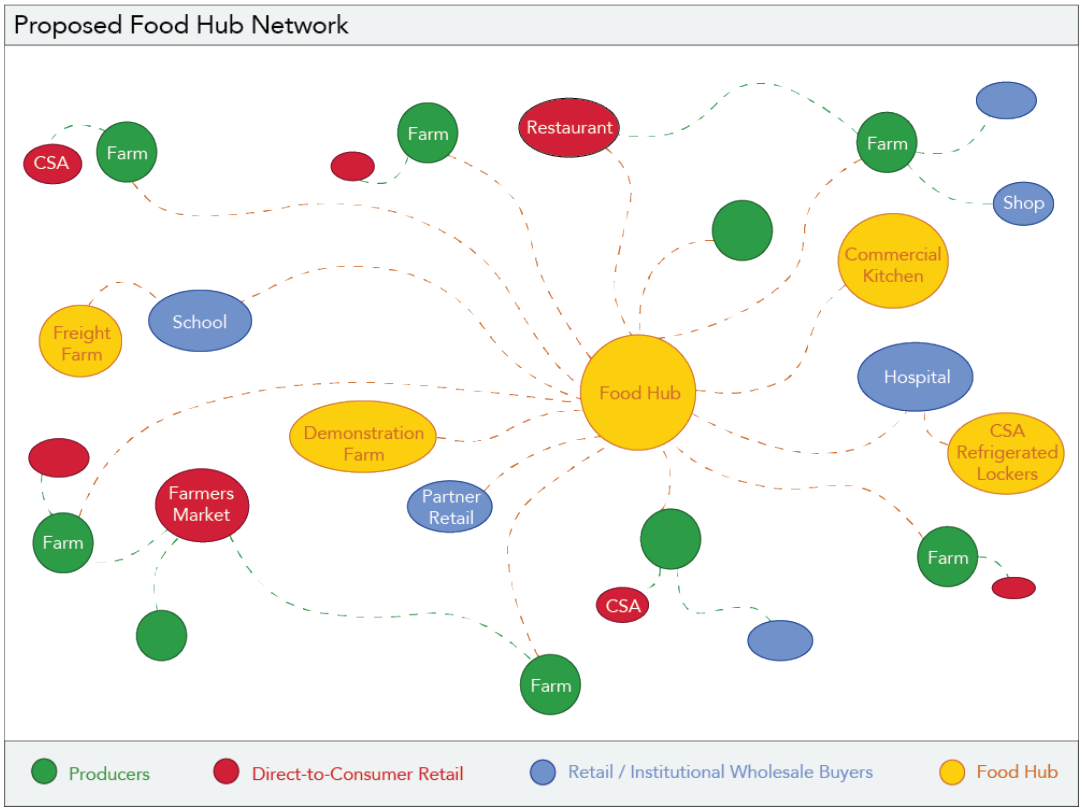


Figure 39. A proposed Food Hub model facilitates more connections between existing resources, as well as injects new infrastructure and resources to support the network. [Source: Author]

Additional benefits from the proposed model include the ability to more quickly maneuver in the case of unforeseen events. If one farmer's crop is lost suddenly to disease, that order can be more easily replaced with another farmer's crop in a pinch. The Food Hub can also more easily link to additional components such as commercial kitchens to support both local farmers and local makers.

Just as the proposed components emphasize co-benefits, so too should the operations. Limited resources spread across a wide geography means the system should rely heavier on partnerships and "piggybacking" rather than interjecting entirely new activities. The strategy of piggybacking uses existing assets to yield multiple functions, i.e., "feed two birds with one seed." For example, peripheral farmers, instead of driving all the way to the central warehouse location, can instead drop off uncleaned, unsorted harvested produce at the closest retail partner location. When the Local Food Works van comes to deliver the purchase order for that retail partner, they simultaneously collect the farmer's produce. This system saves the farmer the driving trip to the central warehouse, or the Local Food Works staff the driving trip to each individual farm. It also reduces the carbon footprint of the local food system by relaying produce from one node to another, instead of each producer driving their own harvests individually. Schedules and timing will ensure harvested produce isn't sitting too long at the retail outlet, and supports such as additional refrigeration, shelving, etc. will be provided to the retail outlet by Local Food Works. The retailer thus also receives additional storage infrastructure for their operations.

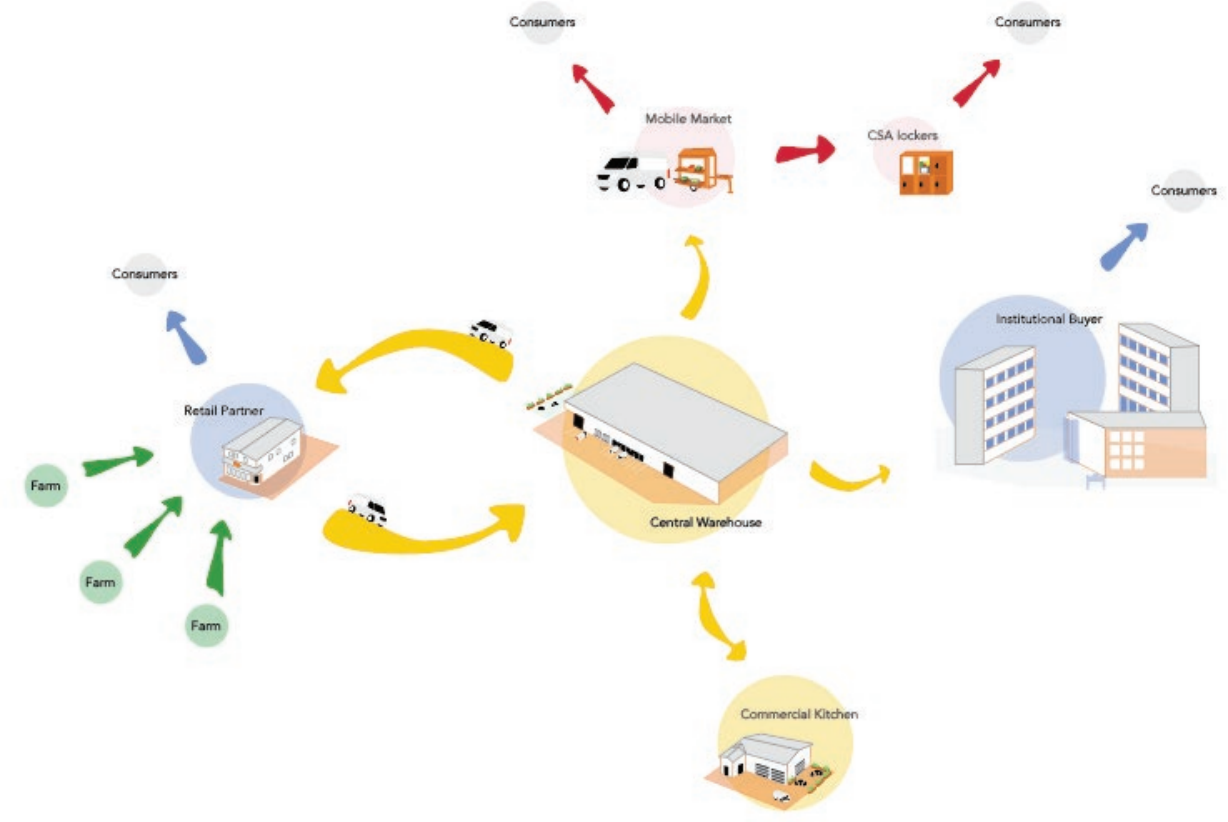


Figure 40. A proposed piggybacking operation sees each node playing a role in the overall system. [Source: Author]

Leafy green seedlings are incubated in rock wool which will be inserted into Growing Places' aeroponic grow towers. Tech-enabled indoor farming is not intended to replace traditional farming, but to supplement it.
Photo by Author (2021)

SITING

In terms of siting various Food Hub components, GIS-facilitated data analysis helps with more strategic decision-making. Algorithm-assisted data analysis can quickly reveal the population reach within a particular service area, as well as determine proximity of two points such as farms and retailers. Data can also highlight areas the project team may want to target, such as low income communities or those with minimal access to transportation or healthy foods.

Siting Task 1: Identify top retail options (based on largest service area) from a larger list.

To illustrate this siting process, the methodology has been applied on four different categorical retail lists, as defined by the North American Industry Classification System (NAICS).[57] These lists are not the only available options, but provide a sample of existing retail.

1. Fruit, Vegetable, and Meat Markets
2. Supermarkets and Grocery Stores
3. Convenience Stores
4. Gas Stations

These four categories were selected and kept separate under a hypothetical strategy that develops creative partnerships with both traditional and non-traditional food retail sites. For example, Local Food Works might explore options of providing healthy foods at local convenience stores, to target the underserved populations that patronize convenience stores as their main grocery outlet. Regardless of the category, the same process can be run to evaluate services areas within a predetermined drive time to pare down suitable options. Ideally, Local Food Works would run the analysis on their own list of potential retail partner options, to help inform their decision-making and priorities.

Business data for each of these categories was compiled for the following townships: Ashburnham, Ashby, Athol, Ayer, Barre, Clinton, Fitchburg, Gardner, Groton, Harvard, Hubbardston, Lancaster, Leominster, Lunenburg, Orange, Pepperell, Petersham, Phillipston, Princeton, Royalston, Shirley, Sterling, Templeton, Townsend, Westminster, and Winchendon. The author acknowledges that North Central Massachusetts is not a definitively marked area, thus some businesses on the edges may be included/not included in this iteration of the analysis.

While the analysis is useful to inform siting decisions, it is important to ground-truth the data to ensure that the GIS methodology aligns with what is desired and possible within the local context. For example, a local business with a large population reach may not be an ideal retail partner for reasons such as management restrictions, unsuitable infrastructure, or simply declining to participate in the Food Hub. Another local business with a slightly smaller population reach may be an ideal retail partner due to eagerness to participate, local ownership, strong ties to the community, etc. It is thus recommended for the project team

57 Business data for defined areas was extracted in July 2021 using ReferenceUSA (Data Axle), and manually verified and updated by the author to the best extent possible.

to iteratively move between GIS data and local context to determine the best partnerships. Population reach through large service areas is important, but is not the only factor in building strong customer bases and financial stability.

Furthermore, it is also important to recognize a basic condition of this type of calculation, that is, population reach is a consequence of density, therefore it is unsurprising that the isochrone maps in the following analysis reflect fairly similar outcomes. The densest populations tend to be located in areas like Leominster and Fitchburg, and thus will yield higher populations in their 15min drive service areas. Of course, as an equity-focused Food Hub, the goal is to disperse the "spoke" nodes throughout the region, and not cluster them only in areas of high population densities. To address this, the team may want to select retail options based not only on population reach alone, but by township.

Siting Task 2: Identify retail options that are convenient for nearby farms.

One of the goals of the North Central MA Food Hub is to improve retail operations for local small farms. In the earlier *Operations* section, a system of piggybacking was proposed, which sees retail partners acting as both distribution nodes to consumers and reception nodes from farmers. Thus, in addition to having a sizable service area, retail partners should be conveniently reachable by as many farms as possible.

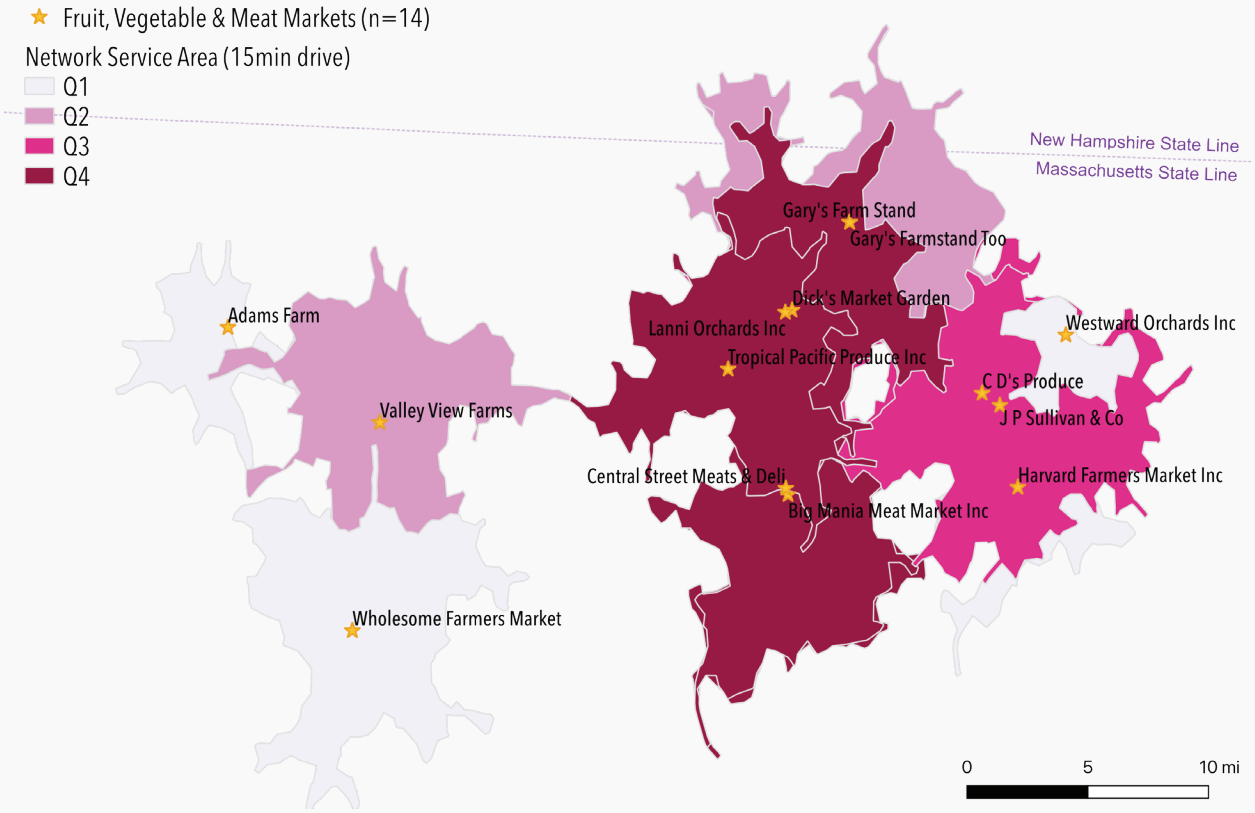
An origin-destination (OD) cost matrix was performed between the farms (origin) and the retail options (destination). This algorithm outputs one route for every Farm-Retailer combination. For example, one farm and five retailers yields five routes, two farms and seven retailers yields 14 routes, etc. The routes calculated by the selected algorithm (QNEAT3) uses the TIGER road network to determine the most direct route (note: the GIS visual output appears to produce Euclidian "as the crow flies" distances, but in actuality, the lines represent calculated network-based distances.)

In order to address convenience for farmers, we can narrow the route choices by limiting the OD cost matrix output to only include drive times of 23 minutes or less. This 23 minute tolerance level was determined by averaging the existing drive times between farmers and the farmers markets they joined during summer 2021.[58] By restricting the cost amounts produced in the OD cost matrix, we are displaying only "acceptable" Farm-Retailer combinations, i.e., those within similar drive times to what is currently tolerated.

What follows is the analysis indicating (1) the top quartile of population reached within a 15min drive service area, and (2) the ranking of retail options based on number of farms within a 23min drive. The analysis was conducted on the four categorical lists. These lists are intended only as samples for illustrating the data analysis process.

58 The exact average produced was 22.922 minutes, which has been rounded to 23 minutes for ease. The full breakdown of included drive times is included in Appendix A.

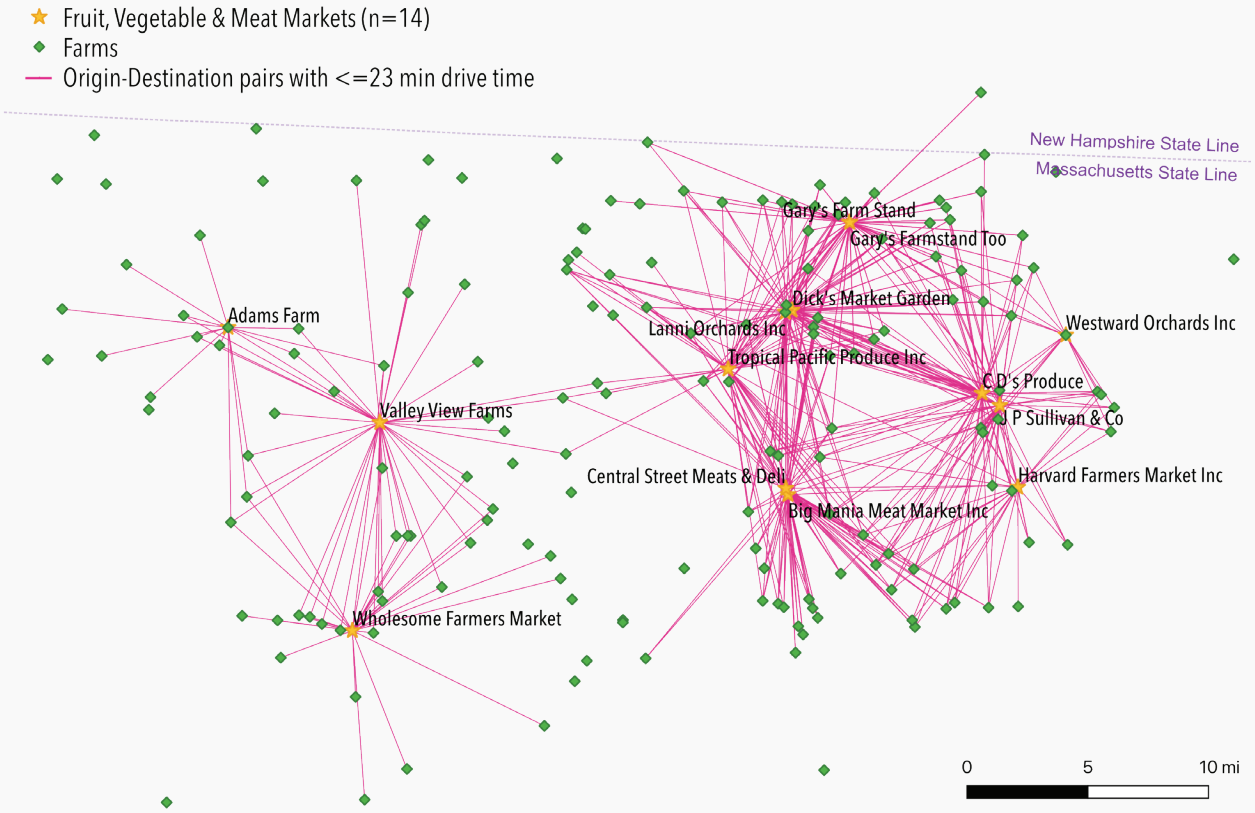
Siting Task 1: Identify top retail options based on service area (population reach)



Retail options within top quartile population reach (Q4 >= 78,523 people) ** Population data from EU Commission Global Human Settlement Layer via openrouteservice.*		
Tropical Pacific Produce	97 Birch St, Fitchburg, MA, 01420	Pop. 88,988
Lanni Orchards	294 Chase Road, Lunenburg, MA, 01462	Pop. 82,857
Central Street Meats & Deli	739 Central St, Leominster, MA, 01453	Pop. 79,436
Big Mania Meat Market Inc.	1037 Central St, Leominster, MA, 01453	Pop. 78,752

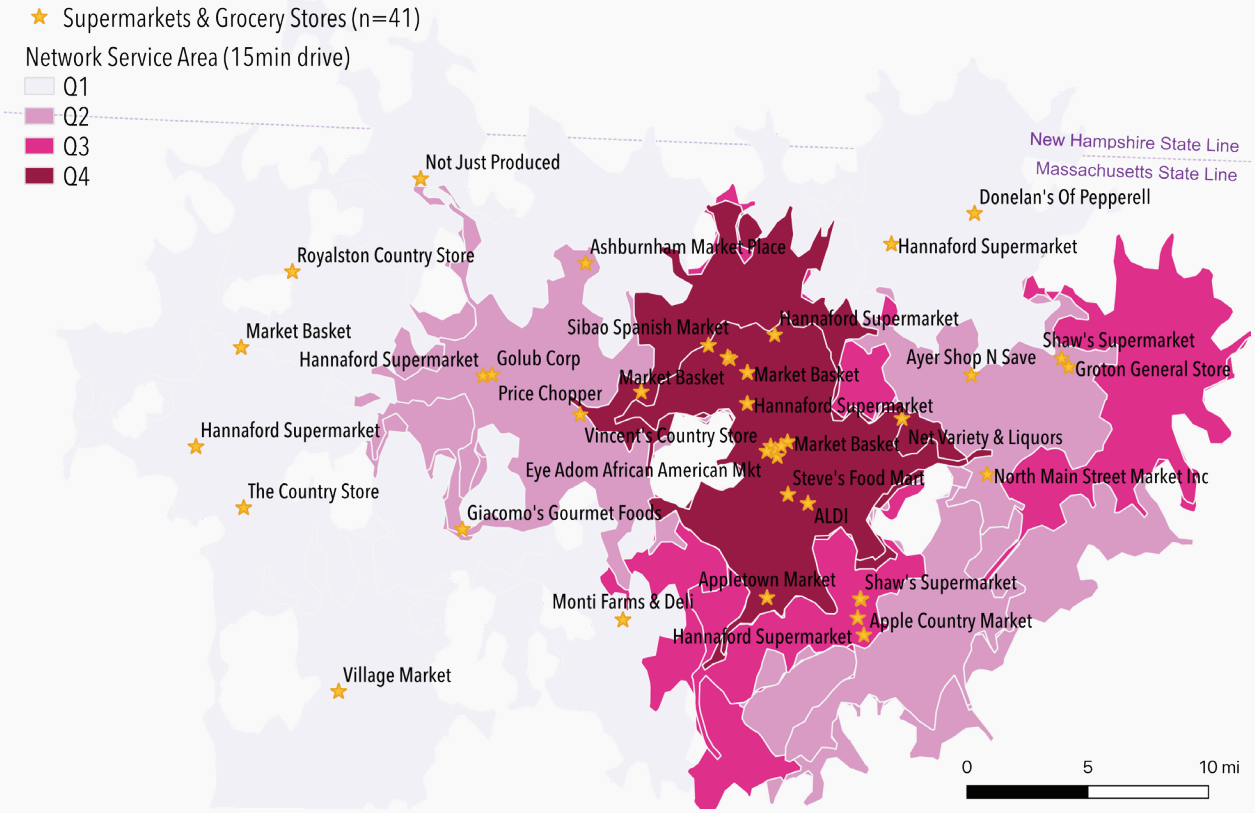
**Note: Some retail options include the word "farm" within their name. This may indicate a working farm with an on-site market (i.e., Adams Farm), or it may simply be part of the name with no active connection to a working farm (i.e., Honey Farms and Cumberland Farms which are both chain convenience stores).*

Siting Task 2: Identify top retail options based on convenience for farms



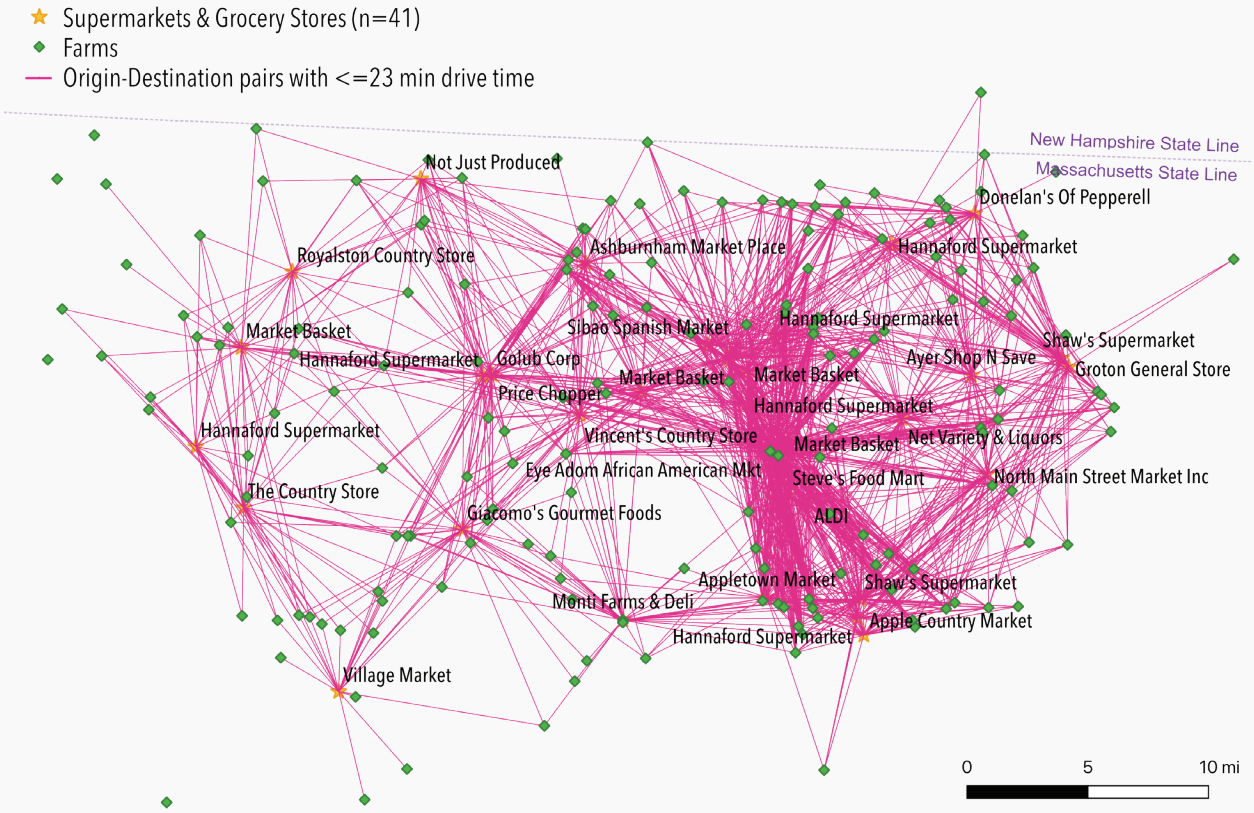
Retail options with number of farms served (<= 23min drive time) * *Networked drive times calculated using OpenStreetMaps.*		
C D's Produce	16 Main St, Ayer, MA, 01432	55 farms
Tropical Pacific Produce Inc	97 Birch St, Fitchburg, MA, 01420	55 farms
J P Sullivan & Co	50 Barnum Rd, Ayer, MA, 01432	51 farms
Central Street Meats & Deli	739 Central St, Leominster, MA, 01453	47 farms
Lanni Orchards	294 Chase Road, Lunenburg, MA, 01462	47 farms
Big Mania Meat Market Inc	1037 Central St, Leominster, MA, 01453	46 farms
Dick's Market Garden	649 Northfield Rd, Lunenburg, MA, 01462	46 farms
Gary's Farm Stand	159 Main St, Townsend, MA, 01469	46 farms
Gary's Farmstand Too	161 Main Street, Townsend, MA, 01469	46 farms
Valley View Farms	179 Barre Rd, Templeton, MA, 01468	39 farms
Wholesome Farmers Market	596 Summer St, Barre, MA, 01005	29 farms
Harvard Farmers Market Inc	28 Pinnacle Rd, Harvard, MA, 01451	26 farms
Adams Farm	854 Bearsden Rd, Athol, MA, 01331	15 farms
Westward Orchards	178 Mass Ave, Harvard, MA, 01451	13 farms

Siting Task 1: Identify top retail options based on service area (population reach)



Retail options within top quartile population reach (Q4 >= 86,466 people) ** Population data from EU Commission Global Human Settlement Layer via openrouteservice.*		
Market Basket	71 Sack Blvd, Leominster, MA, 01453	Pop. 95,780
Hannaford Supermarket	927 Merriam Ave, Leominster, MA, 01453	Pop. 95,561
J & D Spanish-American Market	104 Mechanic St, Leominster, MA, 01453	Pop. 94,967
Bourbeau's Mkt & Liquor Dept	192 Water St, Leominster, MA, 01453	Pop. 94,912
Fromagerie Madeline	43 Main St, Leominster, MA 01453	Pop. 93,890
Market Basket	399 John Fitch Hwy, Fitchburg, MA, 01420	Pop. 93,542
Caribbean Market	540 John Fitch Hwy, Fitchburg, MA, 01420	Pop. 93,542
Hannaford Supermarket	118 Lancaster St, Leominster, MA, 01453	Pop. 89,507
Eye Adom African American Market	49 Pleasant St, Leominster, MA, 01453	Pop. 89,023
Market Basket	90 Water St, Fitchburg, MA, 01420	Pop. 86,629

Siting Task 2: Identify top retail options based on convenience for farms



Retail options with number of farms served (<= 23min drive time) * *Networked drive times calculated using OpenStreetMaps.*		
Market Basket	399 John Fitch Hwy, Fitchburg, MA, 01420	64 farms
Caribbean Market	540 John Fitch Hwy, Fitchburg, MA, 01420	64 farms
Hannaford Supermarket	927 Merriam Ave, Leominster, MA, 01453	64 farms
Market Basket	130 Water St, Fitchburg, MA, 01420	60 farms
Market Basket	90 Water St, Fitchburg, MA, 01420	58 farms
Fromagerie Madeline	43 Main St, Leominster, MA 01453	56 farms
J & D Spanish-American Market	104 Mechanic St, Leominster, MA, 01453	56 farms
Net Variety & Liquors	5 Front St, Shirley, MA, 01464	55 farms
Hannaford Supermarket	118 Lancaster St, Leominster, MA, 01453	54 farms
Hannaford Supermarket	333 Massachusetts Ave, Lunenburg, MA, 01462	54 farms
Market Basket	71 Sack Blvd, Leominster, MA, 01453	54 farms
Bourbeau's Mkt & Liquor Dept	192 Water St, Leominster, MA, 01453	54 farms
Eye Adom African American Mkt	49 Pleasant St, Leominster, MA, 01453	54 farms

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Retail options with number of farms served (<= 23min drive time) ** Networked drive times calculated using OpenStreetMaps.*		
North Main Street Market Inc	280 Ayer Rd, Harvard, MA, 01451	52 farms
Ayer Shop N Save	22 Fitchburg Rd, Ayer, MA, 01432	52 farms
Sibao Spanish Market	1151 Main St, Fitchburg, MA, 01420	50 farms
Vincent's Country Store	109 Main St, Westminster, MA, 01473	50 farms
ALDI	241 New Lancaster Rd, Leominster, MA, 01453	49 farms
Oliveiras Market Inc	217 State Rd E, Westminster, MA, 01473	48 farms
Hannaford Supermarket	18 Main St, Townsend, MA, 01469	46 farms
Steve's Food Mart	1026 Central St, Leominster, MA, 01453	46 farms
Appletown Market	9 Main St, Sterling, MA, 01564	46 farms
Shaw's Supermarket	1175 Main St, Clinton, MA, 01510	44 farms
Hannaford Supermarket	333 Brook St, Clinton, MA, 01510	42 farms
Next Door Market	1183 Main St, Clinton, MA, 01510	42 farms
Shaw's Supermarket	760a Boston Rd, Groton, MA, 01450	42 farms
Golub Corp	560 Main St, Gardner, MA, 01440	42 farms
Price Chopper	560 Main St, Gardner, MA, 01440	42 farms
Giacomo's Gourmet Foods	32 Main St, Hubbardston, MA 01452	41 farms
Hannaford Supermarket	21 Timpany Blvd, Gardner, MA, 01440	41 farms
Apple Country Market	159 Mechanic St, Clinton, MA, 01510	41 farms
Donelan's Of Pepperell	75 Main St, Pepperell, MA, 01463	41 farms
Ashburnham Market Place	50 Main St, Ashburnham, MA, 01430	37 farms
Groton General Store	871 Boston Rd, Groton, MA, 01450	37 farms
Monti Farms & Deli	194 Worcester Rd, Princeton, MA 01541	36 farms
The Country Store	2 North Main Street, Petersham, MA, 01366	31 farms
Market Basket	147 Tower Rd, Athol, MA, 01331	31 farms
Not Just Produced	290 Central St, Winchendon, MA 01475	24 farms
Village Market	387 Main St S, Barre, MA, 01005	23 farms
Royalston Country Store	21 Main St, Royalston, MA, 01368	21 farms
Hannaford Supermarket	150 New Athol Rd, Athol, MA, 01331	22 farms

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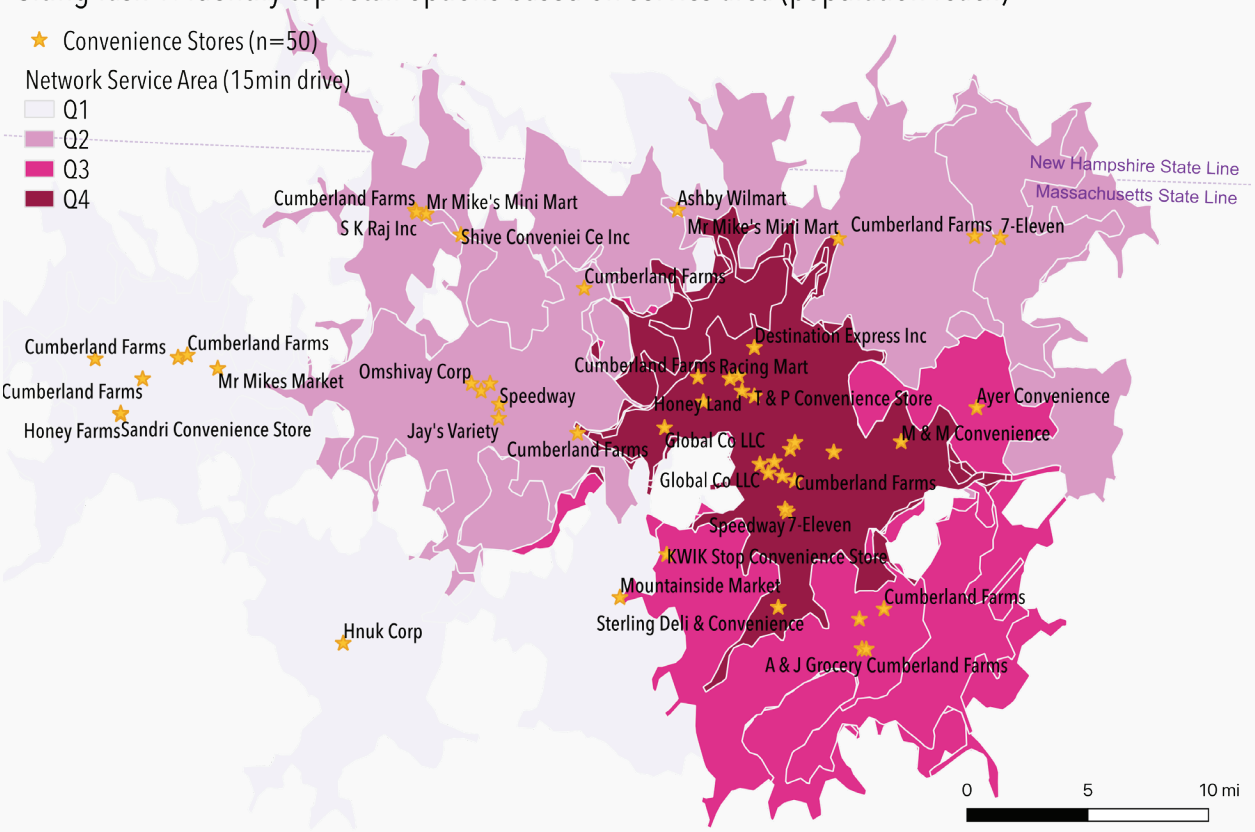
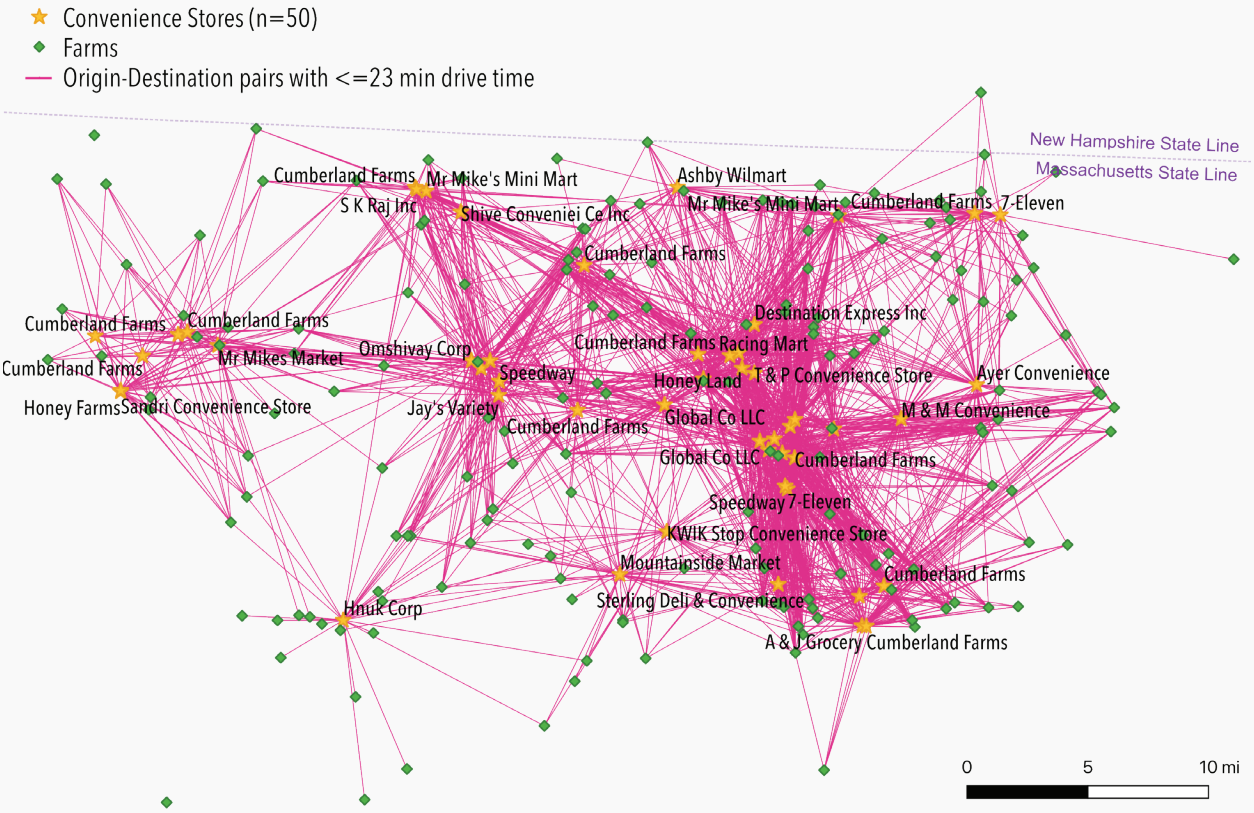
Siting Task 1: Identify top retail options based on service area (population reach)



Retail options within top quartile population reach (Q4 >= 87,905 people) ** Population data from EU Commission Global Human Settlement Layer via openrouteservice.*		
Speedway	482 Main St, Leominster, MA, 01453	Pop. 105,913
Turnout Variety Store Inc	636 Main St, Leominster, MA, 01453	Pop. 102,445
Cumberland Farms	1289 Main St, Leominster, MA, 01453	Pop. 98,865
Cumberland Farms	454 Mechanic St, Leominster, MA, 01453	Pop. 96,476
Honey Farms	134 Leominster Shirley Rd, Lunenburg, MA, 01462	Pop. 94,361
Senay's Package-Convenience	220 Mechanic St, Leominster, MA, 01453	Pop. 93,645
Honey Land	220 Summer St, Fitchburg, MA, 01420	Pop. 93,180
Global Co LLC	487 Princeton Rd, Fitchburg, MA, 01420	Pop. 92,407
Global Co LLC	202 Merriam Ave, Leominster, MA, 01453	Pop. 91,946
Jayzi Mart Inc	9 Pleasant St, Leominster, MA, 01453	Pop. 91,295
T & P Convenience Store	5 Summer St, Lunenburg, MA, 01462	Pop. 89,537
ABS Gas & Go	115 Lunenburg St, Fitchburg, MA, 01420	Pop. 88,965
Racing Mart	75 Main St, Fitchburg, MA, 01420	Pop. 88,147

Siting Task 2: Identify top retail options based on convenience for farms



Retail options with number of farms served (<= 23min drive time) * *Networked drive times calculated using OpenStreetMaps.*		
Speedway	482 Main St, Leominster, MA, 01453	69 farms
Honey Farms	134 Leominster Shirley Rd, Lunenburg, MA, 01462	68 farms
Turnout Variety Store Inc	636 Main St, Leominster, MA, 01453	65 farms
Honey Land	220 Summer St, Fitchburg, MA, 01420	64 farms
T & P Convenience Store	5 Summer St, Lunenburg, MA, 01462	61 farms
Cumberland Farms	454 Mechanic St, Leominster, MA, 01453	60 farms
ABS Gas & Go	115 Lunenburg St, Fitchburg, MA, 01420	59 farms
Cumberland Farms	1289 Main St, Leominster, MA, 01453	58 farms
Senay's Package-Convenience	220 Mechanic St, Leominster, MA, 01453	58 farms
Global Co LLC	487 Princeton Rd, Fitchburg, MA, 01420	58 farms
Racing Mart	75 Main St, Fitchburg, MA, 01420	57 farms
Jayzi Mart Inc	9 Pleasant St, Leominster, MA, 01453	55 farms
M & M Convenience	1 Front St, Shirley, MA, 01464	55 farms

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Retail options with number of farms served (<= 23min drive time) ** Networked drive times calculated using OpenStreetMaps.*		
Ayer Convenience	60 Park St, Ayer, MA, 01432	55 farms
Cumberland Farms	479 Electric Ave, Fitchburg, MA, 01420	54 farms
Cumberland Farms	550 Kimball St, Fitchburg, MA, 01420	54 farms
Global Co LLC	202 Merriam Ave, Leominster, MA, 01453	53 farms
Speedway	700 Central St, Leominster, MA, 01453	48 farms
Mr Mike's Mini Mart	238 Main St, Townsend, MA, 01469	48 farms
Cumberland Farms	460 High Street Ext, Lancaster, MA, 01523	48 farms
Cumberland Farms	68 Main St, Westminster, MA, 01473	48 farms
Sterling Deli & Convenience	50 Leominster Rd, Sterling, MA, 01564	47 farms
7-Eleven	766 Central St, Leominster, MA, 01453	46 farms
Speedway	19 Pearson Blvd, Gardner, MA, 01440	45 farms
Jay's Variety	32 E Broadway, Gardner, MA, 01440	45 farms
Mountainside Market	23 Hubbardston Rd, Princeton, MA, 01541	45 farms
Destination Express Inc	34 Cortland Ave, Fitchburg, MA, 01420	44 farms
Cumberland Farms	94 Main St, Lancaster, MA, 01523	44 farms
Honey Farms	53 Chestnut St, Gardner, MA, 01440	43 farms
Omshivay Corp	157 West St, Gardner, MA, 01440	42 farms
Cumberland Farms	130 Main St, Gardner, MA, 01440	42 farms
KWIK Stop Convenience Store	106 Main St, Princeton, MA, 01541	42 farms
Cumberland Farms	121 Main St, Pepperell, MA, 01463	41 farms
Cumberland Farms	1 Chestnut St, Clinton, MA, 01510	41 farms
A & J Grocery	252 High St, Clinton, MA, 01510	41 farms
Ashby Wilmart	1274 Main St, Ashby, MA, 01431	39 farms
Cumberland Farms	67 Main St, Ashburnham, MA, 01430	37 farms
7-Eleven	2 Tarbell St, Pepperell, MA, 01463	34 farms
Hnuk Corp	6 Moulton St, Barre, MA, 01005	31 farms
Mr Mikes Market	2143 Main St, Athol, MA, 01331	31 farms
Mr Mike's Mini Mart	234 Spring St, Winchendon, MA, 01475	27 farms
S K Raj Inc	50 Spring St, Winchendon, MA, 01475	26 farms

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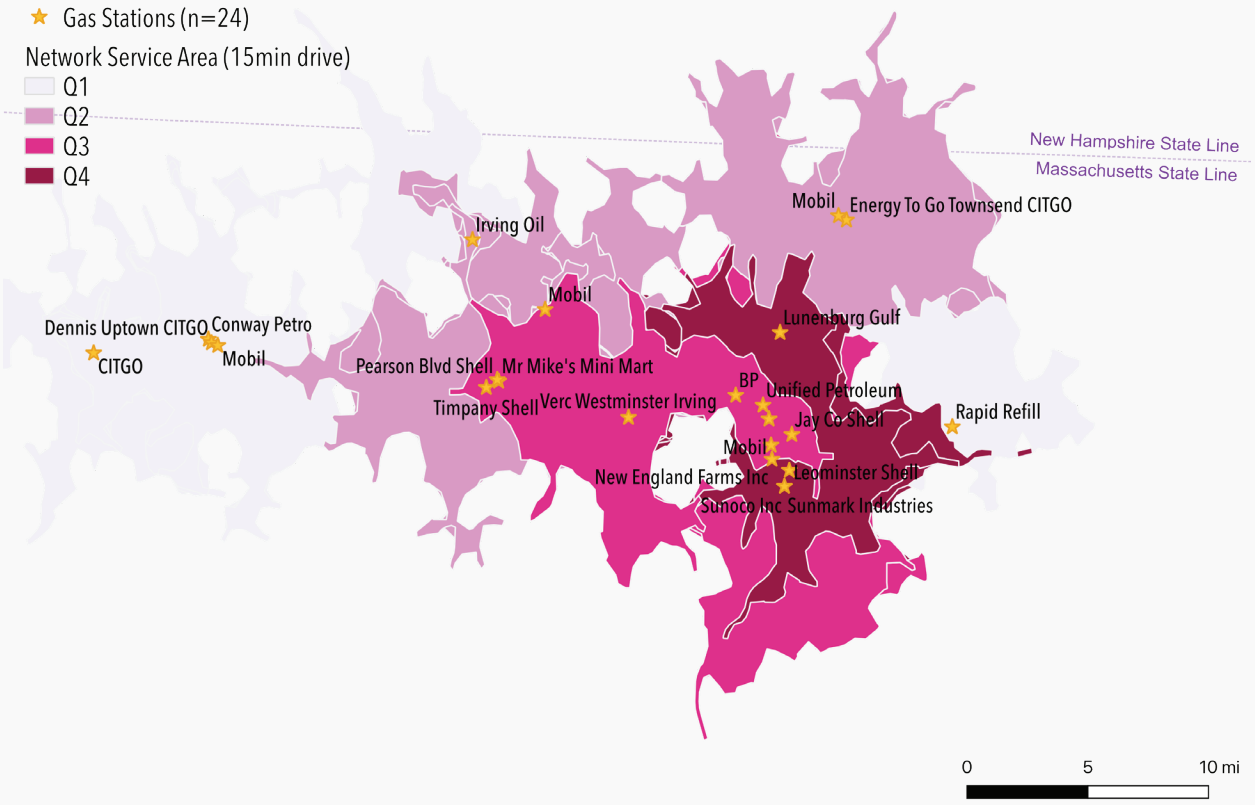
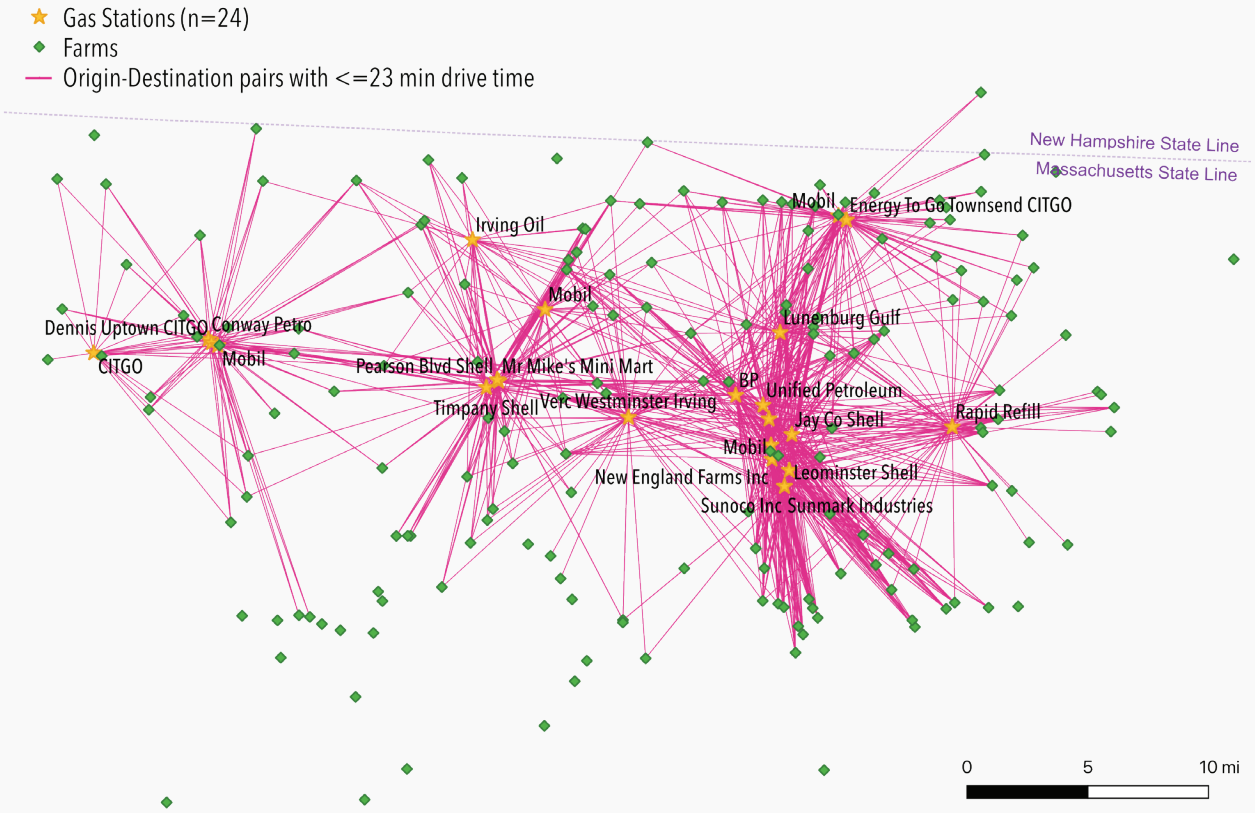
Retail options with number of farms served (<= 23min drive time) ** Networked drive times calculated using OpenStreetMaps.*		
Shive Convenience Inc	670 Spring St, Winchendon, MA, 01475	26 farms
Cumberland Farms	32 Central St, Winchendon, MA, 01475	25 farms
Cumberland Farms	297 Main St, Athol, MA, 01331	24 farms
Country Convenience	49 S Main St, Athol, MA, 01331	23 farms
Cumberland Farms	25 E Main St, Orange, MA, 01364	19 farms
Cumberland Farms	109 Brookside Rd, Athol, MA, 01331	18 farms
Honey Farms	167 Daniel Shays Hwy, Orange, MA, 01364	18 farms
Sandri Convenience Store	164 Daniel Shays Hwy, Orange, MA, 01364	18 farms

Siting Task 1: Identify top retail options based on service area (population reach)



Retail options within top quartile population reach (Q4 >= 89,712 people) ** Population data from EU Commission Global Human Settlement Layer via openrouteservice.*		
Conway Petrol / Sunoco A Plus	344 N Main St, Leominster, MA, 01453	Pop. 104,106
Jay Co Shell	26 Commercial Rd, Leominster, MA, 01453	Pop. 103,662
Unified Petroleum	592 N Main St, Leominster, MA, 01453	Pop. 97,309
BP	942 South St, Fitchburg, MA, 01420	Pop. 96,822
Mobil	76 Main St, Leominster, MA, 01453	Pop. 96,647

Siting Task 2: Identify top retail options based on convenience for farms



Retail options with number of farms served (<= 23min drive time) * *Networked drive times calculated using OpenStreetMaps.*		
Sunoco A Plus	344 N Main St, Leominster, MA, 01453	65
BP	942 South St, Fitchburg, MA, 01420	65
Conway Petrol	344 N Main St, Leominster, MA, 01453	65
Unified Petroleum	592 N Main St, Leominster, MA, 01453	64
Jay Co Shell	26 Commercial Rd, Leominster, MA, 01453	62
Mobil	76 Main St, Leominster, MA, 01453	55
Verc Westminster Irving	21 Village Inn Rd, Westminster, MA, 01473	52
Lunenburg Gulf	451 Massachusetts Ave, Lunenburg, MA, 01462	52
Leominster Shell	436 Lancaster St, Leominster, MA, 01453	51
New England Farms Inc	180 Central St, Leominster, MA, 01453	51
Sunoco Inc	701 Central St, Leominster, MA, 01453	48
Sunmark Industries	701 Central St, Leominster, MA, 01453	48
Mobil	238 Main St, Townsend, MA, 01469	48

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Retail options with number of farms served (<= 23min drive time) ** Networked drive times calculated using OpenStreetMaps.*		
Rapid Refill	4 Andrews Pkwy, Devens, MA, 01434	47
Energy To Go Townsend CITGO	197 Main St, Townsend, MA, 01469	47
Pearson Blvd Shell	6 Pearson Blvd, Gardner, MA, 01440	46
Mr Mike's Mini Mart	17 Pearson Blvd, Gardner, MA, 01440	44
Timpany Shell	264 Timpany Blvd, Gardner, MA, 01440	43
Mobil	6 Gardner Rd, Ashburnham, MA, 01430	36
Mobil	2143 Main St, Athol, MA, 01331	31
Dennis Uptown CITGO	1728 Main St, Athol, MA, 01331	28
Irving Oil	93 Gardner Rd, Winchendon, MA, 01475	27
Conway Petro	1590 Main St, Athol, MA, 01331	25
CITGO	272 S Main St, Orange, MA, 01364	19

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Siting Task 3: Identify underserved or vulnerable communities to site HIP-eligible retail.

A notable difficulty with benefit programs (such as federal nutrition subsidy schemes) within a market-based food system is that rules and regulations of the schemes can pose challenges to operational efficiency. For example, Massachusetts' Healthy Incentive Program (HIP) provides additional monthly funds for SNAP-eligible households, to be spent on healthy local fruits and vegetables. This scheme not only benefits recipients by adding dollars to their monthly allotment, but it benefits the local food economy by injecting funds specifically into locally-produced items. Thus, it provides a massive opportunity for local food/agriculture producers and processors.

This opportunity, however, is not being utilized as much as it can. Based on the SNAP/HIP Gap, which represents unenrolled eligible recipients (the "gap"), the region is missing out on approximately $12million per month of SNAP funding and $1.43million per month of HIP funding due to unenrollment (see Appendix B).[59] As discussed in *Part 1.2 Food As A Planning Concern*, this gap is often due to lack of information and knowledge, but also lack of convenient access.

While SNAP dollars can be spent at a variety of chain stores such as CVS, Dollar Tree, ALDI, etc., the HIP dollars can only be spent at approved vendors. The vendors approved in North Central Massachusetts tend to be organizations operating farmers markets, farm stands, CSAs, and mobile markets. Approved HIP vendors are few and not permanently located. Similarly, WIC dollars can only be spent in-state, posing inconveniences for border towns.

One effective solution to supporting a local food economy while also improving healthy food access for underserved populations is to advocate for more HIP- and WIC-eligible vendors. This policy approach would expand the available retail options that can serve a wider demographic of customers. As of currently, HIP and WIC recipients must carefully plan where to grocery shop in order to ensure their allotment dollars can be used at that location.

This policy approach might be the most effective way to improve food equity, however, policy changes are slow and resource-intensive. Communities that are facing immediate challenges may not be able to wait for improvements to schemes and benefit programs. In the interim, therefore, it is recommended to incorporate targeted design approaches in food system planning. In the case of North Central Massachusetts, this can take the form of strategic siting of HIP-eligible retail components, such as the mobile market and the CSA program, in communities of need.

Under the proposed operation plan, the mobile market and CSA drop-off are non-permanent retail fixtures within the region. Unlike the previous siting tasks for retail partners, the mobile market and CSA siting is based moreso on route and targeted support. While these retail channels exist for all customers regardless of income level, they present the opportunity to provide targeted support for specific communities that may lack access to healthy foods, vehicles and transportation, or alternative markets.

59 Based on a $503 monthly SNAP allotment for a 4-person household, and a $60 monthly HIP allotment for a 3-5 person household. More details in Appendix B.

To explore optimal routing and siting of these components, it requires a true mixture of data and lived experiences. The data can indicate underserved areas to be targeted for mobile market and CSA services. Figure 41 highlights specific census tracts that have been flagged by the USDA as low income communities with low access to supermarkets (greater than 20 miles) and/or low prevalence of vehicle ownership.[60]

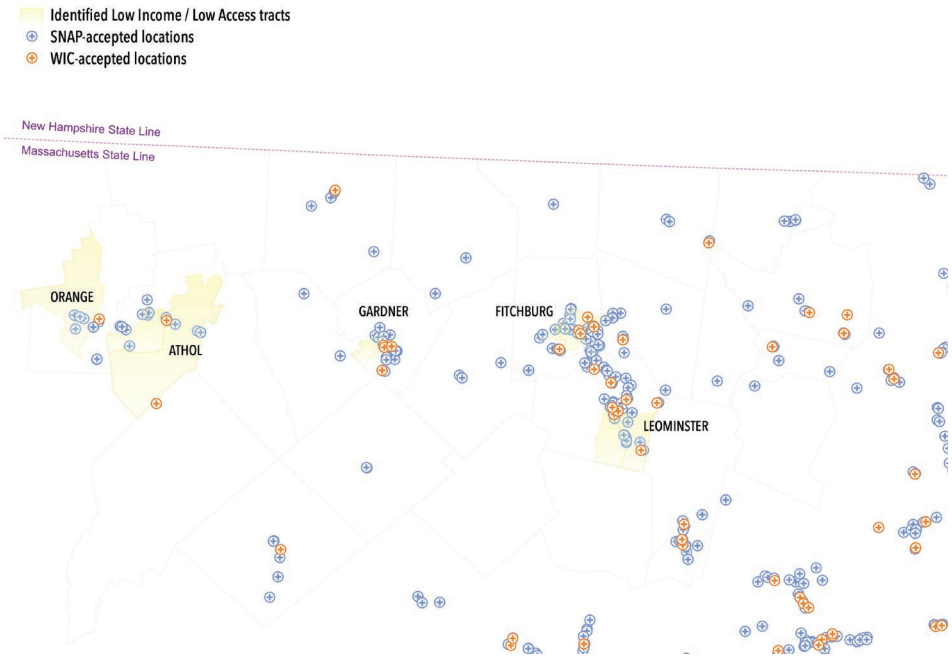


Figure 41. Identified low income / low access tracts, as well as SNAP and WIC eligible retailers. Source: Author. Tract data: USDA Food Access Research Atlas 2019 (LILATracts_Vehicle)]

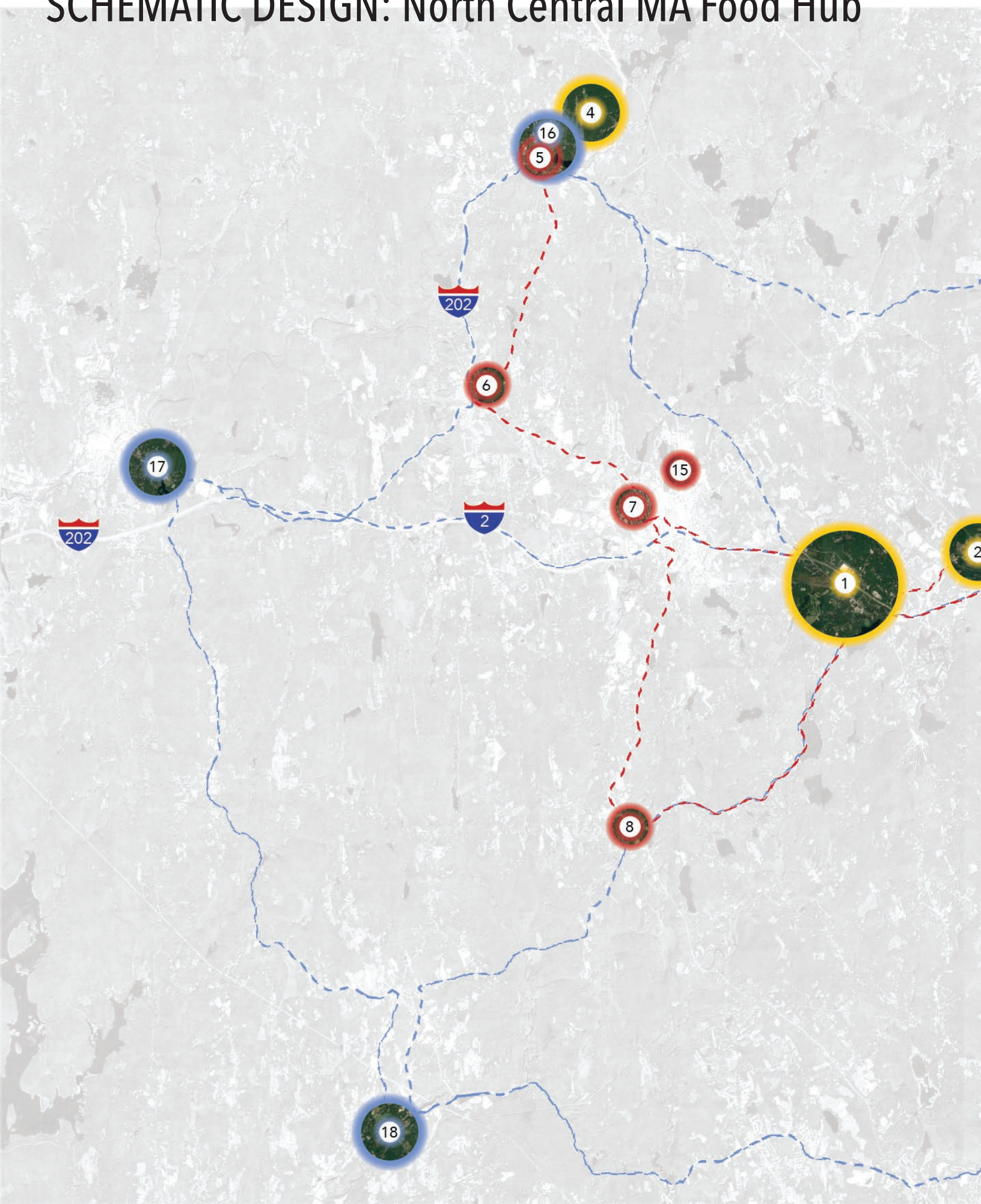
However, it is important to recognize that data does not provide the full picture, and it is vital to integrate local experience and knowledge. For example, the data flags five areas within the region as low income / low access communities. Yet stakeholders indicate there are other areas not reflected in the data that face significant challenges to accessing healthy foods.

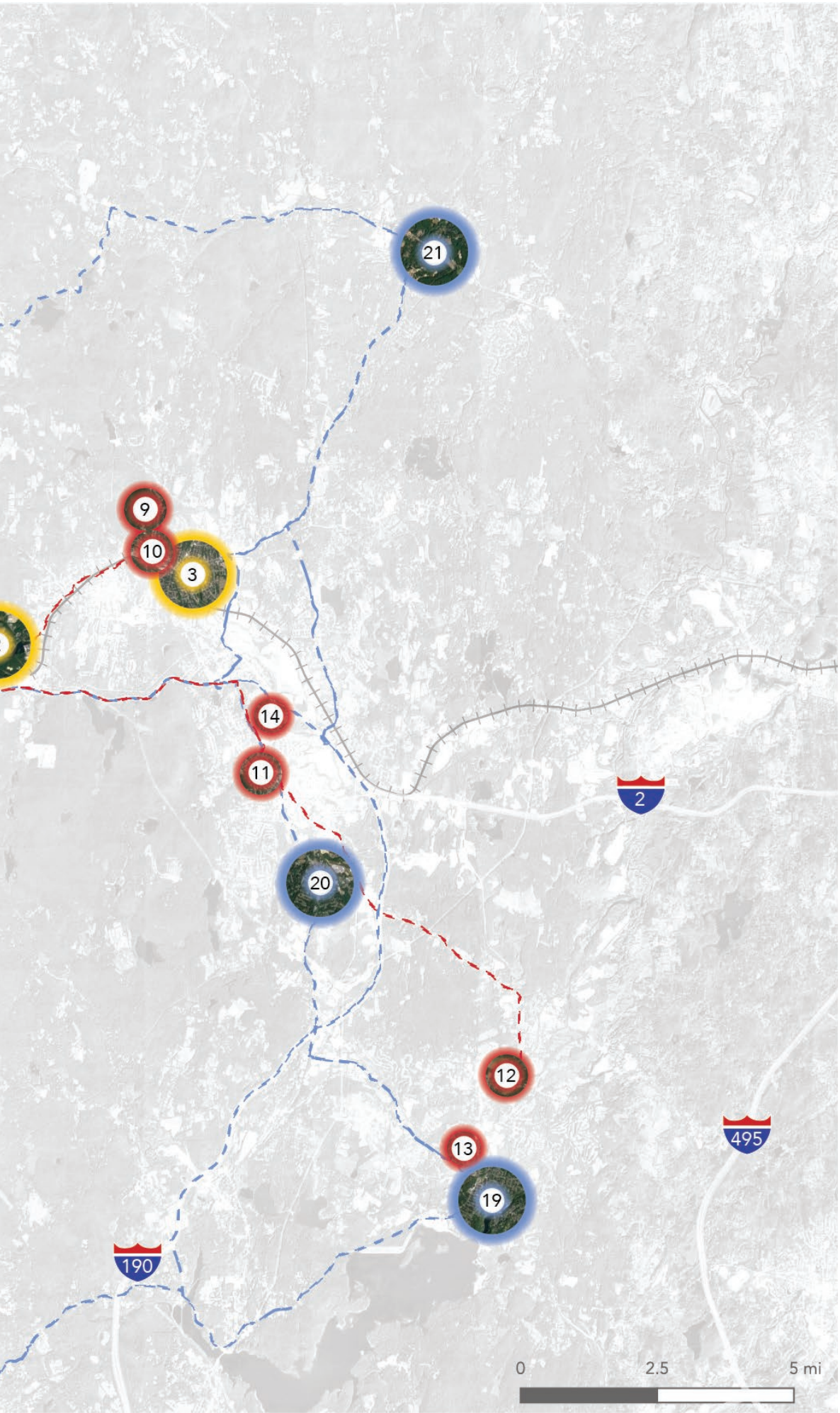
Furthermore, decision-making around the siting of mobile market stops (at which the vendor parks and remains for a temporary period of time) is highly nuanced. Stop locations are heavily influenced by partnerships with nearby entities such as senior living centers, veteran associations, etc. that may orchestrate shared van rides from the facilities to the mobile market stops. Therefore, for the purpose of this schematic design iteration, no new siting is proposed for the mobile market. What is included instead are the existing stops of the mobile market as currently operated by Growing Places. Their mobile market was purpose-built in early 2020 by their own staff to address issues of food access, and the operation and siting was informed by their accumulated knowledge working with local entities and underserved communities.

Thus, the following proposed schematic design incorporates a mixture of existing mobile market retail sites, as well as proposed sites for newly incorporated components.

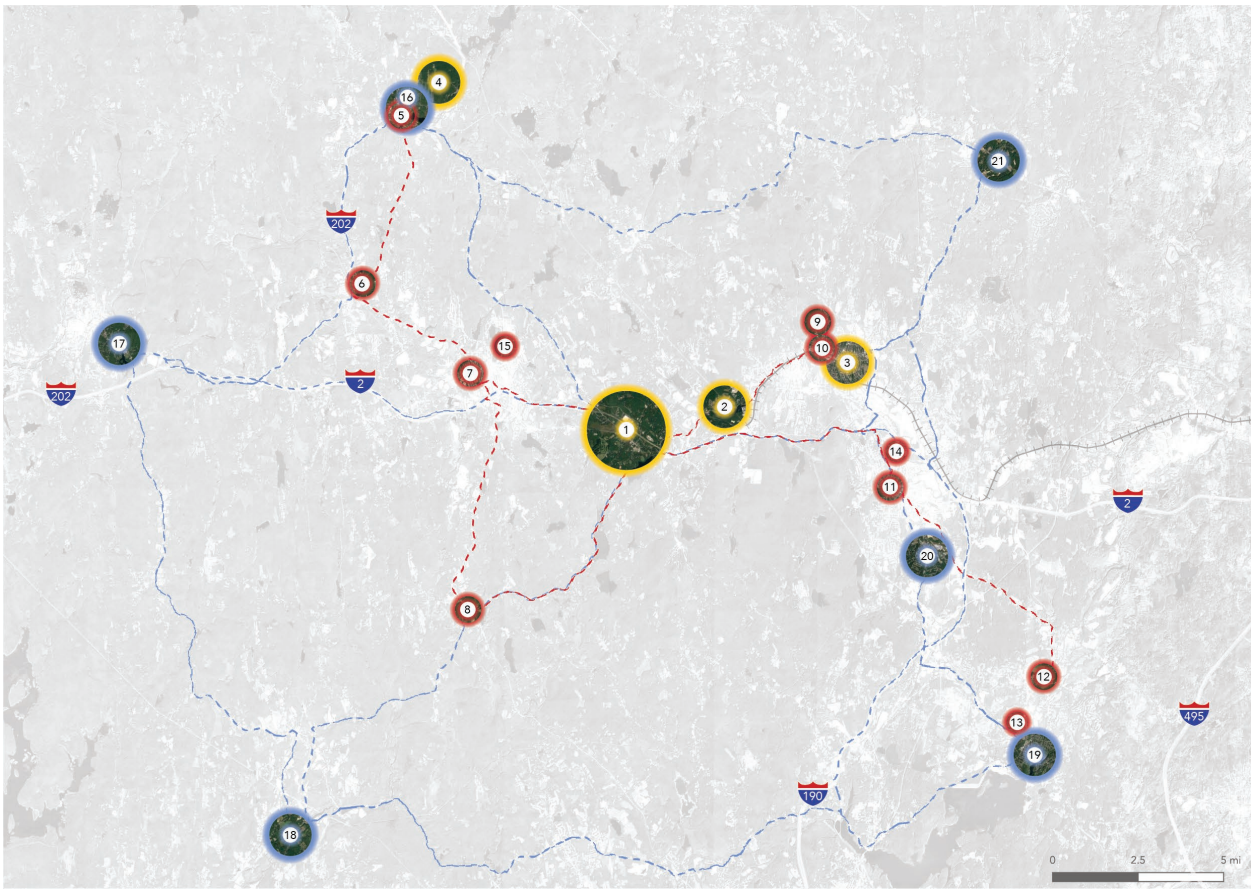
60 More info: https://www.ers.usda.gov/data-products/food-access-research-atlas/documentation/

SCHEMATIC DESIGN: North Central MA Food Hub





1. Central Warehouse
2. Freight Farm
3. Commercial Kitchen
4. Demonstration Farm
5. Mobile Market stop
6. Mobile Market stop
7. Mobile Market stop
8. Mobile Market stop
9. Mobile Market stop
10. Mobile Market stop
11. Mobile Market stop
12. Mobile Market stop
13. Refrigerated Lockers
14. Refrigerated Lockers
15. Refrigerated Lockers
16. Retail Partner
17. Retail Partner
18. Retail Partner
19. Retail Partner
20. Retail Partner
21. Retail Partner



SCHEMATIC DESIGN & FUTURE VISIONING

The schematic design visualizes a proposed option for siting and operating a Food Hub in North Central Massachusetts, based on inputs shaped by the project team and chosen by the author. The overall plan incorporates the various spoke components and uses data-informed and experience-informed strategies to locate them in optimal places for strategic operations and project objectives.

Three distinct colors indicate different operations within the Food Hub network, but in reality it is envisioned as one intermingled system.

Yellow indicates newly proposed operational or educational components, which are overseen by Local Food Works. These items typically require intense start-up capital, and represent the heart and central headquarters of the Food Hub network.

Red indicates retail sites, both existing and new, that can accept SNAP/HIP dollars since they are directly operated by Local Food Works. Given this ability to target low-income consumers, the siting strategy of red retail sites differs from blue retail sites.

Blue indicates retail sites that are partnerships with existing retailers. Local Food Works sells wholesale produce to these blue sites, which then apply their own markups.

1. Central Warehouse

Proposed siting is at the Aubuchon Hardware Warehouse space, located off Route 2 in Westminster. This location has the floorspace, loading amenities, and convenient transportation infrastructure needed for a centralized Food Hub operation.

2. Freight Farm

Proposed siting is at Montachusett Vocational Technical School.

3. Demonstration Farm

Proposed siting is adjacent to the Fitchburg train station for high visibility and proximity to Fitchburg State University.

4. Commercial Kitchen

Proposed siting is in downtown Winchendon, adjacent to one of the retail outlets, Not Just Produced. Many of the interviewed local makers indicated Winchendon as their top location priority for a kitchen/maker space. Furthermore, the new town manager of Winchendon has expressed interest in this type of project that boosts economic and employment opportunities for the town.

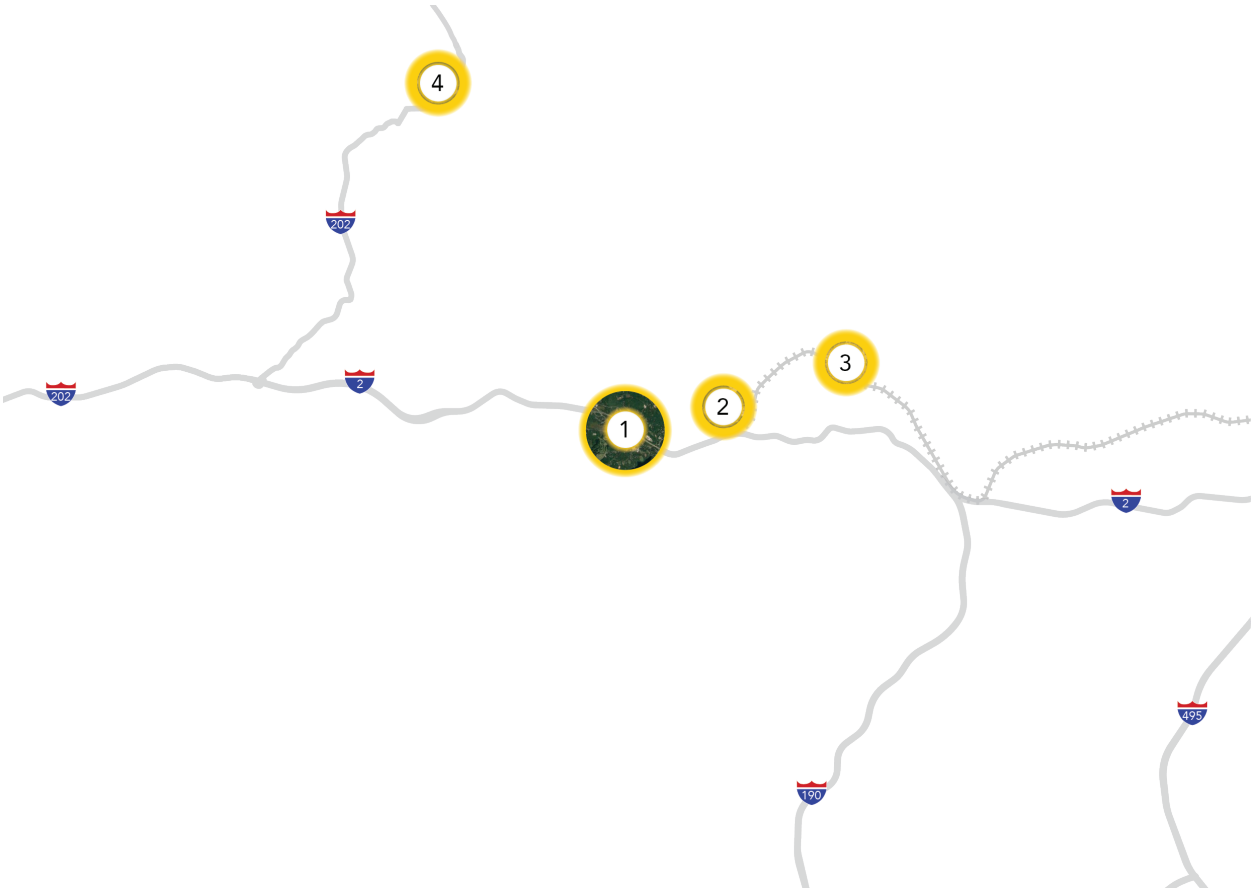


Figure 42. Proposed new components in yellow, operated or overseen by Local Food Works. [Source: Author]

5-12. Mobile Market stops

Siting has been replicated using the existing 8 stops of Growing Places' mobile market.

13-15. Refrigerated Lockers

Proposed siting of 3 refrigerated lockers is at Heywood Hospital located in Gardner, the UMass Memorial HealthAlliance in Clinton, and the UMass Memorial HealthAlliance in Leominster. These three towns were identified as ideal locations given the populations they serve and their accessibility. Furthermore the hospitals act as community anchor points with a logical alignment to improving nutritional health.

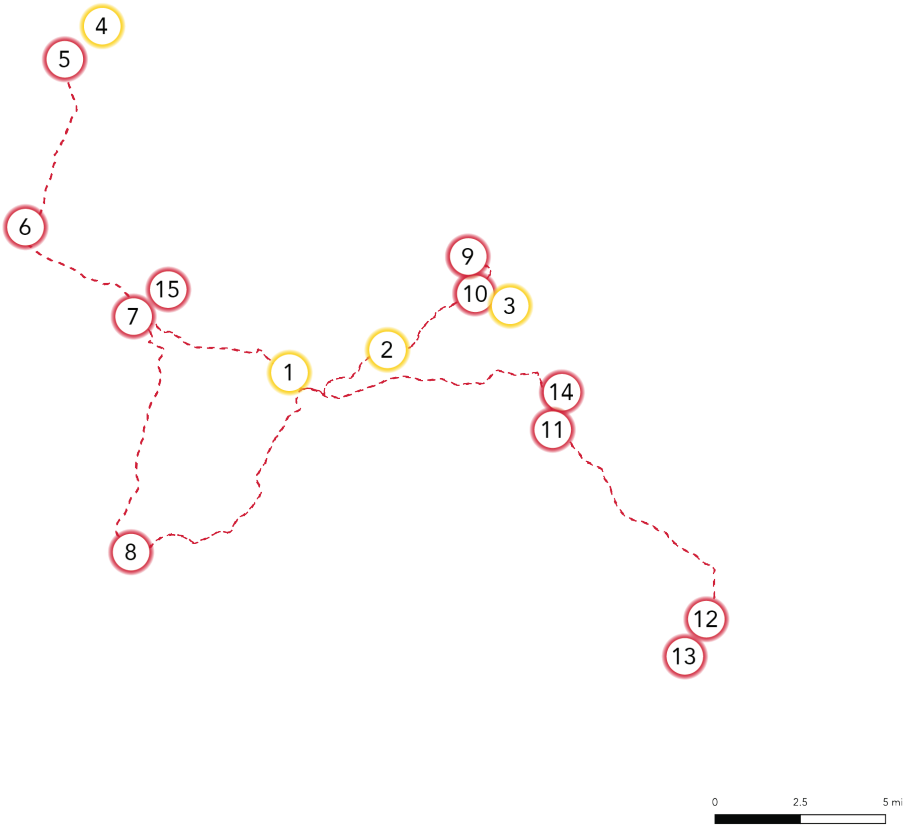


Figure 43. Food components in red are direct-to-consumer (B2C) retail channels that have the capability to accept SNAP/HIP benefits. [Source: Author]

The proposed operation, based on what is currently done by Growing Places nonprofit, runs the mobile market 3 days per week. With additional funds, capacity, and staffing, there is potential to increase the amount of stops and/or expand the route to reach further populations. As can be seen in Fig 44, the current routing covers a sizable portion of the geography with a considerable service area (15min walk in purple, 15min drive in red).

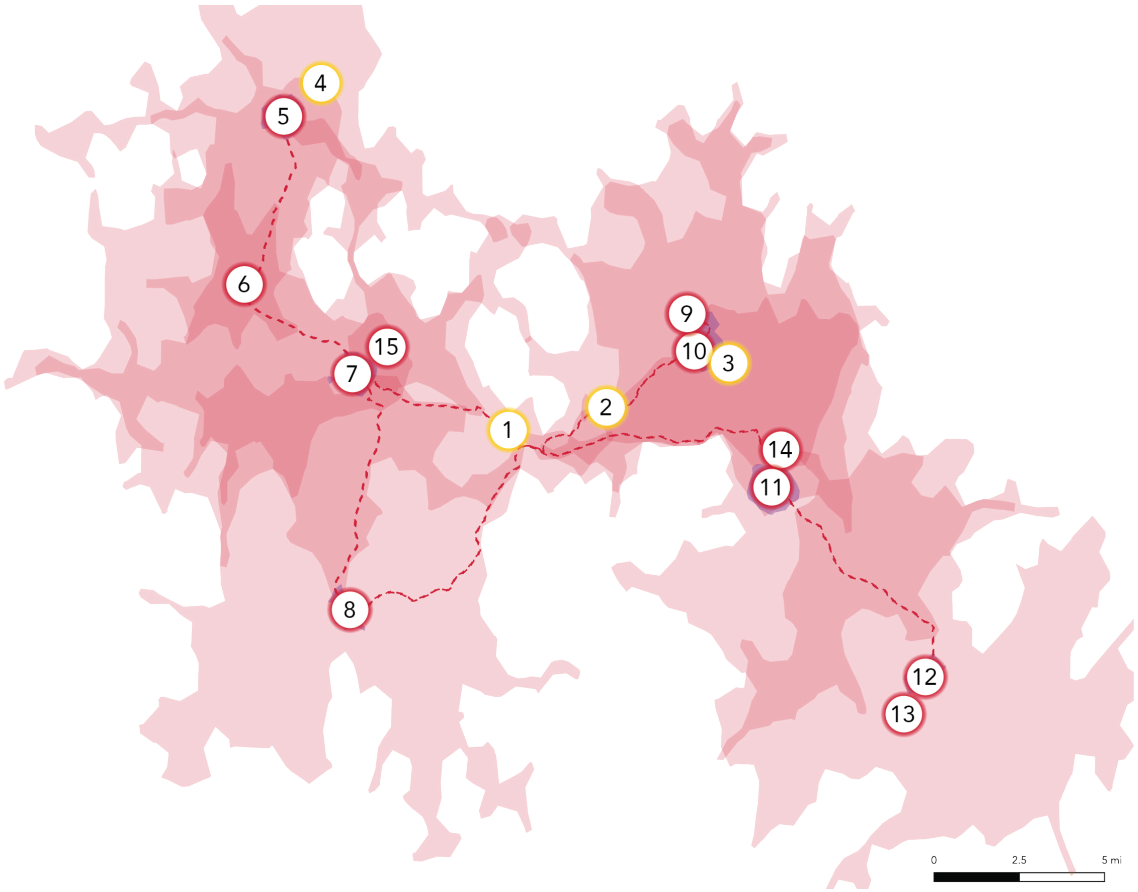


Figure 44. Service areas of mobile market stops (#5-12). CSA locker sites are also included (#13-15). [Source: Author]

16-21. Retail Partners

A sample of 6 retail partners are shown below, selected not for service area and farm proximity alone, but on distributional spread, community input and funding availability. The unit amount and selection of retail options should depend on the resources and capacity of Local Food Works, however it is important to have multiple retail "spokes" to serve the large region.

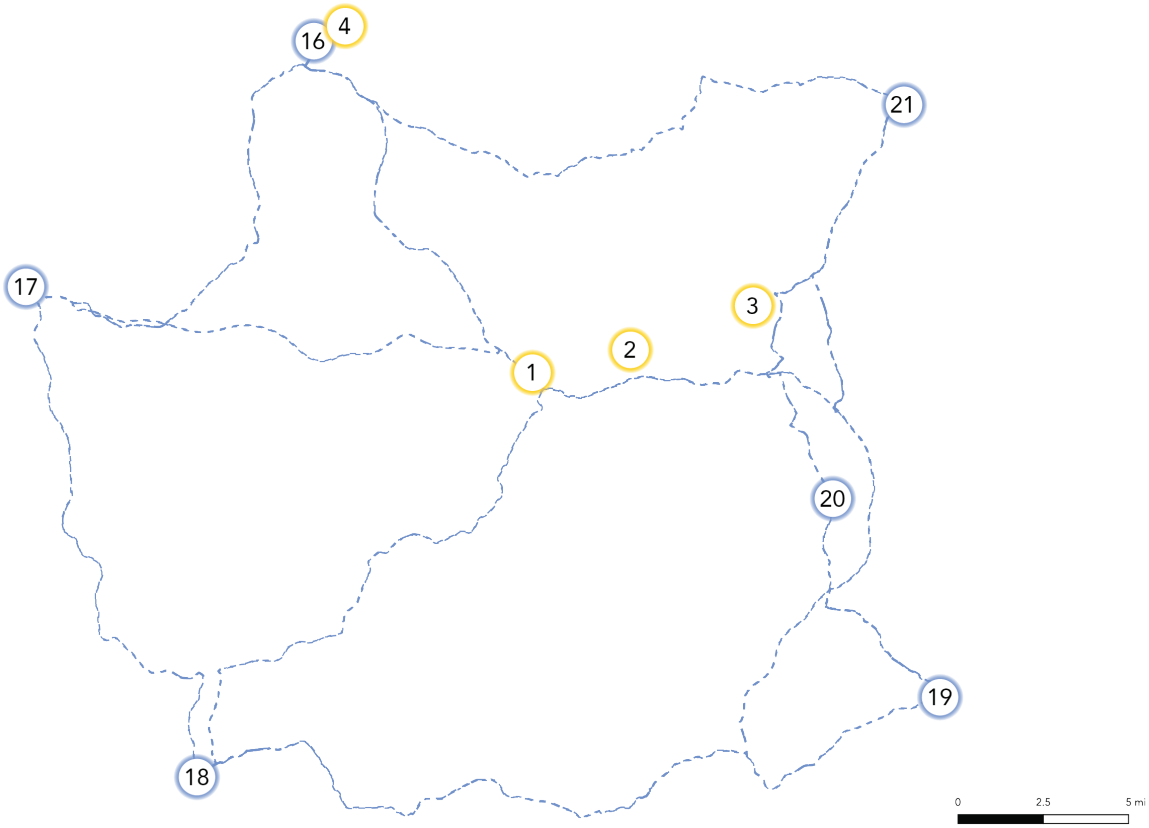


Figure 45. Blue components are wholesale (B2B) retailers that are not guaranteed to accept SNAP/HIP, and thus prioritize service area size and distributional spread as siting criteria. [Source: Author]

Map #	*Name*	*Type of Retailer*	*Town*	*Service Area*	*Farms in Proximity*	*Drive time to Warehouse*
16	Not Just Produced	Supermarket & Grocery Store	Winchendon	Pop. 26,383	24	17 min
17	Mr Mike's Market	Convenience Store	Athol	Pop. 24,039	31	18 min
18	Village Market	Supermarket & Grocery Store	Barre	Pop. 11,834	23	30 min
19	Apple Country Market	Supermarket & Grocery Store	Clinton	Pop. 49,406	41	27 min
20	Big Mania Meat Market	Fruit, Vegetable, & Meat Market	Leominster	Pop. 78,752	46	20 min
21	Mr Mike's Mini Mart	Convenience Store	Townsend	Pop. 43,193	48	30 min

As can be seen in Figure 46, the service area of the proposed retail partners (15min drive in blue) covers a wide geographic reach, however there are still large areas left unreachable by these retailers. Therefore, it would be expected that in the next iteration of project expansion, the unserved areas are prioritized.

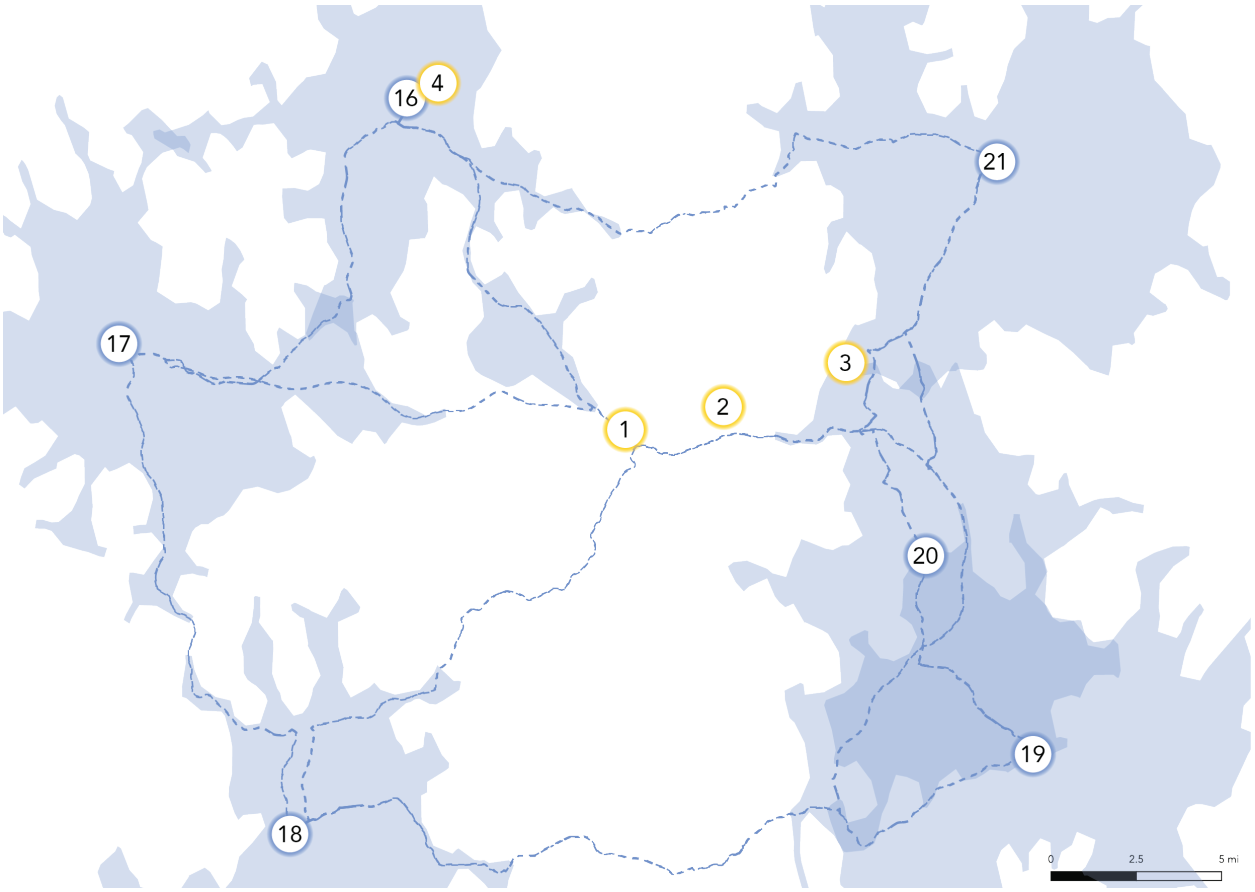


Figure 46. Service areas of selected retailers (#16-21). [Source: Author]

While the proposed siting of the retail partners, the mobile market, and the refrigerated lockers reaches a large swath of the region, it is recommended to examine the census tracts flagged as low income / low access (shown in black in Figure 47) to assess if the siting adequately serves populations in need. Any future phasing and expansion of the Local Food Works project should consider these flagged areas for additional service.

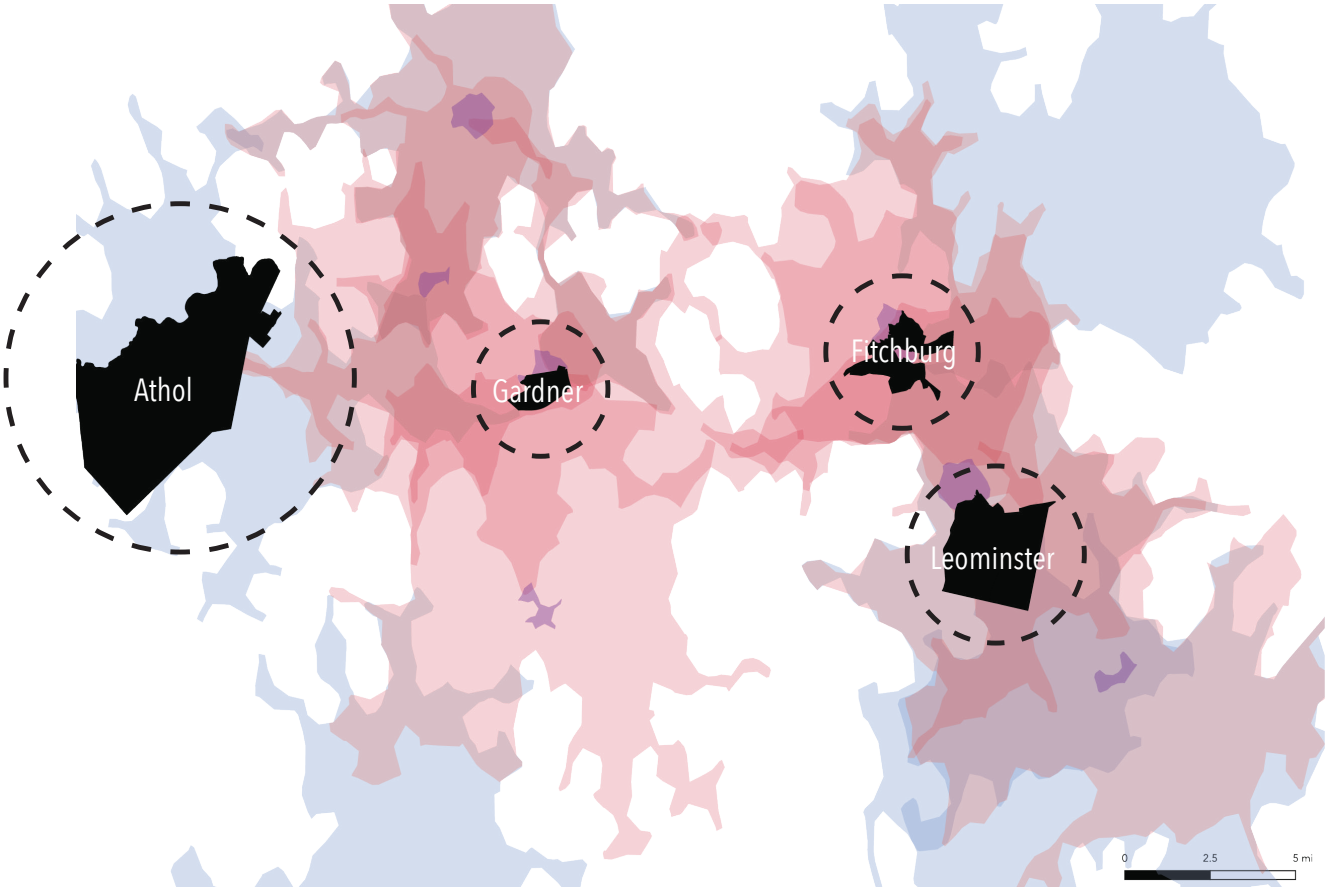


Figure 47. Total service areas covered with the proposed retail siting locations. Also indicated are the identified low income, low access tracts for reference. [Source: Author].

The selections and unit amounts of the Food Hub components are not intended as definitive proposals but are chosen to communicate the wider schematic design and operation plan based on the design-method approach. It may be more ideal to increase refrigerated locker locations, add another freight farm, decrease the retail partners, etc. depending on available funding, staffing, and usage. Actual partnerships and siting should be informed by the Local Food Works team, in discussion with the wider community and stakeholders, and iterated throughout the project implementation based on assessment and feedback.

Growing Places constructed their own mobile market in early 2020 to better reach targeted neighborhoods that didn't otherwise have access to healthy groceries. Photo by Growing Places (2020)

Mobile markets have the flexibility to visit communities in-need, and are often a nutritional lifeline for underserved neighborhoods. Photo by Sentinel & Enterprise (2020)

Piggybacking Produce Drop-Offs and Pick-Ups

Farms located throughout the region are not required to transport harvested produce to the central warehouse. Instead, they can drop their harvest at their closest Local Food Works retail partner, where it is safety stored in refrigeration until the Local Food Works van collects and brings it to the central warehouse for cleaning, processing, and re-sorting into purchase orders.

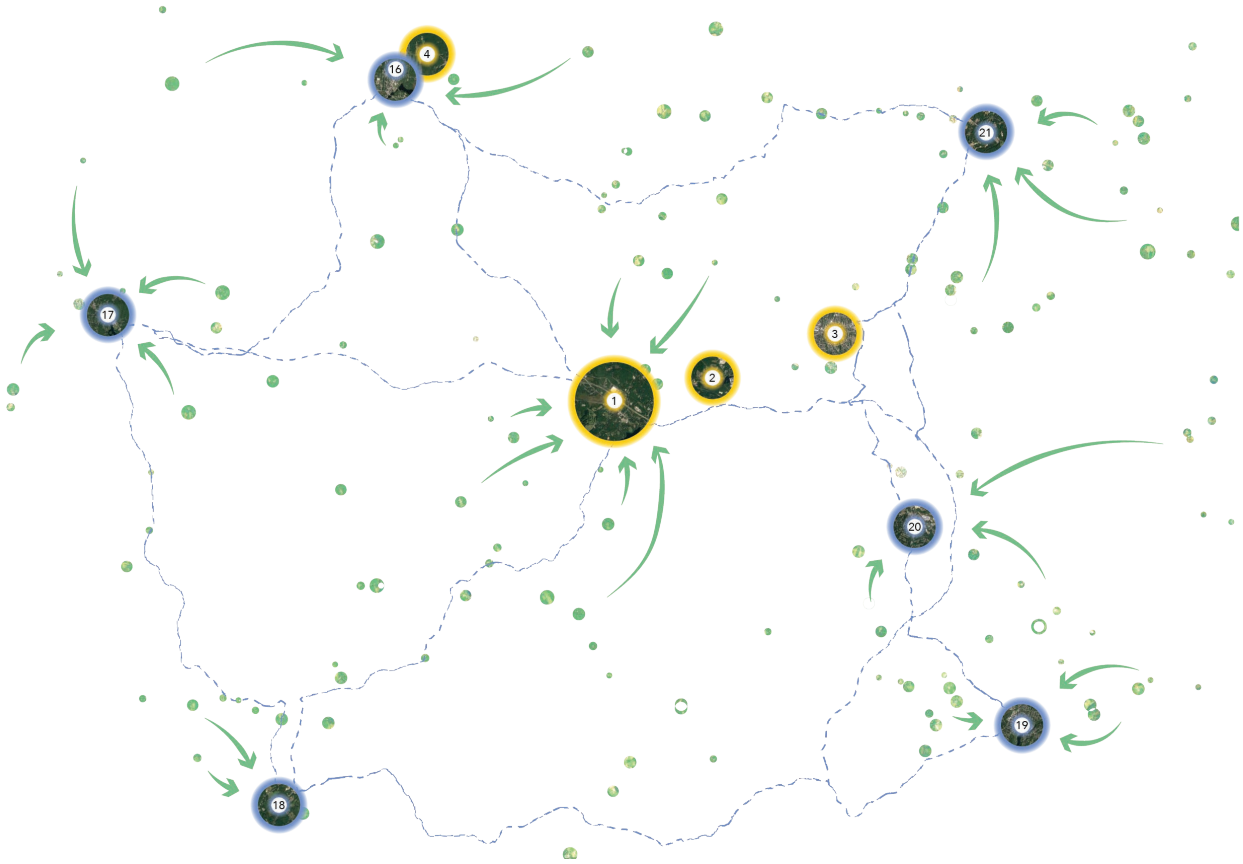


Figure 48. Operational flow of produce from farms to intermediary aggregation points. [Source: Author]

Dispatches from a Food Sovereign Future

Summer 2022

Eng runs a 5-acre farm in Ashby with his daughter.

Last summer, Eng operated a CSA program. Originally he intended for customers to pick-up their weekly order at the farm, but his rural location resulted in low subscription rates and unclaimed orders, so he began offering home drop-offs. He obtained more subscriptions, but lost a great deal of time personally delivering people's orders.

Eng also was a vendor at the Westminster Farmers Market. Typically, he spent the morning harvesting, cleaning, inventorying, packing, and loading his produce. He then drove ~30 min to the market, where he remained for ~4 hours including setting up and breaking down his booth. While there are closer farmers markets to his farm, they don't draw enough customers to make his efforts profitable. Even at the Westminster market, a low turnout or afternoon rains can severely impact his income.

On occasion, his farm has a bumper crop when there is an unexpected yield of produce. Last summer Eng found himself with an extra 10 crates of heirloom tomatoes. Normally he could sell each heirloom tomato for $1-2 but he had no retail channel for this sudden increase. With limited refrigeration he could extend the tomatoes' shelf life somewhat, but in the end the majority of the crop became waste.

Eng recently joined the Local Food Works network.

He stopped operating his own CSA program and now sells to the Food Hub at a quantity triple of what he was previously able to retail. To help him scale up his production, Local Food Works facilitated an infrastructure grant that purchased him a hoophouse and an additional refrigerator.

On Tuesday mornings, Eng harvests produce in crates provided to him by the Food Hub. Without needing to wash the yield, he simply drives it to the closest retail partner, located 9min away in Townsend. By late morning, Eng is back on his farm having successfully transacted a major order of produce for the week.

He still participates in farmers markets, but moreso for the community interaction and visibility. He is not dependent on these markets for his main income source; only as supplementary income.

In case of a bumper crop, Local Food Works is able to purchase the produce to process with flash-freezing or dehydrating, so that less food is wasted. Eng also takes pride in his heirloom tomatoes being incorporated into a new locally-made salsa. Next summer, he has agreed to participate in a regional farm showcase, where he will open his farm to students and visitors eager to learn more about his work and business.

Dispatches from a Food Sovereign Future

Fall 2022

Ayer Town Market had served the community for 12 years.

Owned and operated by Ayer resident Lydia Pfeffer, the store carried general sundries, basic foodstuffs, and household goods. On a few occasions, at the request of the customers, Lydia tried to stock a wider variety of foods. But her shop wasn't centrally located and her purchase orders weren't very large, so food distribution companies wouldn't take her on as a client. She simply couldn't move the same amount of products as larger retailers.

Store earnings were sufficient, but not enough to invest in new equipment or infrastructure. Some perishable items like milk and eggs were carried in the store's one refrigerator but space was limited. Lydia wanted to stock more fresh fruits and vegetables, but without proper shelving and additional refrigeration, this was difficult. Thus, she limited her food products to shelf-stable items like canned vegetables, processed snacks, and dried goods.

In 2015, Lydia tried incorporating locally-grown produce into her inventory. Hoping organic produce would boost sales, she reached out to a handful of farms in the area to retail their products. The customer response was positive, but it became difficult and complicated to coordinate with farms to receive produce. There wasn't any system in place to facilitate transactions, and Lydia found herself driving around the region to personally collect her purchased orders. Her time was being stretched too thinly, and she eventually ceased to purchase from local farmers.

The store recently joined the Local Food Works network.

Lydia heard about the Food Hub initiative in the local paper, and reached out to the group for more information. She was hesitant at first since she had tried doing similar business expansions before and had lost time and money in the process. But Lydia appreciated the transparency of the initiative and the operational strategy it employed. She felt secure knowing there were business plans, funding, and an experienced team leading the project. Another draw was the support offered within the network. This wasn't like her previous engagements with distribution companies, which felt highly transactional. Joining Local Food Works felt grounded and value-based. She was not a client, but a partner.

To help build out her store, Local Food Works supplied a storage unit, two display shelves, and an additional refrigerator. They assist in preparing signage and marketing materials. On Wednesdays, eight farmers from the surrounding area drop off their harvests, which Lydia stores overnight. On Thursday mornings, Local Food Works arrives to pick up the harvest and deliver Lydia's wholesale purchase order of vegetables, eggs, and locally-made products such as bread, jam, and dried herbs. In the summer and fall months, she sets up outdoor picnic areas and has seen an increase in customers spending longer amounts of time socializing at the space.

Over the years, Lydia has come to personally know many of her customers, and she takes pride in playing a part to improve the health of her community.

An imagined narrative of a local retail partner.

RETAIL PARTNER

Local Food Works provides infrastructural and marketing support to retail partners. This might take the form of extra refrigeration, storage shelving, display shelving, and signage.

Public space is provided to encourage community interaction and shared meals.

Updated signage not only promotes the retail store but highlights local farms and makers to boost visibility of the local agricultural scene.

Soft durable landscaping (such as gravel and ground cover plantings) replace much of the current cracked asphalt parking lots. Parking is still provided but reduced to prioritize usable friendly spaces for leisure and interaction.

An imagined product processed by Local Food Works or a contracted local small business.

Dispatches from a Food Sovereign Future

Winter 2022

New businesses on the horizon

With the opening of a commercial kitchen in Winchendon, MA, a few opportunities arose.

Existing local makers began scaling up their businesses. The kitchen offered the storage, space, equipment, and processing permits required to increase the yields of baked goods, dried herbs, hot sauces, pickles, and other items that were already being produced at a smaller scale in the region.

New food-based businesses began to grow with the help of the business incubation program and related training courses held at the kitchen site. With an increase of local businesses being formed in the area, the town development boards likewise shifted more focus to the economic development potential of food/ag businesses. Momentum and energy was growing around the local maker scene.

Proudly made in North Central Massachusetts

To decrease food waste and support farmer income, Local Food Works developed products that reflected local agriculture. For example, their best-selling salsa roja incorporated tomatoes from Eng Family Farm, onion and garlic from Magpie Farm, Cilantro from Hope Farm, and serrano chiles from Holly Hill Orchards.

Using their bulk purchasing power for jars, spices, and other miscellaneous parts, they could process the salsa in the commercial kitchen for $3.50. This price covered the wholesale cost of ingredients, labor, and materials.

Local Food Works retailed the salsa for $7 through their CSA and mobile market. They also sold the salsa at the $3.50 wholesale price to retail partners and contributing farms. Ayer Town Market regularly ordered 25 jars in their weekly order, which they then sold to customers at the $7 retail price. Magpie Farm, which operated its own on-site farm stand and CSA program, also ordered 10 jars per week to sell to their own customers. For Magpie Farm, this product offered an additional profit at no extra production cost to them.

Besides salsa roja, Local Food Works plans to expand to other processed food products, such as dried fruits, dehydrated soup mixes, flash frozen vegetables, and more. Instead of processing these products themselves, they have contracted out the labor to local makers, thus also creating new employment and business opportunities.

An imagined narrative of new food-based businesses in the region.

COMMERCIAL KITCHEN

A 24hr shared space includes equipment such as commercial-scale ovens, dehydrators, stainless steel tables, storage and freezers.

Business incubation and support programs are held at the commercial kitchen space to help local small businesses grow and connect to wider markets.

The commercial kitchen is used by local makers and entrepreneurs, as well as network members for teaching and culinary education purposes, such as the 'Prep & Pack' bulk cooking class.

Prep & Pack Cooking Classes

Refine your cooking skills while bulk-preparing takeaway frozen/prepared meals. Each recipe is healthy, nutritionally-balanced, and incorporates locally-grown ingredients.
**All ingredients and storage containers included. Number of takeaway meals varies per class.*

Class 1: Marinara Sauce
Skill-Level: Easy
Main Ingredients: tomatoes, onion, green pepper, mushroom, garlic, red pepper flakes, basil, oregano

Class 2: Chicken Soup and Bone Broth
Skill-Level: Medium
Main Ingredients: whole free-range chicken, onion, celery, carrot, garlic, dill, parsley, oregano

Class 3: Simple frozen veggies, "ready to steam"
Skill-Level: Easy
Main Ingredients: kale, spinach, peas, corn, carrots, peppers, broccoli, cauliflower

Class 4: Tamales Verdes
**enseñado en español*
Nivel de Habilidad: Medio
Ingredientes Principales: masa, pollo, tomatillos, pimienta, poblano chiles, jalapeño, cebolla, ajo

Class 5: "Just add water" dehydrated soup mix
**dehydrated soup mix will store for 6-8 months.*
Skill-Level: Medio
Main Ingredients: potatoes, onions, tomatoes, summer squash, carrots, zucchini, cabbage, homemade bouillon dehydrated stock

- The commercial kitchen also serves as a teaching kitchen to support education around nutrition and cooking.
- Integrating bulk preparation and take-home easy-prep meals into cooking classes offers an additional benefit, providing ready-to-heat homemade meals for busy people who can't cook regularly.
- Course costs are kept low. The fee covers ingredients and storage containers. Kitchen space usage and instruction fees are subsidized by Local Food Works.
- Recipes also teach how to "use all parts" to reduce food waste.
- Participants leave with new skills as well as easy-to-reheat meals in packaged portions (unit number varies per dish).
- Classes are held in a variety of languages and culinary styles to be more inclusive and reach a wider population.
- Recipes and ingredients are culturally diverse, and incorporate lesser-known ingredients such as kohlrabi.

An imagined bulk preparation cooking class held at the commercial kitchen facility.

Brassica Crop Varieties of North Central MA

Belstar Broccoli

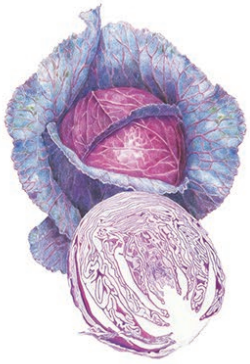
Purple Kohlrabi

Konan Kohlrabi

Brussel Sprout Stalk

Snow Crown Cauliflower

Redbor Kale



Red Cabbage

Red Russian Kale

Passat Cabbage

Winterbor Kale

Napa Cabbage

Pak Choy

A sample poster design intended to educate and attract people to purchase locally-grown products. Images sourced from botanical documents, independent illustrators, and heirloom seed advertisements.

DEMONSTRATION FARM

The demonstration farm acts more as a site of education, information and leisure, rather than agricultural production. Featured plants are hearty with minimal maintenance needs. Pathways, signage, and seating are included to draw people to the space.

Proximity to major town anchors, such as a commuter rail stop, supports agrotourism efforts and community leisure space needs.

Attractive multi-lingual signage highlights local agriculture, environmental protection, and native species. Interpretive signage helps to educate the public on food systems, local supply chains, health and nutrition, and food/ag initiatives happening around town.

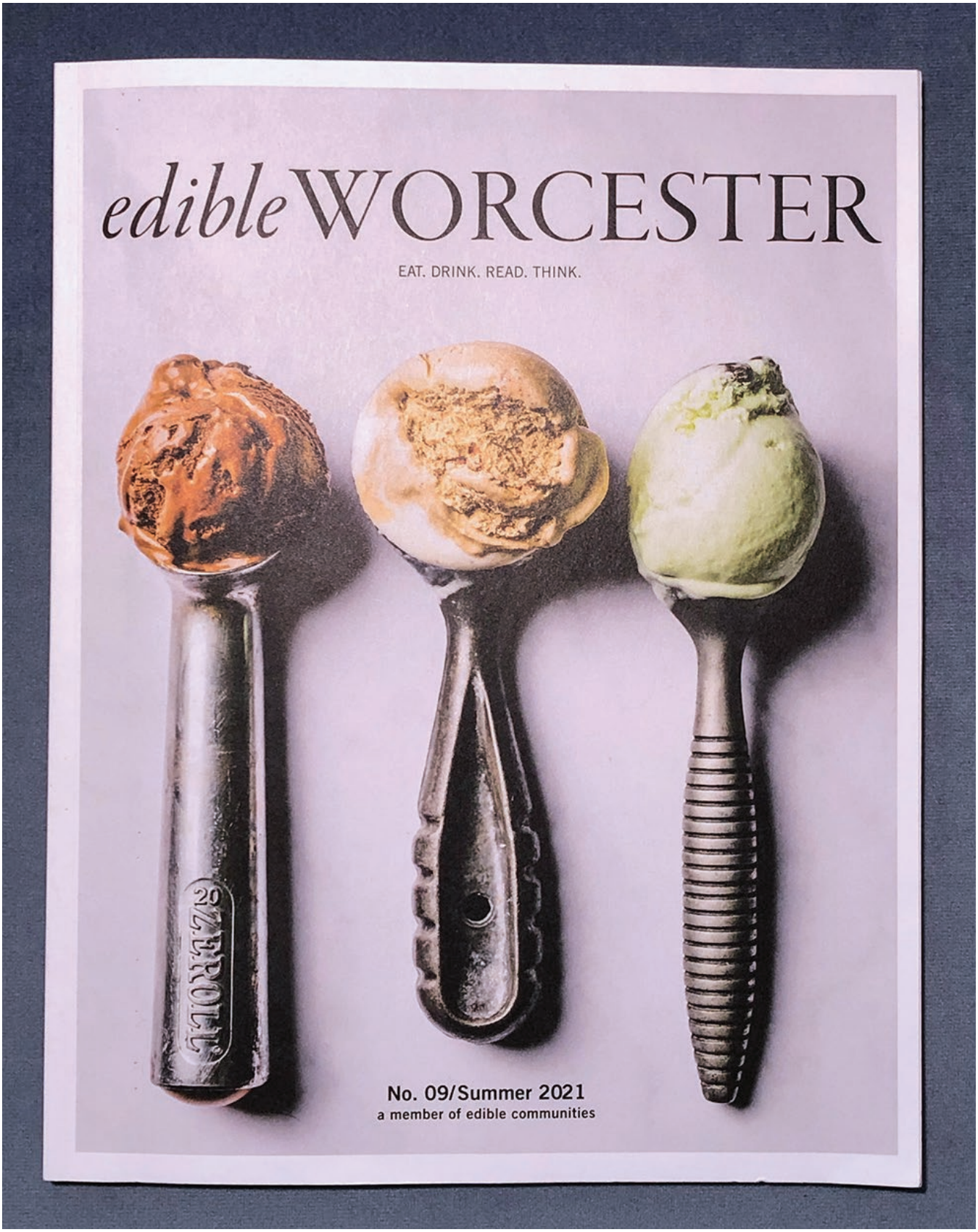
TOOLS OF COMMUNICATION

It is hoped that through the various rendered designs, the community of North Central MA can further envision what role a Food Hub network could play in their lives. Portrayed in a multitude of scales, the Food Hub network has not only grand-level impact potential on regional economic development, civic action, public education and patterns of leisure and mobility, but also granular-level impact potential on small business profits, local retail variety, and individual entrepreneurship.

Over the course of research for this thesis, it was stated that many low-income households and individuals do not patronize local food retailers, such as farmers markets, due to a perception of high price and exclusivity. It is shame that direct-to-consumer places, such as farmers markets, have become symbols of luxury. This perception often results in the precluding of low-income shoppers to participate in such markets. If the goal is to increase access to healthy local foods, then a project cannot only strategize to lower prices but also to address feelings of exclusion and cultural unfamiliarity. New food system spaces must be welcoming to all, yet this emphasis on inclusivity cannot be a passive action. It must be deliberately built-in to how programs operate, how outreach and marketing is conducted, where food is delivered, who is part of the leadership team, and even what produce is grown.

Multi-pronged communication strategies must extend to diverse consumer audiences, as well as emphasize local producers and makers. Farmer visibility and traceability of product was consistently stated as important, not only for food safety concerns but also to build consciousness of where the food products come from and who contributed their skill and labor to the product. The standard grocery store stocks “peppers”, but less commonly do they indicate variations such as Ancho, Cherry, Banana, El Rey Jalapeno, Habanero, Serrano del Sol, Wax, Cubanelle, Bell Lafayette, Bell Northstar, etc., which are all varieties of peppers grown in the northeast. Rarely do they identify the farm on which the pepper grew.

Food system redesign is as much about education and communication as it is about new infrastructure and improved operations. Since it would be immensely challenging for one initiative to cover all aspects, especially in a large rural region, it is recommended to instead develop strategic and mutually-supportive partnerships with other local entities to create a network of communication and collaborating actions.



The summer 2021 issue of *edible*WORCESTER featured Mrs. Moriconi's locally-made ice cream. Mrs. Moriconi vends at the Westminster Farmers market and contributed insight into small business operations for this research.

Conclusion

Concluding Remarks

Limitations & Future Actions

4.1 Concluding Remarks

This thesis presented a design-method approach using data and lived experiences, but the undercurrent of this research was always an effort to highlight the initiatives and work being done by local civic actors. It is an attempt to bring to light the challenges faced by rural populations that aren't given adequate attention, especially in the fields of planning and design. It also attempts to acknowledge and celebrate the innovative strategies being developed within rural agricultural communities regarding economic development, food access, and environmental conservation. The high level of engagement, co-creation, and partnership seen in the Local Food Works project speaks great volumes to the energy and passion of the community.

It is the author's hope that food system planning will not only be better integrated into the planning curriculum and professional field going forward, but that the industry works to become more holistic and inclusive with how it approaches food and agriculture. Recognition of the diversity of actors, the multi-scalar nature of food, the environmental impacts, and links to public health are all intricately tied to the creation of healthy spaces and places, and designers should play a larger role in integrating these elements.

If planning is about future visioning, then it must be recognized that the exclusion of rural geographies and populations is a harmful omission that impacts both rural and urban life. There is a great amount of knowledge and expertise in non-urban environments, yet the dominant perception places innovation squarely in urban realms. This misconception has real effects in the forms of investments, migration, business, and economic development. It is this author's belief that allocating more attention and resources to rural-based initiatives, especially those centered on multi-scalar systems such as food production and consumption, is a necessary shift that presents significant impact potential for all populations regardless of locality.

4.2 Limitations & Future Actions

There were a handful of limitations to this research. This thesis posed challenges in that it attempts to make proposals to a real project, yet that project was ongoing and evolving throughout the duration of the research. Changes to the case study project were incorporated as much as possible into the design proposal, however the author acknowledges that there are inevitable misalignments between the proposal and the project. To address this, the author framed the design proposal not as prescriptive (i.e. not to be followed exactly as presented), but as demonstrative of the design-method approach.

In terms of data, there are clear limitations from included/excluded information. Analysis results are based on inputs which prioritized selected towns, farms, and business types. For example,results for peripheral businesses will be skewed as the inputs simply don't include farms outside of the region. Data on businesses and farms was collected and verified as much as possible, but omissions and errors are expected with this scale of region.

Future actions on rural food system planning research should begin to dive deeper into how rural-urban connections can be strengthened, and how alternative food networks can better serve localities. For Local Food Works in particular, it is recommended that they prioritize which components to be implemented first, and develop lists of potential partners and locations to site such components. From these lists, they can run the design-method approach in order to assess potential outcomes per option.

The project team is in process of transitioning from a volunteer-led group to a more formal organizational structure. This is a major process that requires careful orchestration, guidance, and planning in order to be successful in the long term. Pending funding and available resources, the first phase of Local Food Works activities are expected to commence in early 2022.

Appendix A: Calculating Farmer Drive Time Tolerance

The below table indicates the region's farmers markets and the farms that participate. As a note, farmers markets typically operate weekly (a few operate monthly), and farms generally participate for the entire season however they may vary in terms of their commitment. This data is meant to be used as a proxy to determine drive tolerance of farmers to a retail site.

** The below drive times were calculated using OpenRouteService via QGIS.*
*** A lack of participating farms does not necessary indicate the size of market; other vendors might include local aggregators such as Growing Places, crafters, makers, and other non-farm vendors.*

Destination	*Origin*	*Drive Distance (kilometers):*	*Drive Time (minutes):*
Athol Farmers Market	Almosta Farm	3.1	4.862
	Kiwi Meadows Farm	12.36	15.055
	Niemi's Apiary	1.33	2.708
	Sweet Cottage Farm	7.69	15.386
Barre Farmers Market	Autumn Morning Farm	4.72	10.079
	Bee Nice Farm	18.10	33.015
	Chase Hill Farm	39.61	46.990
	Hancock Farm	1.71	3.581
	Hartman's Herb Farm	8.84	18.981
	Holloway Farm	3.38	4.749
	Ladybug Farm Produce	8.14	9.847
	Ragged Hill Orchard	27.95	35.634
	Rock Harvest Farm	15.32	16.726
	West Slope Farm	34.7	45.774
	White Rabbit Farm	103.58	92.288
Fitchburg Farmers Market	Amy's Raw Honey	1.97	3.360
	Hames & Axle Farm / Surfing Goat Soaps	13.87	20.998
	Hollis Hills Farm	4.04	9.933
	Sholan Farms	13.25	20.103
	Wellwood Farms	33.58	42.248

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Destination	*Origin*	*Drive Distance (kilometers):*	*Drive Time (minutes):*
Groton Farmers Market	Laszlo Family Farm	23.01	27.033
	Shagbark Farm	15.67	20.451
	Spiczka Farm	0.00	0.001
	Valicenti Pasta Farm	15.52	20.404
Leominster Farmers Market	Sholan Farms	4.94	7.337
Lunenburg Farmers Market	Ayotte Farm	11.66	13.972
	Bitz N Peace Farm	30.69	38.682
	In The Meadow Farm	1.88	3.009
	Oak Tree Homestead & Forge	0.54	1.115
	Shagbark Farm	1.45	2.555
	Tully Farms Dairy	24.99	40.213
	Wellwood Farms	44.26	50.555
	Whitemarz Farm	3.73	10.230
Petersham Farmers Market	Kiwi Meadows Farm	23.10	23.757
Princeton Farmers Market	Elzire's Acre Goat Milk Soap	5.15	7.359
	Hillside Herbals	6.7	7.842
	Oakdale Farms	104.57	85.589
	Owl's Nest Farm	6.67	9.572
	Sap Castle	7.46	11.333
	Shagbark Farm	29.92	35.454
	Walnut Kitchen Homestead	51.27	55.755
Shirley Farmers Market	In The Meadow Farm	10.71	12.914
	Whitemarz Farm	12.56	20.136
Sterling Farmers Market	Hancock Farm	33.79	38.305
	Meadowbrook Orchards	5.57	7.127
	Pineo Family Farm	2.13	5.353
	Wellwood Farms	29.81	34.452
Toy Town Farmers Market	7 Acre Farm	2.88	3.823

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Destination	*Origin*	*Drive Distance (kilometers):*	*Drive Time (minutes):*
Westminster Farmers Market	Bee Nice Farm	13.43	19.101
	Clearview Farm	34.81	31.787
	Greenwood Hill Farm	16.67	19.488
	Hubbard's Farms LLC	18.92	31.182
	ML's Greenery in Motion	11.2	22.077
	Moonlight Farm	23.69	27.857
	Pease Orchard	18.43	23.837
	Rachel's Everlasting	37.97	34.691
	Sholan Farms	23.03	29.346
	Singing Valley Farm	20.67	22.245
	Sweet Pumpkin Farm	26.98	35.933
	Valicenti Pasta Farm	48.12	52.478
	West Slope Farm	14.68	24.483
		Average Drive Time:	**22.922**

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Appendix B: Calculating the regional SNAP/HIP Gap

This table calculates an approximate SNAP/HIP Gap for the designated North Central Massachusetts region. Data sources and calculation information are included after the table.

Town	*Zip Code*	*SNAP eligible*	*SNAP enrolled*	*SNAP Gap #*	*SNAP Gap %*	*Unclaimed SNAP funds*	*Unclaimed HIP funds*
Asburnham	01430	275	762	487	64%	$244,961	$29,220
Ashby	01431	146	398	252	63%	$126,756	$15,120
Athol / Phillipston	01331	2358	3819	1461	38%	$734,883	$87,660
Ayer	01432	533	1295	762	59%	$383,286	$45,720
Barre	01005	315	755	440	58%	$221,320	$26,400
Clinton	01510	1544	3267	1723	53%	$866,669	$103,380
Fitchburg	01420	9468	14166	4698	33%	$2,363,094	$281,880
Gardner	01440	3586	5340	1754	33%	$882,262	$105,240
Groton	01450	217	736	519	71%	$261,057	$31,140
Groton	01470	0	24	24	100%	$12,072	$1,440
Groton	01471	0	2	2	100%	$1,006	$120
Groton	01472	0	41	41	100%	$20,623	$2,460
Harvard	01451	40	262	222	85%	$111,666	$13,320
Harvard	01467	0	38	38	100%	$19,114	$2,280
Hubbardston	01452	164	422	258	61%	$129,774	$15,480
Lancaster	01523	259	712	453	64%	$227,859	$27,180
Leominster	01453	5484	10378	4894	47%	$2,461,682	$293,640
Lunenburg	01462	595	1361	766	56%	$385,298	$45,960
Orange	01364	1590	2285	695	30%	$349,585	$41,700
Pepperell	01463	548	1350	802	59%	$403,406	$48,120
Petersham	01366	48	190	142	75%	$71,426	$8,520
Princeton	01517	0	2	2	100%	$1,006	$120
Princeton	01541	58	226	168	74%	$84,504	$10,080
Royalston	01368	158	258	100	39%	$50,300	$6,000
Shirley	01464	375	866	491	57%	$246,973	$29,460

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Town	*Zip Code*	*SNAP eligible*	*SNAP enrolled*	*SNAP Gap #*	*SNAP Gap %*	*Unclaimed SNAP funds*	*Unclaimed HIP funds*
Sterling	01564	193	666	473	71%	$237,919	$28,380
Templeton	01468	288	558	270	48%	$135,810	$16,200
Townsend	01469	358	845	487	58%	$244,961	$29,220
Westminster	01441	0	12	12	100%	$6,036	$720
Westminster	01473	266	791	525	66%	$264,075	$31,500
Winchendon	01475	1397	2374	977	41%	$491,431	$58,620
Winchendon	01477	0	7	7	100%	$3,521	$420
					Total unclaimed SNAP funds (monthly):	**$12,044,335**	
						Total unclaimed HIP funds (monthly):	**$1,436,700**

SNAP Eligibility Data:

- SNAP eligibility is based on MassHealth eligibility data from the MA Medicaid Policy Institute, recipients by zip code as of September 2016. MassHealth data reflects incomes under 200% Federal Poverty Level (FPL), as a proxy for potentially eligible SNAP recipients.
- SNAP enrollment is based on the MA Dept of Transitional Assistance (DTA), recipients by zip code as of November 2016.
- Data is compiled by the Food Bank of Western MA, which includes the following adjustment note: *"[The data] include a 20% downward adjustment from the 1.8 million MassHealth recipients living at or below 200% of the federal poverty level to reflect a reasonable percent of MassHealth recipients likely SNAP-eligible (e.g., long-term care recipients, certain students, foster children, non-citizens and/or other individuals). It is impossible to do this by zip code but reflects a standard adjustment."*
- View the interactive map and data: https://public.tableau.com/app/profile/food.bank.of.western.ma/viz/MHandSNAP/Story1

SNAP Assistance Calculations:

- Monthly SNAP allotments are calculated by multiplying the household net monthly income by 0.3, and subtracting the result from the maximum allotment for one's household size. The 30% reflects the individual's expected personal contribution to their food spending.
- The above table calculates monthly SNAP allotments based on a 4-person household with a net monthly income of $1,106. This income is multiplied by 0.3 (= 331.80 rounded to $332). This $332 represents the personal contribution. It is then subtracted from the maximum allotment for a 4-person household ($835), yielding a total of $503 monthly SNAP dollars for the household.
- For more info: https://www.fns.usda.gov/snap/recipient/eligibility

HIP Assistance Calculations:

- SNAP eligibility qualifies for HIP. Monthly HIP allotments are calculated by household size.
- The above table calculates monthly HIP allotments based on the same 4-person household, which puts the recipients in the 3-5 person household bucket. This gives them $60 per month of additional spending on healthy local foods.
- Fore more info: https://www.mass.gov/service-details/massachusetts-healthy-incentives-program-hip

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