Resetting the Table *in the* Lehigh Valley

A STUDY OF TECHNOLOGY, NATURE AND LOCAL FOOD

By the Students of EGRS/EVST 373

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Abstract

This book was written by students in the Spring 2014 semester of "Technology and Nature" at Lafayette College. The 19 students—representing eight majors across campus and including sophomores, juniors and seniors—took the subject of local food as their topic and the Lehigh Valley as their site of attention. The book followed many weeks of background study about the ways those two unwieldy concepts, technology and nature, could fit together. Their goal, lofty though admirable, was to propose a way to promote sustainable technologies for the sake of an ecologically healthy food system. Rather than the industrial model of technology and agriculture, that is, they considered what it takes to imagine technologies that promote environmental health, not undermine it. The eight chapters of the book proceed in three parts. First, two chapters canvas historical and cultural backgrounds that have led to our current food system and the local context of the Lehigh Valley that frames the analysis to follow. Second, four chapters bring us from farm to fork by assessing alternative technologies for production, small-farm management, distribution, and consumption. A final part includes two chapters. One assesses the role of culture and policy in leading change for sustainable agriculture. The other discusses how we need to get beyond technology alone in our goal of building a sustainable future. In the end, the students find that a more sustainable food system is one that is scale-sensitive, ecologically attentive, and economically feasible. It will not come about, they show, by new technologies alone, but with new ways of understanding the relationships between technologies and nature.

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*"Don't judge each day by the harvest you reap
but by the seeds that you plant."*

Robert Louis Stevenson


The Lehigh Valley
of Pennsylvania
NORTHAMPTON
Easton
Bethlehem
LEHIGH
Allentown

Introduction

B. R. Cohen

There are many ways to tackle the questions and problems of sustainability. Indeed, this is the environmental watchword of our era—not occupational health, not endangered species, not wholesome living, not going back to the land, not pollution, not the ozone layer, but sustainability. Of course all of those previously top-of-the-list issues are still with us. They too remain the fount of important questions about how we live on earth. But in a world where climate change is the dominant environmental concern, sustainability is the dominant way to think about making a better future. It is ubiquitous and easy to say, while far more difficult to actually enact. As it is, people don't agree on what it would mean to enact and achieve a sustainable future, even though we all seem to agree that it is important.

One dominant feature of discussions about sustainable futures deals with technology and engineering. This is because how we distinguish between the natural and the technological often informs how we understand the pragmatic—what is possible—and the ethical—what is permissible. But how hard and fast are these boundaries? How might we instead examine relationships between technology and nature instead of strict boundaries? What could we learn from doing so?

These questions were the prompts for the Lafayette College class "Technology and Nature," a course in Spring 2014 cross-listed between engineering studies and environmental studies. As a basic premise for the class, we did not assume that technology (human *artifice*, in some definitions) and nature (all that is not human) were opposed. At the same time, rather than seeking to confirm a specific definition of technology or nature, the students put their focus instead on understanding the sometimes-contentious relationship *between* the natural world and human attempts to understand and control it. In our fifteen-week course, we surveyed ethical, social, artistic and engineering approaches to linking the natural world and the human-built world with examples that included gardens, farms, trains, cars, cities, rivers, factories, and more. We analyzed the ways technologies reveal certain kinds of nature (while concealing others), the ways we build technologies to control our surroundings, and the ways technological systems mediate our interactions with and connections to the broader environment.

We pursued this course of study to envision technologies that promote ecological health rather than undermine it. This is a large and ambitious ideal. To make our study more manageable, we approached the larger goal in two ways: one, by putting our attention on sustaining relationships *between* technology and nature, not just the two pieces on either side; and two, by focusing on the technologies of local food in the Lehigh Valley. This means we were not after a new technology that would save us, a new machine that would be more efficient, a new system that one could drop into the landscape as a way to solve environmental problems. We were after thinking about technology more effectively and placing our technological visions within the specific environmental contours of the Lehigh Valley.

This, then, is a project about sustainable technologies. For us, those are technologies that *reveal* nature in a manner that we can maintain into the indefinite future without sacrificing ecological health. This means we cannot reveal a nature that is merely a commodified storehouse of nutrients and materials for our eventual use (cf. Heidegger, 1954). We are imagining, as a point of background, that we are revealing a nature of which we are a part, an ecology that has us, the land, the crops, the food, and the physical equipment of agriculture as members. Sustainable technologies for us are also those that *mediate* our relationships with the environment in ways that are less destructive to those environments than current models (Meinig, 1979). And they are, thirdly, technologies that are rooted in a gardener's ethic not to *control* our surroundings, as in to dominate, but to recognize the symbiotic (mutually health-promoting) relationship between people and the land (Pollan, 2003).

One feature of our work has been to understand technology as a system of objects, activities, and knowledge (Matthewman, 2011). This is opposed to the more popular public vision of technologies as things. Technologies for us are ways we orient ourselves in the world, they are means of structuring our connections to one another and to the earth. As just one example (it returns in Chapter 5), a farmers' market is a kind of distribution technology—it has the physical components of farmers, and food, and people, and products, and a space downtown. It also has the activities of coordination between producers and consumers, of policies and health standards, of economics and access and organic principles. It is a system that connects producers and consumers. Akin to a machine with various inter-related parts, all of those things work together to define what we call a farmers' market. For us, though, we didn't think about machine metaphors; we considered ecology instead, that a good technological system operates as a kind of ecological whole, where all the parts work together in a way that avoid undermining the other elements.

The result of the prompts above is the book that follows, comprised of eight chapters in three parts. The first two chapters ("Part I: Setting the Table") canvas the historical and cultural backgrounds that have led to our current food system and the local context of the Lehigh Valley that frames the analysis to follow. The four chapters of Part II ("Technologies from Farm to Fork") bring us from sites of production to sites of consumption by assessing alternative technologies for small-farm management, distribution, and consumer-based systems of storage, waste disposal, and food recovery. A final part. "Resetting the Table," includes two chapters. One assesses the role of culture and policy in leading change for sustainable agriculture. The other reflects on how we need to get beyond technology alone in our goal of building a sustainable future.

In the end, the students find that a more sustainable food system is one that is scale-sensitive, ecologically attentive, place-based and economically feasible. It will not come about, they show, by new technologies alone, but with new ways of understanding the relationships between technologies and nature. We can promote a more sustainable, place-based food system in the Lehigh Valley if we consider technologies that help make our connections to the land more apparent. In the end, and following Robert Louis Stevenson's epigraph, we hope that this book is a way to plant the seeds for a more sustainable harvest.

PART 1

Setting the Table

1

A Brief History of Modern Agriculture in the United States

Joseph Ingrao and Matt Schultheiss

We can view the history of modern agriculture as a history of modern technology. This comes from understanding technology not just as machines or individual things, but as systems of physical objects, organizational systems, and human practices. Agricultural history tells the story of how farming has evolved from the simple technologies of the beginning of the twentieth century (i.e., manual tools and basic cultivation techniques) to the multi-row tractors, sprayers, packinghouses and other components of today's industrial agriculture.

This technological history brings us to a system of farming that relies heavily on fossil fuels, devalues and works against community building, and has been shown to do everything from polluting groundwater to eroding topsoil to contaminating food with residual pesticides and herbicides (Berry, 1977; Beus & Dunlap, 1990; Rodale, 1983). This conventional or industrial model of agriculture is based on the outlook that creating more food is worth any negative consequence. It was possible to make this model a reality because of technological 'innovations' that treat the Earth as a static collection of unrefined resources to be used and molded into forms more helpful to humans. We see this as a limited point of view leading to a design philosophy that is ultimately unsustainable in its over-reliance on non-renewable inputs, like fossil fuels, and in its disregard of the dynamic nature of the world. Over time, we envision developments in sustainable agriculture that will power the change necessary to live within the means of the Earth's natural resources.

The technologies needed for a sustainable agricultural model already exist. The implementation of these more environmentally conscientious approaches would drastically change the environmental impact of feeding the world's population. Agricultural alternatives such as non-synthetic fertilizers, naturally derived pest and weed control, crops which do not require tillage and different methods of stopping soil run-off are all examples of technologies that can make positive impacts on the farming system. Farmers' markets, small farm management practices, food waste collection programs and other ways of increasing the efficacy of the food loop between farms, gardens, kitchens, and composting all show a way of thinking that values community, diversity, and ecology rather than simply production.

In writing this book we wish to propose a model of ecologically attentive engineering, one that brings a design philosophy to technology that is scale-sensitive, future-oriented, economically feasible and, most importantly, sustainable. We do so through a case study of the Lehigh Valley, our home and the home of Lafayette College, a place important to the development of the sorts of technologies that follow this model and a place that can be a proving ground for the future But to talk about the Lehigh Valley and sustainable technologies, we begin with some historical background about how the United States got to the point we are at today.

The Evolution of Agriculture

Agricultural advances from the turn of the twentieth century involved a laundry list of technological innovations and changes that allowed for the development of modern agriculture. Before these developments, an increase in agricultural production required an increase in the total area used. Farmers used tools such as manual tillers, plows driven by horse or small tractor, and a high amount of manual (human and animal) labor. With the advent of mechanized agriculture, the possibilities for industrializing food production became seemingly limitless. There was a shift from animal powered to steam and gasoline powered tools, and as a result farms around the country could become more massive but with fewer people working the farms. This shift ultimately meant that the percentage of farmers in the total United States labor force was cut in half in only 30 years from about 41% in the first decade of the twentieth century to only 21.5% by 1930 (USDA, 2005). As farming technologies like tractors and new tools for irrigation like drip lines and advanced sprinklers became common, agricultural operation was rapidly changing. However, these advances in technology did not come easily or without hardship.

The decline into the Great Depression of the 1930s and then the second World War led to sweeping changes in how people farmed and the kinds of foods they cultivated. For a short period of time, people returned to the idea of sustenance farming, where farmers fed their families with their own crops and sold the rest, a process that encouraged crop diversity. While the Great Depression was a stark reminder of the challenges that farmers would face if they grew a small number of crops, the troubling development of mono-crop farms had already begun in World War I. During this "Great War" food production in Europe had almost halted, causing a high demand for wheat and other staple crops (Moore, 2011). This drove up both production levels and price, ultimately lending itself to the so-called "production first" culture that supported producing as much as possible. But as the Great War ended and America began a return to normalcy, farmers found themselves producing more crops than they needed. This increase in supply drove down prices for wheat and many other crops. Ultimately this downward pressure on prices caused a drop off in revenues for farms. This created a trend of farmers needing to "get big or get out," which would continue for decades. It forced many farmers off the land and forced the rest to become larger, leading to the point of wide expansive farms we have today (Moore, 2011)

As agricultural production continued to grow, and prices continued to fall, a public policy was needed to fix the increasing rate of insolvency among farms. Prices on certain crops became so low that, at times, farmers would burn their crop as a resource for heat (Ganzel, 2003). Finally, in 1933 the Agricultural Adjustment Act (AAA) began an era of change for farming policy. The AAA was meant to provide price support, supply controls, and set parity price goals (AFPC, 1999). This led to a laundry list of other Agricultural Acts which the government used to continually adjust the policy based on the needs and ideology of the time. Soon, farms even started to have direct financial contribution from the federal government. Farmers now planned their budget with the support of government policy in mind. These laws from the 1930s continue today as the Farm Bill, which is renewed every five years or so.

Throughout those times of hardship many natural disasters riddled the agricultural industry. One of the most notable was the great Dust Bowl. This event affected many of the states on the Great Plains. The Dust Bowl represented the greatest environmental disaster that had unfolded in centuries. There was a shortage of rain the extent of which had never been experienced in America. Mixed with the new cultivation techniques that farmers were using (e.g. mechanized tilling), this created a dry dusty land that was unsuitable to crops, leading to much of the unsettled dirt being kicked up into massive dust storms that "piled up just like snow piles" (Ganzel, 2003). In this way technological fixes were adding to the hardship of the dust storms, and in the long run they changed the whole agricultural market landscape. As Donald Worster discusses in *Dust Bowl*, the productivist paradigm brought about the techniques that drove these environmental anomalies (1979). With the focus on production, land was considered a capital resource as opposed to a dynamic resource that responds to unsustainable practices, like those that helped to aggravate the conditions related to the Dust Bowl.

As the economy continued to recover from these episodes of environmental disasters and depression, agriculture was always changing and becoming a more 'efficient' producer of food. As the USDA outlines:

> Since 1900, the number of farms has fallen by 63 percent, while the average farm size has risen 67 percent [Fig. 1.1.] Farm operations have become increasingly specialized as well [Fig 1.2]—from an average of about five commodities per farm in 1900 to about one per farm in 2000. (USDA, 2005, p. 2)

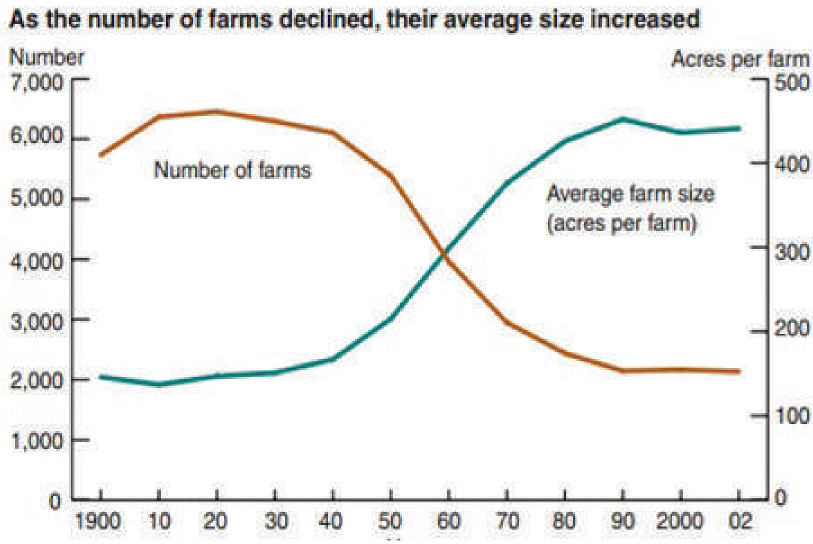


Figure 1.1 The trend in total number of farms against the average farm size in acres from 1900–2002, revealing the increase in farm size as number of farms decreases (USDA, 2005, p. 5).

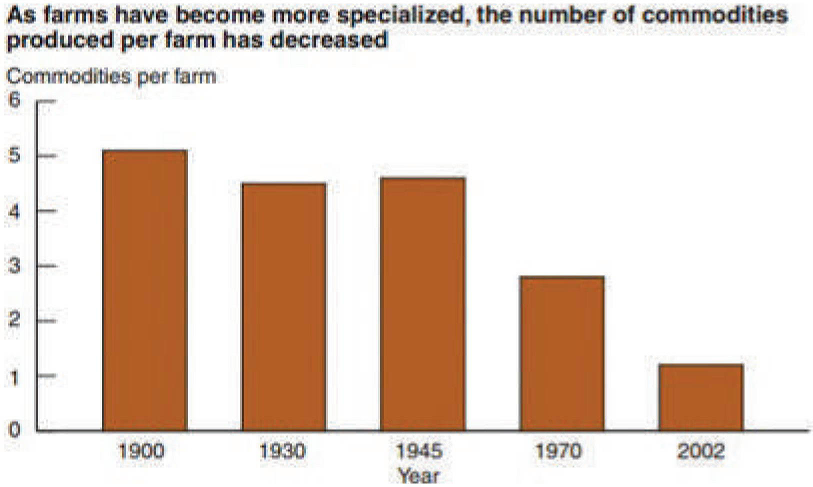


Figure 1.2 The number of commodities produced per farm overtime, showing a marked decrease towards the end of the 20th century (USDA, 2005, p. 5).

The changes that were seen in these figures are representative of a larger societal change that was occurring during this century. The advent of the automobile and later the airplane played a role in major changes in the availability of numerous resources. Farms were able to get the raw materials they needed faster, and with better timing. Mechanical farming was standard by the 1960s. Throughout the twentieth century advances in plant and animal breeding allowed for levels of production and output that had never before been seen with livestock. From these innovations and market changes, "growth in agricultural productivity averaged 1.9 percent annually between 1948 and 1999" while productivity growth in manufacturing during the same period was only 1.3 percent annually (USDA, 2005). Farming quickly became an enterprise that rewarded expansion and specialization, where a successful farming business needed these characteristics to survive.

As the pressure for centralized and massive farming operations increased, so did the use of fertilizers and pesticides. These modern chemicals provided farmers the ability to increase their yield in the short run. As the agricultural industry increasingly relied on these chemicals, the evidence of their negative side effects began to mount. For example, DDT (dichlorodiphenyltrichloroethane) was one of the most popular insecticides used during the middle of the twentieth century. This insecticide however is highly dangerous to animals that ingest it, and to the environment at large. The increased use in these sorts of chemicals, both in agriculture and industry, caused massive environmental backlash throughout the 1960's and 1970's. Popular culture began to join the discussion as well. Rachel Carson's *Silent Spring* is one of the crowning books that generated attention to the movement. As literature and evidence against "conventional" agriculture mounted, so did the public movement for environmentalism. This time of environmental awareness and motivation leads to this book's topic: a more sustainable and environmentally friendly means to food cultivation.

Critiques of Industrial Agriculture

For many decades, farmers, scientists, and policy makers put a lot of effort into producing as much food as possible with the technology of the time, advancing technology to increase the levels of production, and creating policy to facilitate maximum output. This assumption was so ubiquitous that it was possible to say as late as 1990 that "The superiority of modern industrial agriculture in the United States has been beyond question or debate" (Beus & Dunlap, p. 591). Despite this hyperbole, there had been critiques of modern industrial agriculture for many decades before they gained popularity, and the earliest were not from American agriculturalists. American agriculturalists were inspired by influences like Sir Albert Howard and Lady Eve Balfour in England, who had been studying organic methods of producing food since the early twentieth century (Case, 2014; Brander, 2003).

The organic movement in America can be traced back to Jerome Irving Rodale and his 'organic food cult' in Emmaus, Pennsylvania. Rodale was influenced by Sir Albert Howard's studies into the nutritional value of food raised in soil degraded by conventional farming, and was the first agriculturalist in America to use 'organic' as a term to describe a method of agriculture. This Rodale Institute, as its now known, has and continues to be centered in the Lehigh Valley, where its members have been promoting organic farming practices since the 1940s (Case, 2014).

Rodale and other organic production advocates called for a balance between conventional methods of farming and a complete reduction of civilization and agriculture. Robert Rodale (1983), J.I. Rodale's son, even said "the organic farming alternative is much less radical than many people think. It is not a total rebellion against the dominant idea [of conventional farming]" (p. 18). It was, and still is, an alternative based primarily on solving the real quantifiable problems of industrial agriculture. Robert Rodale (1983) cites soil erosion, reliance on non-renewable resources, and depletion of soil nutrition as reasons to switch to organic and other forms of 'regenerative' agriculture methods, since conventional agriculture "is very likely to collapse when the world's store of fossil energy runs out" (p. 20). JI Rodale himself wrote about soil erosion in conventional farming as early as 1945, and it's difficult to find a concern more practical than the destruction of human health that originally drove Rodale's intrigue in organic farming (Case, 2014).

The Rodale family drove the development of many important alternative agriculture technologies on multiple fronts. Rodale, Inc., a press company created to publish magazines and books about organic farming and natural living helped spread the word that there is an alternative to conventional agriculture. In a more direct fashion, the Rodale Institute has been working since 1947 to actually test sustainable farming practices in the Lehigh Valley. Before the 1970s, these practices were hardly in use in America. In that decade, though, environmentalism led to a surge of popularity in alternative agriculture.

Environmentalism, as we understand it, is often premised on ideas like limits to growth and that nature has value beyond its usefulness to humans. Therefore, it easily finds issue with many of the technologies that brought agriculture to the level it reached in the 1970s (and, given the continued growth of agricultural production, the levels that it continues to reach each year). These technologies embody the ideal that nature exists exclusively in its usefulness to humans, specifically in their reliance on the use of non-renewable resources pulled from the earth (e.g., fossil fuels). This and the way agricultural technologies challenged the earth to produce as much as it can without regard for the long-term consequences caused agriculture to come under fire from environmentalists.

At the same time that it became apparent that many other industries were polluting the land, oceans, and air, it finally became widely known that what Rodale's organic farming was meant to remedy—groundwater contamination, soil erosion, the passing on of potentially hazardous chemicals to foods—was being exacerbated by industrial agriculture. Big agriculture was (and is) also pushing many families off the land and dismantling rural communities (Beus & Dunlap, 1990). These consequences come from a model of agriculture produced from policies supported by people who place more value on production than anything else. One notable figure in this productivist camp was Earl Butz, USDA Secretary from 1971-1976. Butz ended some principles of New Deal era policies like the AAA, which had created incentives to keep farm production somewhat limited in order to guarantee high prices and returns for the farms, and replaced them with policies which directly paid farmers for producing certain crops based on the quantity produced. This was the strongest possible endorsement of productivity-focused technologies that aim to produce as much as possible. It led to the current state of agriculture with extraordinarily low crop prices that many, especially consumers, believe is good.

This antithesis was wonderfully summed up by the famous environmental farmer Wendell Berry in 1977 in a debate with Earl Butz, as he said that "he's arguing from quantities and I'm arguing from values" (Beus & Dunlap, 1990, p. 593). Arguing from values rather than quantities isn't always viewed as a positive development though, and Earl Butz was neither the progenitor of the productionist paradigm nor the last one to advocate for it. As early as 1967, people who were anti-pesticide (aside from those who were thought to be purposefully misinforming people to market natural foods) were called "compulsive…neurotics, driven by primitive, subconscious fears to the point that they see more reality in what they imagine than in fact," by prominent voices in support of industrial agriculture, showing how reasoning based on values was seen as negative for much of the twentieth century (McLean, 1967, p. 616).

Values are a very important part of the history of agriculture though. What we value creates our culture and after all, "food is a cultural product; it cannot be produced by technology alone" (Berry, 1977, p. 43). If agriculture was only able to come to where it is because of technological development, technology only developed this way because of the values placed on what it did: the value placed on abundance, on cheapness. Valuing community and diversity of food production, valuing culture over economy, and valuing ecological health will lead to things like farmers' markets, small farms, and closed food loops. The values of prominent alternative agriculture activists therefore have a huge impact on the methods we have today.

Wendell Berry and others advocated in the 1970s and '80s that a decentralized, small-scale form of agriculture is superior to the industrial system not just because of technical reasons as Rodale argued, but because of the lack of values in industrial agriculture—or, perhaps, its unsustainable industrial values. In *The Unsettling of America* (1977), Berry argues against the industrial agriculture of his time in much the same way that many in the local food movement still do today. Berry sees the drive in agriculture to "Get big or get out," as being "devoid of any conception of a better, as opposed to a mechanistic, society" (Kury, 1978, p. 694). He also addresses more extreme groups of environmentalists who perhaps revere nature too much, in a way that may be described as naïve, saying also that these groups could be elitist or exclusionary (Kury, 1978).

Berry asserts that industrial agriculture kills communities in several ways. Industrial agriculture, requiring less labor and more space for maximized output, literally dismantles rural communities by forcing many farmers off of their lands and into cities or suburbs, which takes away much of the community input for innovating that is present in small scale agriculture. Additionally, large-scale agriculture physically separates farmers from those who consume their food and does not allow for the same importance in most communities that farmers once had. Berry uses the values of community as well as harmony with nature to advocate for organic, localized farming as an alternative to the 'conventional' system.

Alternative Agriculture after the Environmental Movement

Of course, these values haven't yet been universally embraced. Just as the Rodales' efforts weren't necessarily the most popular right as they were first developed, natural food movements did not keep much momentum through the decades after the environmental movement began. The 1970s and 1980s were also a time of the popularization of genetically modified foods, with nitrogen fertilizer, herbicide, and pesticide use continuing their upward trend as farmers became more and more dependent on government subsidies. Indeed, as Wendell Berry says in his 1986 amendment to his 1977 book, "Every problem I have dealt with in this book, in fact, has grown worse since the book was written" (p. VIII). These were times when the Ford and Rockefeller foundations along with the US government were funnelling billions of dollars into agricultural production research in Mexico, India, and much of Asia, while American farmers simultaneously exported huge amounts of excess grain to these same countries (grain grown because of the new government incentives to grow surplus food) (Cullather, 2010). Fluctuations of foreign demand in global markets along with other economic factors like the rising price of energy and therefore fertilizers led to a farm financial crisis in the 1980s. That crisis did not lend well to experimentation with alternative methods and technologies of agriculture and certainly affected the decline in popularity of these methods and technologies during this decade (USDA, 2005; Rodale, 1983).

By the 1990s the global agriculture market was reviving and the Cold War was over, decreasing the pressure of American agriculturalists from working on developing agriculture in Asia (USDA, 2005; Cullather, 2010). During the same decade, alternative ways of growing began to regain attention. This was accompanied by a renewed set of arguments against industrial agriculture, which both built upon and in some cases divorced themselves from the historical roots described above.

Working from a point reminiscent of Wendell Berry's, Michael Pollan and many others over the past decade and more have worked to revive the support of local, sustainable, (usually but not necessarily) organic food. Pollan and others have been part of a rising voice arguing that GMO foods and industrially produced foods are not "real" and calling for a return to real foods, foods that don't use overly processed crop derivatives like high-fructose corn syrup or too many ingredients gathered from too many sources (Pollan, 2006). In *The Omnivore's Dilemma*, Pollan attempts to do this by investigating and describing the methods employed by industrial agriculture and juxtaposing that against sustainable methods of production.

Pollan thusly encourages grass-fed beef, cover crops and crop rotation, and abandoning the use of synthetic fertilizers and pesticides for more direct weed, pest, and plant management strategies. Some find that an over-emphasis on just these technologies can limit the alternative agricultural movement, and these critics have been equally vocal. This has specifically been the argument of the social justice movement, which when colliding with the alternative agriculture movement can be called a movement for food justice.

The food justice movement wishes to address the consideration of justice and equity in the distribution of food in order to make alternative agriculture a system that can feed the entire world sustainably. We can see the current inequity in food distribution when the common argument against embracing local, organic, or other alternative food sources is the high cost barrier (Block Chavez & Allen, 2012). This price issue is sometimes more idea than reality, given that recent examinations of local farmers' markets have shown that prices on most commodities are generally comparable to their counterparts at grocery stores (Buy Fresh Buy Local, 2013). In reality, a technological infrastructure that makes it simpler and easier to go to a grocery store than out to a farmers' market is most likely more to blame.

Despite that, arguments by social activists about the exclusionary nature of the local food movement are neither unfounded nor should they be ignored. A 2008 study by food studies scholar Julie Guthman found that many farmers' market managers in California believe it is education and cultural differences that lead to the disproportionate representation of white customers and not economic or other barriers to entry, such as lack of access to cars or the necessary storage technology. Her conclusion suggests that the local food movement is not without misunderstandings of issues of poverty and race that should be addressed as the movement moves forward (Block, et al., 2012).

Food justice activists call for an assessment of food access and food sovereignty in America. Food sovereignty is the right of people to produce and consume culturally and otherwise diverse food and the right of people to have a hand in defining their agricultural policy (La Via Campensina, 1996). Movements based on food sovereignty seek to address how those of low income have either been historically ignored in discussion of food distribution, or have lacked any representation in such discussions. This has led to a prevalence of top-down agricultural policy solutions that fail to address the accessibility issues that people of low-income and minority groups struggle with in relation to healthy food (Block et al., 2012).

Not everyone who finds trouble with the local food movement is seeking a more accessible alternative. There are many who believe that eating locally does not necessarily translate to eating responsibly. One large argument employed by these neo-environmentalists is that the ethical ethos evoked by people like Michael Pollan and Wendell Berry is based off a notion of restoring the land to some golden age of agricultural balance that never actually existed (McWilliams, 2009). Supporters of this camp advocate for responsible use of land, reduced (perhaps, but not necessarily, to zero) production of meat and animal products, and increased planting of perennials and other plants that do not require tillage (McWilliams, 2009). Interestingly, these arguments usually do recognize that conventional agriculture is far worse than an organic or local alternative, and even promote many organic, local sustainable and other alternative agricultural methods. They differ from more mainstream alternative agriculture advocates because they advocate for these methods while attempting the conventional-organic debate in order to prevent premature assumptions that local food is always more sustainable than food grown far away.

The Manifestations of the Alternative Agriculture Movement.

The accruing criticism of industrial agriculture has led to an abundant amount of alternative technologies that can be used to create a more sustainable agricultural system. On-the-farm technologies include a series of options: methods of composting, non-chemical ways of dealing with pests and weeds, the implementation of cover crops, and crop rotation to protect against erosion and reinvigorate the soil with nutrients evolved to produce food sustainably. Distribution methods to get more 'real' food to more consumers came into being in the forms of farmers' markets, community supported agriculture (CSAs), and food hubs. Food policy councils to address food access and sustainability have soared in popularity across America. Such a number of individual techniques for bringing forth a sustainable agriculture system exist that we cannot supply an exhaustive list here, but the potential for such a system is solid and supported by both scientific evidence and by ethically based argumentation in its many forms, as explored earlier in this chapter.

This system continues to prove itself. As of 2011, there were 3,587 certified organic farms covering 935,450 acres of land in the US (USDA, 2013). By 2010, there were over 1,400 community supported agriculture programs and well over 5,000 farmers' markets in the States (USDA, 2010). In May 2012 there were 193 food policy councils across North America (CSFC, 2012). Since 2013, advocates from non-profits to for-profit companies have built over 200 food hubs in the United States—and these numbers are only growing (BFBL, 2013). These features suggest that America wants a system that is more sustainable from farm to fork. This book is intended to assist in creating that system.

In the following chapters, we will discuss several specific, sustainable technologies that are part of the growing local food movement. These include ways of restoring nutrients to the soil and some new ways to handle pests (Chapter 3). We detail weed management without synthetic herbicides, and management techniques for increasing the value of crops produced at the farm, like packinghouses and washing stations. We also note educational innovations that spread information to farmers, which is necessary for them to be sustainable. One chapter explores ways of extending the growing season, using greenhouses as well as mulches, row covers, and irrigation techniques (Chapter 4). Then, in Chapter 5, we analyse how the food system distributes its products, through community farming programs, community supported agriculture projects, farmers' markets, food hubs and grocery stores. We follow that with an examination of consumer practices and the motivations behind them in Chapter 6, discussing how cooking at home and eating outside the home fit into sustainable agriculture while also addressing ways to eliminate food waste through composting and other recovery technologies.

Throughout the book we will go into more detail about how these technologies are part of the food system, and are improving the food system. After these observations, the final two chapters conclude with discussion of parts of the food system beyond specific practices. Chapter 7 offers a focus on public and community policy regarding the food system. Finally, Chapter 8 explains how an alternative, sustainable agricultural system is an improvement over the system currently in place; how an alternative system will improve the health, community solidarity, equity, and ethical implications of society. To give the study regional specificity, we take a case study of a specific and historically important context, one that is placed-based for our College: that of the Lehigh Valley in Pennsylvania.

2

The History of Lehigh Valley Land and Food

Erica Gennaro and Scarlett Jimenez

Introduction

Comprised of over 42 square miles of land, the Lehigh Valley is made up of the Allentown, Bethlehem, and the Easton Area. With a projected population growth of thirty five percent within the next thirty years, the Lehigh Valley is the fastest growing and third most populated region in Pennsylvania. A vast history of industrial and urban change pervades the area and with large-scale development foreseen for the future, many local planners anticipate cultural and environmental shifts on the land. One prevalent market prominent to the Lehigh Valley is agriculture. Although people often associate and recognize Pennsylvania and the Lehigh Valley for their steel and mining industries, the area is, and has long been, a vibrant contributor to the agricultural market.

With about 1002 farms in the Lehigh Valley, the trend in population growth presents concerns as to how we might meet food production and needs of the local area while dealing with increased regional development. In response to the rapid change in development and food production, planners have encouraged a number of local efforts, like community-supported agriculture (CSA) movements, to support sustainable local food technologies. To understand the local food movement, we want to recognize the context of the technological infrastructure and natural characteristics that make the Lehigh Valley unique.

With a little under fifty percent of the Lehigh Valley classified as farmland, the Valley is known for its culturally ingrained agricultural institutions. Agriculture within the area has been defined by mom-and-pop seasonal roadside stands, farmers' markets, family owned farms and everything in between, making it clear that within the Valley there is an abundance of agricultural products but also a large potential for more. Local businesses and people envision a better food system for everyone throughout the Valley, but current agricultural infrastructure and assembly needs are at a mismatch with the capabilities of distribution and production.

Geography

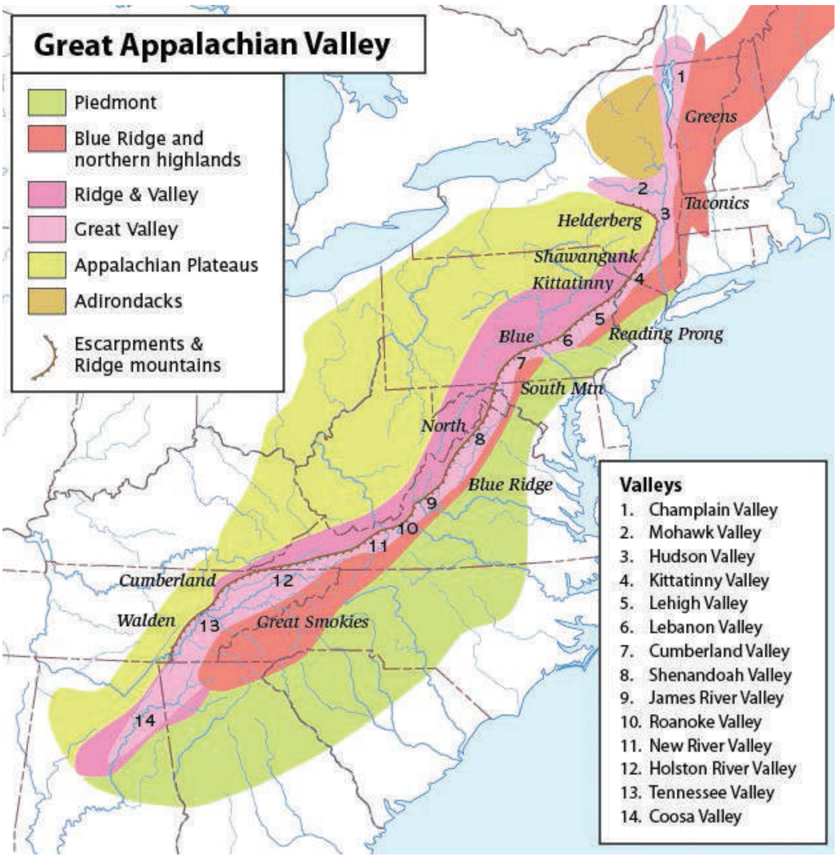


Figure 2.1 Map of the Great Appalachian Valley (Wikimedia Commons, 2014)

Bounded on the north by the Blue Mountain and on the south by the South Mountain, the Lehigh Valley is a small northern section of the Great Appalachian Valley (Figure 2.1), which extends from Quebec to central Alabama. Geographically distinct, the Lehigh Valley is compromised by approximately 730 square miles and over eight hundred thousand residents. Historically named regions tell the stories of past settlers, settler occupation, and biological and ecological features. Early settlers within the Lehigh Valley had an intimate relationship with the environment and the names of multiple places in the Valley, e.g Flint Hill and Sandstone Ridge, depicted the significance of that natural setting.

The fastest growing region in Pennsylvania, the Lehigh Valley, is located approximately sixty miles north of Philadelphia, eighty miles northeast of Harrisburg and seventy-five miles west of New York City. A large part of its rapid growth is attributed to its relative distance to the neighboring regions of Philadelphia, New Jersey and New York, which are large business markets with relatively high costs of living. Its unique location in the central east coast makes the rock and soil composition of the Valley's area unique and fertile. Differing by region, the rocks of the Lehigh Valley Mountains vary from gneiss, limestone, shale, and quartzite. As shown in Figure 2.2, for a relatively small area the Lehigh Valley has a variety of rocks that have helped shape economical benefits of the Valley (Halma & Oplinger, 2001).

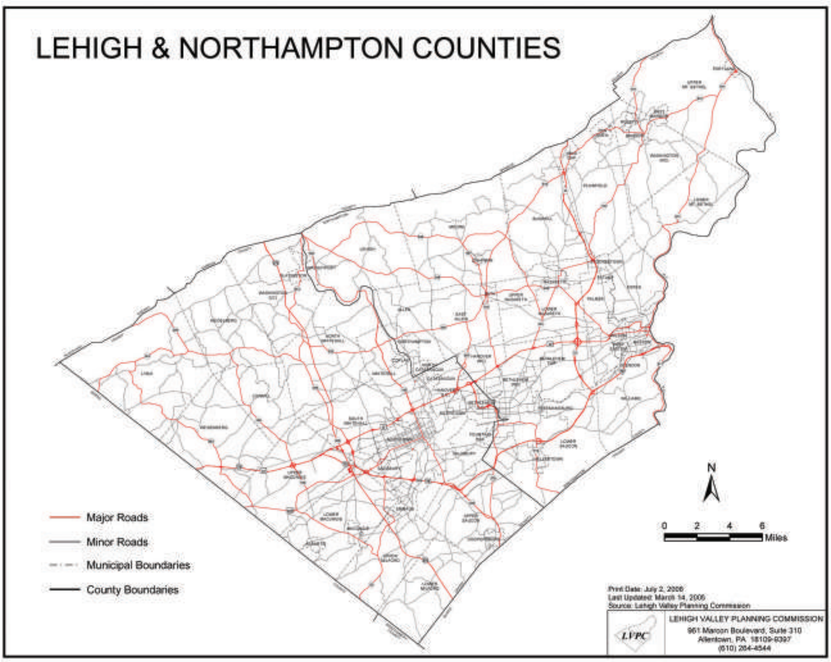


Figure 2.2 Map of the Lehigh and Northampton Counties
(Lehigh Valley Planning Commission, 2012)

Geological Composition

Geography has played a major role in shaping the face of agriculture in the Valley. Water flow has played an influential part in terms of land topography and its contribution and involvement with food production. The vast majority of streams flow into the Lehigh River which connects to the Delaware River. These determined flows of water have shaped the soft shales and limestones into a low-relief valley but as the Lehigh River reaches Allentown, the crystalline rock composition of the area deflects the river east. The availability of water in certain areas of the Lehigh Valley has played a key role in also determining which types of industry flourished in certain areas, more specifically along the waterways.

Limestone, concentrated in the southern region of the Valley, whose composition is largely made of calcium, works as a soil enricher. In the past most farms had their own "mini-quarries" of limestone, from which they would extract it, burn it and then spread it in their fields and essentially use the limestone as soil fertilizer. Today all that remains are ruminants of what once was and quarry holes no longer in use. Although limestone use and collection is no longer of the same type, limestone remains a rock with multiple purposes. The type of limestone that became valuable to the Lehigh Valley was the Jacksonburg Formation. This rock type had a perfect mix for manufacturing American Portland cement, which was first made in the Lehigh Valley in 1871. This availability of limestone led to a growth in the cement market for the southern Lehigh Valley area.

Another beneficial rock to the Valley was slate, a fine grained rock which, due to how it is made under heat and extreme pressure, develops fine lines of cleavage that produce durable sheet like material. The nature of this rock allowed for the manufacturing of indoor fittings such as chalkboards, curbing stones, table tops etc. The availability of this rock started a slate industry during the 1800s and progressed to a point where by World War II the Lehigh Valley supplied half of the slate produced in the United States. This industry came to a standstill in the post war market of production of synthetic materials (Halma & Oplinger, 2001).

Lastly, another set of minerals with extensive influence on the Lehigh Valley has been the distributions of irons and ores, which, during the twentieth century increase in steel mills along eastern Pennsylvania, were used in large part to meet local demand. Ultimately, the steel industry would import most of its ores. Local furnaces slowly decreased in demand because they could not meet request for higher and faster ore production.

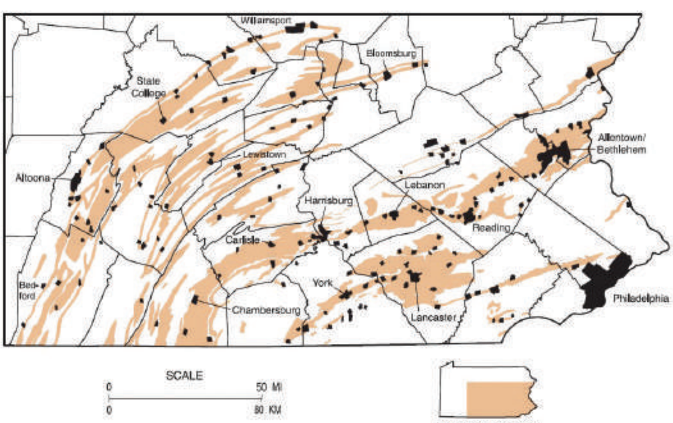


Figure 2.3 Carbonate Bedrock distribution and major population centers in central and eastern Pennsylvania (InspectApedia, 2014).

The distinct composition of the Lehigh Valley bedrock makes different regions susceptible to sinkholes and in turn depicts which types of crop products and farms would be able to successfully thrive in that region.

Soils of the Lehigh Valley

Soils of the Lehigh play a notable part in the region's history. Historically drawing settlers to the area due to its rich soils, the soil has helped shape the industries that have prevailed here. Large parts of the Lehigh region besides manufacturing metals and textiles products are known for processing foods and related products. It is important to understand the soil, how it acts, and its composition in order to understand where the concentrations of certain crops would be expected to grow best.

Table 2.3 *The major soil types of the Lehigh Valley and some of their characteristics*

Characteristics and Resource Base	Major Soil Types		
	Perma-Berks (Bk)	Appalachian DeKalf-Lehew-Laidig (Dkt)	Alluvial floodplains
Location	Northern half of valley; coincides with shale belt	Blue Mountain (northern border of valley)	Along Delaware, Lehigh, Cedar, Jordan, Boshkill, etc.
Topography	Billowy hills, elevation 650–900 feet; hills flat-topped to rounded	Sinuous ridge, grading into steep colluvial talus slopes; elevation 1,000–1,600 feet	Flat alluvial areas bordering rivers, streams
Mean depth to bedrock, in feet (range)	2.5 (2–5)	4 (0–10)	4+ (3–10+)
pH (range)	5.5–6.0	4.0–4.5	5.0–6.0
Source material	Martinsburg shales; Illinoian glacial	Sandstones, quartzites of ridge	Flood deposits
Major crops/land use	Potatoes, small grains, corn, soybeans	Non-agricultural: wildlife; trails; wooded; game lands	Corn, pasture, fruit; protected park and recreation land
Texture	Silt loam, shaly	Stony, sandy loam; very stony	Silty to sandy
Moisture storage capacity	Good	Good/moderate	Good to excellent

Table 2.3 (continued) *The major soil types of the Lehigh Valley and some of their characteristics*

Characteristics and Resource Base	Major Soil Types		
	Washington, Hagerstown (Wh, Hg)	Womelsdorf-Annondale (WA)	Northampton-Kistler (Nh)
Location	Southern valley, roughly coincides with limestone	South Mountain	Northeastern corner of Northampton County; Bangor to Belvidere and northeast
Topography	Undulating hills to broad, flat interstream areas; hill elevation 400 feet	Irregular mountains, many steep slopes; elevation 500–1,000 feet	Large swampy areas
Mean depth to bedrock, in feet (range)	2–10+	3–5	3 (2–5)
pH (range)	6.0–6.5	5.5	5.5–6.0
Source material	Limestones; Illinoian glacial	Residual, from gneisses	Martinsburg shales; Wisconsinan glacial
Major crops/land use	Variety of crops, corn, etc.	Some crops; mostly forested; some development on top	General farming; potatoes
Texture	Silt to silty clay loam	Silt loam to silty clay loam; slopes rocky	Silt loam; shaly silt loam
Moisture storage capacity	Good to very good	Good	Good

SOURCE: Data after Higbee 1967.
NOTE: A narrow band southeast of South Mountain, including Saucon Valley, has some limestone and some Triassic red shale-based soils.

Figure 2.4 Soil Types of the Lehigh Valley and Their Characteristics (Halma and Oplinger, 2001, p. 34-35)

Most of the Lehigh's soil is slightly acidic, deep, and gently sloping. Figure 2.4 provides a list of the major soil types of the Lehigh Valley and some the characteristics attributed to them. Because of varying topographical settings, biological influences, and rock throughout the Valley, all which contribute to the type of soil formation, various soils allow for different uses amongst the regions of the Lehigh Valley. Agronomists determine soil types through soil surveying and classification based on similar groupings throughout different localities.

With soil being used in different ways and for multiple purposes, use and management varies in different parts of the county. In the northern half, with deep soils the most important management problems facing them includes improvement, maintenance and control of soil erosion. For areas north and south of the South Mountain, where there are dispersed areas of deep soils over rock, the biggest management problem they face is similarly erosion control and also drainage management on many farms.

In considering the areas suitable for agricultural technology—for example, different methods of irrigation—the soil types of the county are grouped according to the qualities and characteristics that are most important in irrigations. These attributes include the rate of infiltration, permeability, depth, texture, and moisture-holding capacities of the land.

With the increased population growth in the suburbs of Allentown, Bethlehem and other places, soil type is also important in considering which areas would be suitable for homesites and community developments.

Climate

Agriculture is an important sector of the U.S. economy. In addition to providing us with much of our food, crops, and livestock, Pennsylvania's food production contributes at least $7 billion worth of products a year (NCIS, 2014). Crops grown in the United States, the Lehigh Valley included, are critical for food supply and global food exports. Changes in atmospheric temperature, CO2 emissions and frequency of rain and extreme weather have significant impact on crop yields.

Precipitation within the Valley ranges from forty to forty-five inches annually. Rare to the Lehigh area are hurricanes and extreme episodes of thunderstorms. The Valley, unlike other places, experiences four distinct seasons with cold winters, humid summers, and various seasonal patterns during the spring and fall.

In accordance with the National Oceanic and Atmospheric Administration's (NOAA) annual summary for Allentown,

> A modified climate prevails. Temperatures are usually moderate and precipitation generally ample and dependable with the largest amounts occurring during the summer months when precipitation is generally showery. General climatological features of the area are slightly modified by the mountain ranges so that at times during the winter there is a temperature difference of 10 to 15 degrees between Allentown and Philadelphia, only 50 miles to the south (Halma, 2001, p. 82).

An additional factor that has influenced the Lehigh Valley's agricultural identity is its growing season. On average the total growing season here is approximately 176 days, but can range anywhere from 170 days to 185 days. The growing season generally begins late in April and ends towards the beginning of November. Although the Lehigh Valley seldomly averages high temperatures, it does experience relatively high humidity during the summer. It has vulnerability for thunderstorms that can occasionally cause damage. The winters on average tend to bring variable amounts of snowfall with mild temperatures in the winter.

Winds in the Lehigh Valley are mostly coming in from the west, southwest, or northeast. Wind speeds scale from calm 23% of the time, between 4 and 15 miles per hour 64% of the time, and 16 to 31 miles per hour 12% of the time on annual average. Wind speeds rarely exceed thirty-two miles per hour with the windiest month being

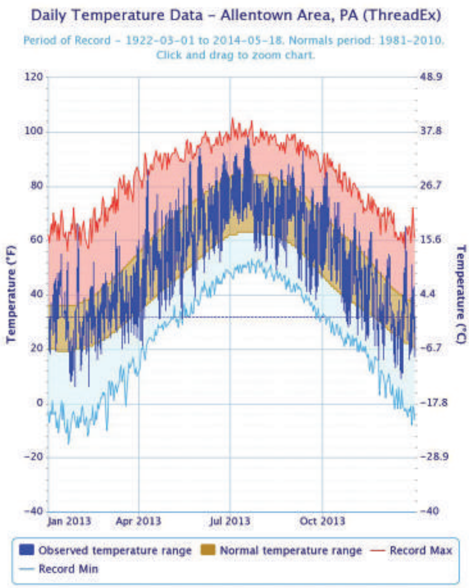


Figure 2.5 Monthly Climate Normal
Source: NOAA (Normals 2010–Present)

March and the calmest month being August. Wind patterns and behavior at different periods throughout the year have unique effects on the Valley due to the surrounding mountain ranges and bodies of water. Because Lehigh Valley has an attributed topography, elevation, and mountains, tornadoes are uncommon.

Agriculture and Food

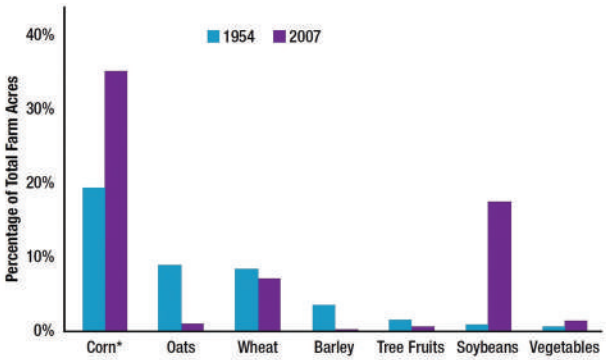
The geography, geology, soil, and climate of the Lehigh Valley have largely shaped the agricultural context of the Valley, which is of course an integral determinant of a successful local food economy. The Lehigh Valley Planning Commission states, "The biggest challenge facing the Lehigh Valley local food economy is the loss of farmland: since 1930, the Valley has lost 80 percent of its farms and 53 percent of its farmland" (Prior, 2013, p.1). Even between the years of 2002 and 2007 when the national number of farms slightly increased, the Lehigh Valley lost nine percent of its farms (Prior, 2013). This loss of farms and farmland is certainly a concern when assessing the local food capacity of the Lehigh Valley.

Another possible concern is the changing distribution of farm size. From 1930 to the early 1990s, the average farm size in the Lehigh Valley generally increased. However, in recent years the average farm size decreased from 201 acres in 1992 to 152 acres in 2007. This decrease is largely attributed to a decrease in mid-sized farms and an increase in large farms, rather than an increase in small farms. The percentage of farms greater than 180 acres increased from 2 percent in 1949 to 16 percent in 2007. Plus, the median farm size in 2007 of only 34 acres indicates that the average was skewed by larger farms. The growth of large farms presents a challenge to smaller farms that cannot benefit from economies of scale (Prior, 2013).

The struggle for small farms to compete with large farms is somewhat evident in the overall decline in their financial performance. Even after excluding the very small noncommercial farms, farms generating less than $250,000 in sales, made up 81 percent of Lehigh Valley farms in 2007. Yet, their share of sales in the Lehigh Valley was only 20 percent. In 2002, the 86 percent that were small commercial farms accounted for 33 percent of total agricultural sales. Even though plenty of small farms are profitable, these statistics indicate that overall agricultural production continues to shift to large farms (Prior, 2013; USDA ERS, 2010).

Over the years, the types of products sold by farms in the Lehigh Valley have become significantly less diverse. From 1954 to 2007, the percentage of farm acres used to grow corn and soybeans considerably increased, while the percentage used to grow oats, wheat, barley, and tree fruits decreased (Fig 2.6). The predominant crops grown today are corn for grain, soybeans, forage, and wheat. Livestock, poultry, and dairy products only constitute 27.9 percent of agricultural sales. In 2007, over 53 percent of Lehigh Valley farmland was used to grow corn for grain or soybeans (Prior, 2013).

Amongst the commonwealth counties, the Lehigh Valley remains the top tier producer of corn. In particular, the types of corn grown in the Valley include field corn, a taller coarse-grained variety of corn, and sweet corn, a sugary tender variety intended to be directly consumed "at the table." Corn in particular is associated with more than 30 percent of economic compensation for agricultural production and is usually available on the market by late July. Like corn, wheat is the principal grass in the Valley, particularly with Berks, Lehigh, and Northampton Counties as top producers.



Source: USDA, Census of Agriculture 2007, BFBL-GLV 2013.

Figure 2.6 Selected Crops Grown in the Lehigh Valley (1954, 2007).
*Corn for grain and silage or greenchop

The increase in commodity specialization, which is influenced by the greater emphasis on production, decreases ecological biodiversity and increases the reliance on chemicals and fuels. Consequently, farmers have become less self-sufficient, soil and water resources have deteriorated, and the nutritional value of food has diminished (Prior, 2013).

The demographics of Lehigh Valley farmers affect the direction in which farming can and will go. Currently, the vast majority of farmers are middle- to older aged white males. Moreover, the average age of farmers has risen over time, from 55.7 years in 1997 to 57.4 years in 2007, and there are now five times fewer farmers younger than 35 than farmers over 65 (Prior, 2013). Part of the reason for the scarcity in young farmers is the fact that entry into farming is challenging in several ways.

One of the major challenges is the procurement of land. Of the Lehigh Valley farmers in 2007, only 17 percent farmed exclusively on land they owned. High land prices and property taxes make owning land difficult, especially for young adults. Other challenges include gaining capital and proper training (Prior, 2013). Thus, even if interest is high, these obstacles limit the number of beginner farmers.

In an attempt to mitigate these problems, programs like The Seed Farm have provided better training and assistance with farm business establishment. Apprentices at The Seed Farm in the Lehigh Valley learn "all aspects of running a small organic vegetable farm, including business planning, crop planning, equipment use, production techniques, and marketing" (Prior, 2013, p.28). Once trained, some are eligible to receive three years of assistance in launching their farm businesses. These efforts are beneficial to increasing the number of farms, the number of successful farmers, and the use of sustainable farming practices.

Many current and potential farming policies can also assist in creating a more sustainable food future. For example, Pennsylvania's Water Quality Management Program regulates the land application of manure and the discharge of other pollutants from farms into water sources. Additionally, the Erosion and Sedimentation Program manages farming practices, such as plowing and animal crossings, that result in significant losses of soil to water sources (PennFuture, 2011). These and other state and local guidelines regarding odor management, dead animal disposal, antibiotic use, land development, and various farming practices, can encourage a greater concern for the health of future generations and the environment as a whole.

With that said, some policies make it more challenging for small-scale farmers to succeed. An LVRC report conducted in 2009 for the Greater Lehigh Valley Buy Fresh Buy Local Chapter found that most farmers felt restricted by zoning regulations, record keeping regulations, inspections, odor control restrictions, and other policies that they felt were more easily met by larger corporate farms (Ruebeck & Niesenbaum, 2009). The goal of local and state policymakers should be to design policies that protect residents and the environment, without discouraging small-scale farming.

Demographics and People

To design sustainable food technologies for the Lehigh Valley, we want to understand the population they are intended to feed and the demographics of that population. The estimated population living in the Lehigh and Northampton Counties in 2010 was 647,232. According to the Lehigh Valley Planning Commission growth projections, this number will increase to 873,954 in just three decades (Fig 2.7, LVPC, 2012).

Of the 2010 population, approximately 15.2 percent were 65 years of age or older. By 2040, the Planning Commission believes that there will be nearly twice as many people in this age cohort as there are today. Five-year estimates from 2008-2012 indicate that there were 54,146 people born in a foreign nation. In 2010, over 23 percent of the population was Hispanic/Latino, Black/African American, or Asian (Prior, 2013; US Census).

Compared to the national median household income of $50,046, the median household income in the Lehigh Valley was $54,008 in 2010. According to the 2008-2012 estimates, 12.9 percent of the population lived below the poverty level. The poverty rate was higher for minorities, at 22.2 percent for blacks, 25.1 percent for American Indians or Alaska Natives, and 33.4 percent of Hispanics or Latinos (Prior, 2013; US Census).

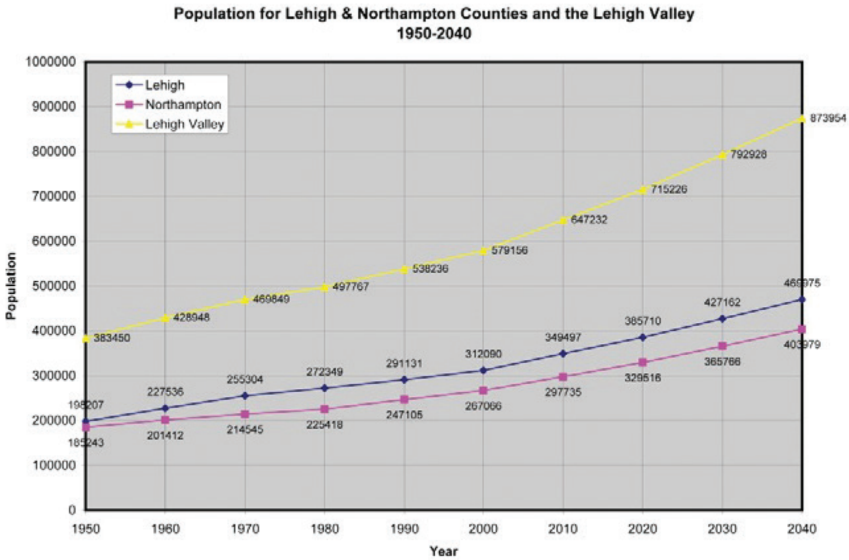


Figure 2.7 Population for Lehigh & Northampton County and the Lehigh Valley (1950–2040). (Lehigh Valley Planning Commission.)

All of these factors should be considered when determining how to sustainably address the food needs of Lehigh Valley. The observed and expected population growth brings up questions about the food production capacity of local land, which is later discussed. The large and growing populations of elderly residents and minority groups affect the types of food that should be grown and distributed. Plus, the considerable levels of poverty contribute to the challenge of ensuring the affordability and accessibility of local foods.

Cultural Landscape

Understanding the cultural characteristics of the Lehigh Valley is also important for designing sustainable ways to feed its residents. In order for most of the proposed changes in policies, farming practices, and consumer behaviors to be effective, we need to consider the current opinions, eating habits and needs of the people of Lehigh Valley.

Luckily, the public has mostly been in support of farmland preservation. In 2002, two separate open space bond referendums, parts of which were aimed to preserve farmland, passed by 71 and 65 percent. That same year, the Lehigh Valley Planning Commission conducted a public opinion survey that found that farmland preservation was the planning issue that most people found in greatest need of being addressed within the next 10 years. With the sale of bonds, cigarette taxes, and state and federal funds, the Lehigh Valley has been able to preserve slightly more than 21 percent of total farm acres (Prior, 2013).

The 2009 LVRC report also shows regional support for the local food movement. All of the sampled farmers within the Lehigh Valley sold the majority, if not all, of their food locally. All of the sampled groceries bought local fruits and vegetables and observed an increase in consumer demand for locally grown foods. The restaurants surveyed bought about half of their food locally, but all "indicated either agreement or strong agreement that they are concerned about strengthening the local Lehigh Valley economy and the future of family-owned farms in the Lehigh Valley area" (Ruebeck & Niesenbaum, 2009, p.11).

In an effort to ensure continued growth of consumer demand for locally grown food, planners should take the typical diet of Lehigh Valley residents into account. Assessing this diet should also identify its shortcomings and encourage healthier future habits. From 1960 to 2011, there was a general decrease in the percentage of annual income that the average household in the United States spent on food (Fig 2.8). Additionally, Americans have spent an increasing amount of their food dollars on food consumed away from home (Fig 2.9). This is concerning because, as the Lehigh Valley Local Food Economy report mentions, "studies have shown that increased away-from-home food expenditures are associated with poor diet quality, higher intakes of fat, and lower intakes of fiber" (Prior, 2013, p.11).

Also concerning are the changes in the types of food purchased to consume at home. Recently, the amount spent on the category of "Other food at home" has increased to roughly one third of the amount spent on foods consumed at home. These "other" foods are typically not healthy, as they exclude fruits, vegetables, grains, dairy, and most protein foods. Furthermore, the average Pennsylvania resident eats vegetables 1.5 times per day and fruit 1.1 times per day. The USDA, however, advises consumers to eat 3.5 to 5 cups per day, or about half of each plate of food (Prior, 2013). A greater emphasis on locally grown food can decrease consumption of "other" foods and increase that of fruits and vegetables. As of now, farming policies encourage

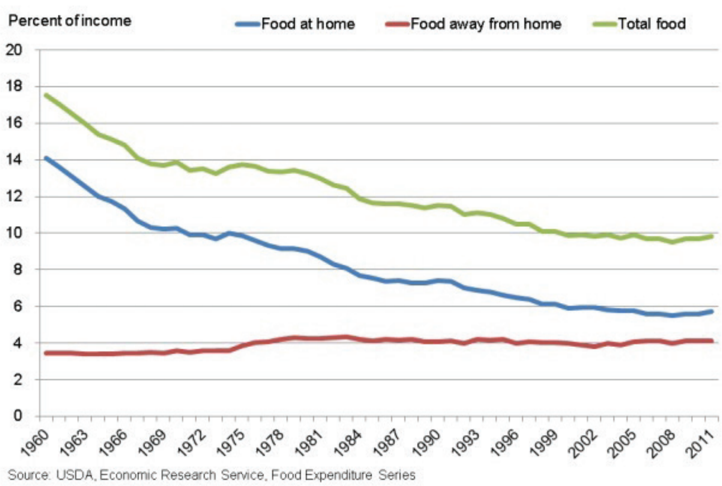


Figure 2.8 Food Expenditures in the United States as a Percentage of Income (1960–2011)

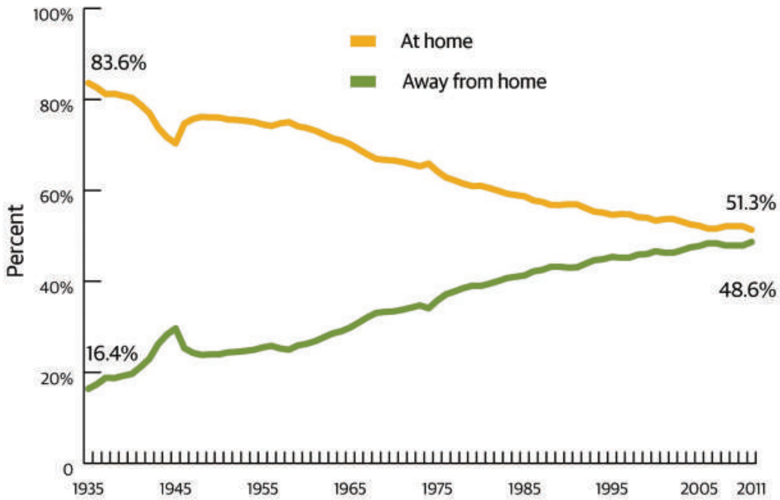


Figure 2.9 Percentage of Food Expenditures At and Away from Home (1935–2011) (USDA Economic Research Service.)

overproduction of the commodity crops discussed earlier. Commodity corn, in particular, is the main ingredient in most of the sweetened and processed foods that make up the "other" category. Support for more sustainable agricultural practices can significantly improve the diet, and thus the health, of Lehigh Valley residents.

Consideration for local dietary preferences may be important for improving the local food economy, as well. Given that over 23 percent of the Lehigh Valley population in 2010 was part of a minority group, there may be a demand for certain ethnic foods. For example, Lafayette farmer and Seed Farm graduate Sarah Edmonds once worked with an international student at Lafayette who inquired about a few specific vegetables grown in China. Experiences like this show the promising potential for the local food movement to meet both the dietary needs and cultural preferences of local residents.

The large and growing proportion of elderly residents is another factor to consider. Many of the diseases commonly suffered by older people, such as certain cancers, cardiovascular diseases, diabetes, and osteoporosis, are affected by diet. Additionally, metabolic changes that occur naturally with age reduce energy requirements. Therefore, it is essential for the limited food that is being consumed to be rich in certain nutrients. Micronutrients, like antioxidants and minerals, are thought to decrease the risk for many age-related diseases. Many of these micronutrients are found in fruits and vegetables. According to the World Health Organization, "increasing consumption of fruit and vegetables by one to two servings daily could cut cardiovascular risk by 30%" (WHO, 2014). Increasing access to locally grown foods will be extremely helpful in this regard.

Feasibility and Technological Context

A successful local food economy depends on the capacity of the Lehigh Valley to meet the food needs of its growing population. According to the Lehigh Valley Planning

Commission, Americans eat an average of 164 grams of meat and eggs per day, which requires about an acre of farmland per person. This means that with the 153,000 estimated acres of farmland remaining, "the Lehigh Valley is only able to feed 153,000 people, or 24 percent of the Valley's current population" (Prior, 2013, p.29). While a more efficient diet of limited meat and egg intake would raise this number to 39 percent (Prior, 2013), and would certainly be beneficial, a combination of methods of promoting sustainability is required to ensure success.

As is discussed in later chapters, there are numerous ways to increase local food production and improve the relationships amongst and between technology and nature in the Lehigh Valley. Many small-farm technologies, such as certain soil enhancement technologies and pest and weed control methods, can be useful for sustainably maximizing agricultural output and maintaining quality. Similarly, short-term and long-term season extension technologies, like greenhouses, high-tunnels, mulches, cold frames, row covers, and irrigation practices, have the potential to provide more food year-round without compromising environmental health. Finally, the combined use of different distribution technologies, including veggie vans, community gardens, farmers' markets, community supported agriculture, food hubs, and grocery stores, can facilitate more extensive attention to the food needs of the Valley.

Without an understanding of the Lehigh Valley, it would be difficult to alter attitudes and behaviors, implement policy changes, and encourage the design and use of more sustainable technologies. The unique geology, soils, and climate of the Valley shape the agriculture of the region and influence the demand for, and subsequent success of, agricultural technologies. Recognizing the loss of farms and farmlands, increased crop specialization, and scarcity of young farmers, and the consequences of those trends, should inspire action. Population growth projections, age distributions, minority populations, and socioeconomic characteristics of the population affect the quantity and variety of food in demand, as well as the accessibility and affordability of that food. Lastly, a study of the culture of the Valley can increase community support for and involvement in the local food movement.

Understanding the unique natural characteristics, agricultural context, people, culture, and existing policies and technologies of the Lehigh Valley is essential for ensuring the success of the local food movement. The broad overview above of the Lehigh Valley and its residents sets the stage for Part II of this book, Technologies from Farm to Fork.

PART 2

Technologies from Farm to Fork

3

Small-Farm Technology and Sustainable Tools and Techniques

Nick Bisignano, Jeremy Cooley and Jeremy Forsyth

Improving local food health in the Lehigh Valley by increasing sustainable production is essential to the future wellbeing of the community. To meet the growing food needs of the population, we want to encourage innovative small-scale farming technologies and techniques to maximize the quality of local produce. Industrial farming operations compromise the nutrient value of its products in order to maximize profit. This characteristic of large-scale farming has been criticized for contributing to environmental problems both locally and globally. Furthermore, we propose that a healthier environmental future for the Lehigh Valley is one that supports local, small-scale farming operations to ensure a healthy food economy and healthy people for years to come.

Although industrial farming has overpowered small-scale farms in the last 75 years, recent developments in technology and increases in demand for organic food have given small farming a new opportunity to successfully re-enter the market. To rewrite the definition of efficiency the greater agricultural community has to realize production increases are not the only factor at play. On average, farmers lose around 18% of their food due to improper techniques. This fact equates to the

Figure 3.1 Buy Fresh Buy Local logo for the Greater Lehigh Valley (Prior, 2013).

diminishing returns currently associated with solely increasing output (UC Davis, 2014). Not just greater production, that is, but learning how to grow food by managing soils effectively, storing food properly, and reducing waste in the production process are all essential for sustainable farming.

FARM HACK
AN OPEN SOURCE COMMUNITY FOR RESILIENT AGRICULTURE.

Figure 3.2 Farmhack logo, taken from their website (Farmhack, 2014).

One great resource for such efforts is Farmhack.net, a beneficial tool for all growers who wish to increase their farming knowledge. Videos and blogs of farming techniques are periodically posted online by other farmers, so that the greater agricultural community can access them. With Farmhack, users are given the opportunity to educate themselves on the most innovative sustainable growing practices currently available. The spread of sustainable farming knowledge—for both techniques and technologies—is crucial in building a more educated, global farming community (Farmhack, 2014). In keeping with the work at Farmhack aimed at improving small-farm technologies, in this chapter we first discuss sustainable farming techniques as part of daily maintenance practices and then review small-farm tools that can help in the post-harvest phase of farming and growing.

Sustainable Farming Techniques—farm maintenance

Effective management of soils, pests and weeds is essential to maintaining an environmentally friendly and profitable farming system. Current agriculture practices do not just come to be; they are a result of adjustments made to overcome the shortcomings and faults of past technologies with cultural and societal values taken into consideration. As knowledge of the biological processes involved with farming continues to grow, agriculture techniques have been refined to respect the integrity of these biological systems in order to grow the highest quality product without jeopardizing the quality of future produce.

Soil Management

Nutrient management, the efficient use of all nutrient sources, is essential for creating a sustainable agricultural system with optimum growth and high-quality harvested products. Efficiently managing nutrient sources is not only a good environmental practice; it decreases costs that would otherwise be needed for additional nutrient inputs. Maximizing nutrient availability in soils while minimizing nutrient losses to the surrounding environment is crucial for maintaining fertile soils. Chemical elements obtained from the soil, in addition to light and water, are essential for plant growth. Plants need at least 16 chemical elements, though there are differences in the quantities required of each nutrient for each plant.

The basic chemical elements are divided into three groups by amount of nutrient required by plants. Primary macronutrients consisting of nitrogen, phosphorus, and potassium are used in the largest quantities—in the range of 50 to 150 lbs/acre. Calcium, magnesium, and sulfur are secondary macronutrients, and about 10 to 50 lbs are needed per acre. Iron, manganese, zinc, copper, boron, molybdenum, and chlorine are all required by plants as micronutrients, though in much smaller quantities—less than 1 lb/acre (University of Minnesota, 2013).

Organic matter in soil consists of the living soil organisms and readily decomposed plant residues, and is an important factor for soil fertility. Not only is it an excellent source of plant nutrients, organic matter also buffers soil pH and helps soluble micronutrients bond as well—all of which are essential to healthy plant growth. Bacteria, fungi, earthworms, mites, and insects are some examples of living soil organisms that make up the soil food web, which carries out the biological nutrient cycling process. These living organisms help decompose organic matter and release nutrients back into the soil for living plants to consume. Growing healthy crops that add large amounts of plant residue and maintaining plant soil fertility are the best methods for adding organic matter to the soil. Reducing or eliminating tilling can also aid in increasing organic matter levels in the soil, as the aeration provided by tilling increases the rate of organic matter decomposition and also increases erosion, which can be detrimental to soil health (Funderburg, 2001).

While the presence of organic matter can sufficiently provide a number of nutrients for plants, primary macronutrients are consumed at a greater rate and need to be replaced regularly. Plants use nutrients to create their crops that are harvested and not returned to the soil; thus a loss of nutrients is inevitable and expected. Of the three primary macronutrients, nitrogen and phosphorus need to be replaced more regularly, which can be done through a variety of methods.

Fertilizers are another element of all farming, with specific needs and forms for small farms. Large-scale commercial farms often use regular applications of synthetic fertilizers even though nitrogen surpluses from excessive fertilizer usage can lead to pollution of the water, air, and soil. Synthetic fertilizers are comprised of chemical compounds that provide plants with the macronutrients and micronutrients they require; these inorganic fertilizers are designed solely to provide nutrients for plants, and as a result, soil health is disregarded. Mineral salts can be used to help plant root absorption, but these salts do not provide a food source for earthworms and other soil microorganisms that are essential for maintaining soil health. Synthetic fertilizers also acidify the soil, which repels living organisms from the affected soil. As a result, there is a loss of organic matter, which causes soil degradation over time. Synthetic fertilizers are ideal for large-scale commercial farms that strive for quantity over quality. While these fertilizers might be an ideal option in the short run, in the long term there will be losses in soil quality. This is a major reason that small farming operations can produce healthier, better quality produce.

Using organic fertilizers is a viable and more sustainable technique of primary macronutrient fixing. Methods and compositions of organic fertilizers can vary as there are a large variety of specialty organic fertilizers as well as more common products. Organic cow-manure pellets and liquid seaweed are easily available for usage in organic fertilizers. Custom mixes can also be used to cater to specific plant needs. Bat and bird guano, composted chicken manure, blood meal, feather meal, and fish meal are all possible nitrogen sources for plants. Kelp and greensand are common organic sources of potassium and bonemeal can be a good source of phosphorus. Organic fertilizers can be used as either dry or liquid fertilizers. Dry fertilizers are generally applied by hoeing or raking it into the top 4–6 inches of soil. Liquid fertilizers should be applied every month, or even twice a month during growing season. A caution with liquid fertilizers is that they should be slightly acidic, with a pH of 6.0 to 6.5, for optimal efficiency, so soil pH levels should be monitored to ensure the soil doesn't become too acidic for agriculture production (*Organic Gardening*, 2014).

There are other nutrient-fixing techniques that can help at the small-farm scale. One of those solutions for small-scale farmers with livestock on their property is biological nitrogen fixation by growing legume cover crops. Growing soybeans or other legumes as part of a crop rotation cycle allows for a large quantity of biologically fixed nitrogen, and is especially effective if livestock is available to consume the legumes. This method of nutrient cycling is efficient because about 75% or more of the primary macronutrients used to grow the legumes is recycled back into the ground when the livestock excrete it.

A 15-year study monitoring carbon and nitrogen balances in legume-based systems versus the conventional fertilizer-driven agricultural systems determined that soil health and nitrogen levels remained much higher over time in the legume systems. The legume systems in the study simulated a beef operation in which pesticides and synthetic fertilizers were not used. Crop biomass was fed to beef cattle in the legume systems and their manure was returned to the field. The conventional system used mineral nitrogen fertilizer applied before planting and pesticides were used "as needed." After the 15-year span, nitrogen and carbon levels in the conventional soil had decreased despite the constant inputs, whereas the overall health and nitrogen levels in the legume-based systems had increased (see Figure 3.3). The additional plant diversity obtained by growing legume cover crops during winter or offseason months allows for a greater variety of soil microorganisms, enhances carbon and nutrient cycling, and promotes root health (Drinkwater, 1998).

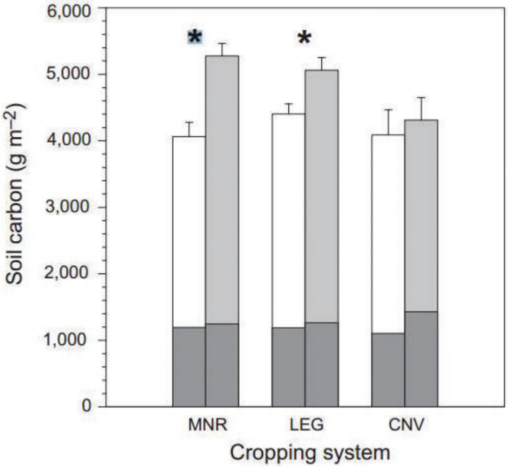


Figure 3.3 Carbon levels in the soil in 1981 (left-hand bars) and 1995 (right-hand bars) for the three different cropping systems. MNR uses manure as a nitrogen source, LEG receives nitrogen directly from legumes, and CNV is the conventional system that uses mineral fertilizer and pesticides (Drinkwater, 1998).

Another technique that can help small farms is the practice of cutting nutrient losses with cover crops. Cover crops are an important tool for all agricultural systems, not just those seeking to utilize legumes with livestock. Winter and summer cover crops both contribute to an increase in organic matter within soils, which improves soil health and fertility during growing seasons. In addition to replenishing nutrients, cover crops reduce soil erosion and runoff by adding stability to the soil. The topsoil layer is the richest layer of soil in both organic matter and nutrient value, and is susceptible to erosion. Having cover crops in the ground during non-harvest seasons increases soil stability, which in turn decreases the amount of soil erosion. Farmers should avoid tilling practices when possible, as the disturbances in topsoil layer increase the chances of water runoff transporting nutrients offsite. Topography of the agricultural area should be noted, and precautions should be made to divert stormwater away from the main agricultural area. Reduced nutrient loss is important in maintaining nutrient efficiency.

Recycling food scraps and yard trimmings through composting is another effective method for reducing waste from food scraps, as well as returning nutrients to soils. Using compost can improve the structure of soils by increasing water retention, which reduces nutrients lost to surface runoff. Effective composting can also promote a larger diversity of soil life, which improves overall soil health. Reusing organic waste is also economically beneficial, as waste as well as the cost of transporting that waste is reduced, and fertilizer costs also decrease because healthier soils produce disease- and pest-resistant crops (EPA, 2013).

Organic Pest Management Techniques

Genetically Modified Organisms (GMOs) are crops that can be designed, among other things, to resist toxic levels of substances that destroy pests (pesticides). Pesticides aim to destroy insects that are detrimental to farming. However, insects that are beneficial to the agriculture ecosystem are also harmed in the process, and farm products are exposed to toxins. Some insects—ladybugs, for example—eat larvae of pests and provide a natural form of pest control (Brackney, 2013). Different techniques can be utilized in order to protect plants from pests without affecting plant health.

Farmers would need to understand lifecycles of pests to properly time pest management effectively. Growing plants at earlier or later times in the season can help avoid pests, especially during beginning stages of growth. Crop rotation can help halt populations of certain pests from accumulating in one area. Pests and diseases can prey on certain plant families—thus, mixing up plant families can be a useful tool for reducing crop losses due to soil-borne pests or diseases (see Figure 3.4 for a table of common crop families). Rotation schemes for crops should run for at least three or four years to ensure that pests and diseases decline to harmless levels (Crop Rotation, 2013).

Symbol	Crop Family	Background	Plants in this Family
	Brassicas (cabbage family)	Light green	Broccoli, Brussels sprouts, all varieties of cabbage, kohl rabi, cauliflower, kale, mizuna, pak choi, radish, arugula, rutabaga, turnip
	Legumes (bean and pea family)	Light blue	Snap peas, peas, bush, pole, lima, fava and dry beans
	Solanaceae (potato and tomato family)	Yellow	Eggplant, potato, tomato, peppers
	Alliums (onion family)	Lilac	Garlic, all varieties of onion, shallot, chive, leek
	Umbeliferae (carrot and root family)	Orange	Celery, celeriac, cilantro, fennel, carrot, parsnip, parsley, dill
	Cucurbits (squash and marrow family)	Salmon	Summer and Winter squash, cucumber, melon, pumpkin
	Chenopodiaceae (beet family)	Pink	Swiss chard, spinach, beet
	Miscellaneous	Grey	All fruit, mint, oregano, rosemary, sage, basil, lettuce, endive, cress, Jerusalem artichoke, corn, asparagus, okra, corn salad, chicory

Figure 3.4 A table detailing plant families (Crop Rotation, 2014).

Plants that are grown with ideal amounts of water, sun exposure, and nutrients can be healthy enough to resist destruction from pests on their own. Pests can often spread from one garden to another from transplanted crops; these plants should always be inspected for infestations. Barriers, row covers, mulch, sticky traps, and hand-picking are tools and techniques that are commonly used to combat pests. If pesticides are a must, then non- petroleum based products are an alternative to other harmful chemicals (Cornell, 2006).

Small Scale Weed Management

Crops that are genetically modified to resist herbicidal effects are a main reason mass production of crops is easier. If weeds are managed properly, then farmers do not have to worry about their crops competing with weeds for soil nutrition. While manure is beneficial for soil nutrition, it is often a breeding ground for weeds. Cover crops can be used to compete with weed plants for water, light, and nutrients. Aggressively removing weeds in the short run will decrease the potential for weed spreading as the quantity of weed seeds will be diminished.

Handpicking weeds is a common weed removal tactic, though it can be quite labor-intensive. A diamond planting technique can be employed to increase the efficiency of removing weeds. By evenly spacing crops when planting, and offsetting adjacent rows such that each plant in one row is located in the space between two plants in adjacent rows, weeding efficiency is increased by going along diagonal paths. Crop rotation is also beneficial for weeding purposes, in addition to pest and disease control as mentioned above. These effective organic practices for weed management can also reduce labor and improve quality of crop yield (Grubinger 2013). All of the above techniques, taken together—soil, pest, and weed management—require a vision of agriculture that prospers from small-scale practices, not just large-scale industrial machinery.

Sustainable Technologies—post-harvest

Increasing food access and availability does not necessarily mean increasing the total amount of food grown. Instead, a more effective method to achieving higher rates of food production as mentioned by Jose Fernandez, the United States assistant secretary of Economic and Business Affairs, "is to ensure that the food already produced is not lost or wasted between the farm and the table" (Fernandez, 2013). In other words, this means the prevention of spoiled food, or the reduction of food being unused postharvest can be just as significant to increasing food production as physically growing more crops. This past year in the United States, 31 percent, or 133 billion pounds—of the 430 billion pounds of food grown was lost (Buzby, 2014). This statistic speaks volumes to how the commercial food industry has improperly used the techniques and technologies available in today's world. There are no longer excuses for farms of any size to use unsustainable technologies that aim solely increase output; the inevitable moral and environmental issues these technologies run into have the potential to irreversibly ruin the landscape and future generations' livelihoods.

If the Lehigh Valley can succeed by implementing sustainable postharvest techniques and technologies it can become a symbol for other communities and companies to rethink their own model. To build a more productive and sustainable food system in the Lehigh Valley only sustainable postharvest technologies that increase the efficiency of the manufacturing process should be utilized. We separate these postharvest technologies into three specific types: post-harvest handling, sanitation and storage. These three categories are equally important to the success of any postharvest operation. Later in this book, Chapter 6 will address post-consumer waste in greater detail, but in this section of the current chapter we will outline information regarding the implementation and effective practice of sustainable postharvest technologies on the farm.

The first part in any postharvest operation is the initial handling of the produce right after being picked. Exhibiting proper postharvest handling and technique at this point in time is extremely critical at determining if the postharvest farming operation will be a success. When handling crops postharvest a proper etiquette must be followed to ensure the quality of the food.

The six principles below are the golden rules of postharvest handling. When practiced effectively can drastically reduce the amount of food lost (Mohd Roseli, 2012).

1. Harvest during the coolest time of day to maintain low product dehydration.
2. Avoid unnecessary wounding, bruising, crushing, or damage from humans, equipment, or harvest containers.
3. Shade the harvested product in the field to keep it cool. By covering harvest bins or totes with a reflective pad, you greatly reduce heat gain from the sun, water loss, and premature senescence.

4. If possible, move the harvest produce into a cold storage facility as soon as possible.
5. Do not compromise high quality product by mingling it with damaged, decayed, or decay prone product in bulk or packed unit.
6. Only use cleaned and, as necessary sanitized packing containers to further transport produce.

These principles can be followed on any farm, including farms in the Lehigh Valley. Also take note that some pre-harvest decisions that can help in following certain rules more effectively are proper organization and planning of produce fields; a farm that is systematized accordingly will lose less produce then one that is not. For example taking notice of areas of land that receive the most shade could be a characteristic of a farm that should be taken into consideration before planting. Planting certain crops that tend to contain less water closer to the shade is essential to prevent spoilage. These plants include many dark, leafy green vegetables like spinach and swish chard, which are both common plants grown in the Lehigh Valley Region. Nevertheless, postharvest handling is merely a third of the entire process and does not guarantee farming success alone.

The next part to a successful postharvest operation is sanitation. The sanitation process should first begin by separating any already infested produce from the rest of the yield. The detection phase of any sanitation effort is crucial to limiting the spread of disease from one item of produce to the next (UC Davis, 2014). Detection itself is most effective when completed outdoors away from any storage infrastructure, or wet areas. Once a suitable location is found, farmers can start by locating any produce that has any noticeably odd-colored spots, or flesh pieces missing. These abnormal produce should be separated from the rest and then disposed away from the rest of produce and crops. The longer the entire harvest is in contact with contaminated produce the greater the risk more food will be eventually lost due to spoilage. Two bacteria that are common perpetrators of spoilage in the United States are *Penicillium expansum* and *Botrytis cinerea* (Barth, 2007). However, the negative effects of these pathogens can be heavily diminished by carefully sorting the produce; the importance of sorting the contaminated produce both carefully and swiftly can make or break a harvest (UC Davis, 2014).

Not all contaminations are easy to spot, or identify. However, Food Technology Notes, an online blogsite focusing on food technology, does provide some helpful pointers on how to detect certain types of spoilages, so that they can be removed from the rest of the produce:

> "Fungal spoilage of vegetables often results in water-soaked, mushy areas, while fungal rots of fleshy fruits such as apples and peaches frequently show brown or cream-colored areas in which mold mycelia are growing in the tissue below the skin and aerial hyphae and spores may appear later." Some types of fungal spoilage appear as "dry rots," where the infected area is dry and hard and often discoloured. Rots of juicy fruits may result in leakage" (Anu Paul, 2009).

In general Food Technology Notes is an excellent resource for all small-scale growers, or farmers wanting to learn more about food sanitation.

To better understand postharvest sanitation as a whole, being acquainted with the microorganisms and diseases that cause food loss is necessary. Therefore, using all the available information on the fungi and bacteria that cause postharvest food loss can minimize the net amount of food being lost in total at later stages during the farming operation. Education is one of the most effective technologies at fighting food lost caused by disease and contamination because it teaches farmers exactly what abnormal characteristics to look out for in their produce.

The rest of the sanitation phase should then take place indoors, more specifically in a postharvest technology known as a packinghouse, a facility that processes food before it is transported to the distributors. Even though they rely on fossil fuels to function, packinghouses can be made into sustainable technologies by making educated decisions about location and infrastructure before construction. Farm-specific planning is a recurrent theme in postharvest operations.

The locations of packinghouses need to be taken into consideration: "When deciding upon where to locate a packinghouse, consider ease of access to both the field and the market point" (UC Davis, 2014, pg. 4.4). In other words constructing a packinghouse in an area where both field workers and transportation intersect is the optimal location. An optimal location results in a reduction of both transit time and fossil fuel usage making the overall postharvest operation more sustainable. Also from a food standpoint lowering the amount of miles a crate of produce must travel before it reaches its distributor lowers the percent of food that is ultimately lost due to spoilage or road damage. After the location is determined, the next step in building a successful packinghouse is to determine what processing equipment and infrastructure should be employed in the packinghouse.

Figure 3.5: A stainless steel sink being implemented in a packinghouse (ISU Extension, 2010).

In smaller scale farms, packinghouse equipment does not have to include industrial sized conveyer belts, or large volume spray washers. Instead packinghouse equipment should more closely resemble a typical, commercial restaurant kitchen to ensure the food being processed is well attended to, so food loss does not appear in the equation. Additionally, some equipment that should be employed in all small-scale postharvest operations includes stainless steel tables and sinks (see Figure 3.5). Stainless steel surfaces are easier to keep clean and sanitize than other less-expensive substitutes (ISU Extension, 2010). Smooth-surfaced tables are the ideal area for workers to continue sorting and cleaning produce effectively. Sinks should be large enough to fit several pounds of produce at a time so that they can be soaked and or rinsed before storage. The amount of sinks employed should be enough that your maximum calculated harvest would not have to wait to be attended too; having too few sinks may jeopardize your operation. Both tables and sinks are examples of very pedestrian technologies, but if employed correctly can positively impact production on small-scale farms.

The last technology that should be employed in a small-scale packinghouse to improve postharvest operations is organic sanitizers. Organic sanitizers can be applied to produce during rinsing by pouring it into the water, or hand applied pre/post rinse. In the farming community sanitizers that are popularly used include chlorine, iodine, hydrogen peroxide, quaternary ammonium compounds, and some other organic acids (ISU Extension, 2010). Sanitizers are useful, yet they can have some devastating effects on produce if used improperly. Therefore, sanitizers being used need to be already approved by the EPA for food contact before implementation (EPA, 2014). Also the known safe concentration of the sanitizer needs to be calculated; too much sanitizer regardless of its toxicity level can aid food loss. Nevertheless, using a sanitizer to protect the health of the produce is necessary especially when immediate transportation is not an option. After sanitation is complete, storage, the last phase of the postharvest operation begins.

Storage is a contentious technology in the small-scale farming community because in a perfect food economy it would not be needed. Food would be harvested, sanitized, and then brought immediately to market, and at the end of the day all food harvested would be sold to consumers. Unfortunately, today that is rarely the case. Hence, storage is the most reliable technological fix to keep unused food fresh and from going to waste. Moreover, storage plays an even more important role at reducing food loses in farms that do not have the option of continually transporting fresh produce to market every day. These farms' livelihoods would be lost without storage technology.

The storage technology that is most popular and effective at preventing spoilage is known as a cold room, or a large-scale refrigerator. James F. Thompson, an agricultural engineer and advocate for cold room implementation, mentioned the benefits of what a well-designed cold room can administer on a postharvest operation: "By investing in a cold room, small scale farmers, packers, or merchants can significantly slow the quality loss of their produce" (Thompson, 1996, pg. 3). Cold rooms can increase production by maintaining food quality until consumers are ready to purchase. Slowing down the time in which food quality deteriorates gives produce that did not get sold the day before a fair, second try at the market. Ultimately, the quality of a given food determines a consumer's buying behavior. Nevertheless like any technology, appropriate design is imperative in delivering the full value of a cold system.

A cold system should be constructed in an area similar to that of a packinghouse. If possible to shorten the travel distance between packinghouse and cold room, the cold room can be built into the packinghouse; this will minimize the chance any food loss would occur during the transfer between postharvest phases. The next step in designing a successful cold storage is to determine how large it should be and what materials to construct it with. As stated by Thompson: "Cold room size is based on the typical volume of produce (measured in cubic feet) handled during peak harvest" (Thompson, 1996, pg. 3). This should mean no produce should be left without space during a typical harvest; determining the size of the cold room is a lot easier then deciding what materials should be used to construct a cold room because there are many known possibilities and options for farmers to use. The most commonly used cold rooms can be separated into six categories: new prefabricated, used prefabricated, rail car, highway van, marine container, and owner built (Thompson, 1996). Each category of cold room has its own varying costs associated, as shown in Figure 3.6.

After the cold room is constructed it must then be used appropriately. If it is not, like many technologies, it can cause more harm than good. The most important detail about operating a cold room is its functioning temperature. The resting temperature of a produce needs to be taken into consideration before cold storage because if it not

TABLE 2. Cost comparison of small-scale cold rooms

	Cost (dollars per square foot)		
Type of Cold Room	Equipment & materials	Modification & transport to site	Total
New prefabricated*	—	—	45
Used prefabricated†	10-30	0	10-30
Rail car‡	6	22-27	28-33
Highway vans§	33-45	0	33-45
Marine container»	30-33	5-10	35-43
Owner-built#	10-20	0	10-20

* Prefabricated panels with metal interior and exterior facing attached to foam-board insulation. Building assembled by a commercial contractor, 400 square feet of floor area, and 2-hp refrigeration system installed (add 5% if installed outside).

† Owner installed.

‡ Diesel/electric refrigeration system. Floor dimensions are 9x45 feet.

§ Diesel powered. Cost to convert to electricity powered refrigeration is $10 to $20 per square foot. If wheels are left attached, a truck-high dock or ramp may need to be installed at extra expense.

» Electrically powered; no wheel, axles, or suspension system are attached.

Wood-frame construction, similar to plan in figure 6. Installed by owner and includes a contractor installed used refrigeration system.

Figure 3.6 Costs of constructing different types of cold rooms (Thompson, 1996).

Compatible Fresh Fruits and Vegetables During 7 Day Storage

	Groups 1A & 1B 32-36°F, 0-2°C, 1A: 90-98% rh, 1B: 85-95% rh			Group 2 45-50°F, 7-10°C & 85 -95% rh		Group 3 55-65°F, 13-18°C & 85-95% rh	
Vegetables	alfalfa sprouts	Chinese cabbage*	mint* **1A**	basil*		bitter melon	
	amaranth*	Chinese turnip	mushroom	beans; snap, green, wax		Boniato*	
	anise*	collard*	mustard greens*	cactus leaves (nopales)*		cassava	
	artichoke	corn;sweet, baby	parsley*	calabaza		dry onion	
	arugula*	cut vegetables	parsnip	chayote*		ginger	
	asparagus*	daikon*	radicchio*	cowpea (Southern pea)		jicama	
	beans; fava, lima	endive*-chicory	radish	cucumber*		potato	
	bean sprouts	escarole*	rutabaga	eggplant*		pumpkin	
	beet	fennel*	rhubarb	kiwano (horned melon)		squash; winter (hard rind)*	
	Belgian endive*	garlic	salsify	long bean		sweet potato*	
	bok choy*	green onion*	scorzonera	malanga*		taro (dasheen)	
	broccoli*	herbs* (not basil)	shallot*	okra*		tomato; ripe, partially ripe &	
	broccoflower*	horseradish	snow pea*	pepper; bell, chili		mature green	
	brussels sprouts*	Jerusalem	spinach*	squash; summer,(soft rind)*		Yam	
	cabbage *	artichoke	sweet pea*	tomatillo			
	carrot*	kailon	Swiss chard*	winged bean			
	cauliflower*	kale*	turnip				
	celeriac	kohlrabi	turnip greens*				
	celery*	leek*	waterchestnut				
	chard*	lettuce*	watercress*				
Fruits and Melons	apple	elderberry	prune **1B**	avocado, unripe	lime*	atemoya	rambutan
	apricot	fig	quince	babaco	limequat	banana	sapodilla
	avocado, ripe	gooseberry	raspberry	cactus pear, tuna	mandarin	breadfruit	sapote
	Barbados cherry	grape	strawberry	calamondin	olive	canistel	soursop
	blackberry	kiwifruit*		carambola	orange	casaba melon	
	blueberry	loganberry		cranberry	passion fruit	cherimoya	
	boysenberry	longan		custard apple	pepino	crenshaw melon	
	caimito	loquat		durian	pineapple	honeydew melon	
	cantaloupe	lychee		feijoa	pummelo	jaboticaba	
	cashew apple	nectarine		granadilla	sugar apple	jackfruit	
	cherry	peach		grapefruit*	tamarillo	Mamey sapote	
	coconut	pear: (Asian & European)		guava	tamarind	mango	
	currant	persimmon*		Juan Canary	tangelo	mangosteen	
	cut fruits	plum		melon	tangerine	papaya	
	date	plumcot		kumquat	ugli fruit	Persian melon	
	dewberry	pomegranate		lemon*	watermelon	plantain	

• Ethylene level should be kept below 1 ppm in storage area.
* products marked with an asterisk are sensitive to ethylene damage.

Thompson & Kader, UC Davis 1999

Figure 3.7 Chart of optimal resting temperatures of different groups of produce (Thompson and Kader, 2013).

produce damage like frost and ice damage can become a lot more common especially when the cold room is filled to capacity (ISU Extension, 2010). This would go against the end goal of increasing food production by reducing the amount of food being lost. Not all produce has the same comfortable temperature and that fact should be documented (Thompson, 1996). Once the produce is stored in a well-designed cold room that is functioning at that crops' optimal resting temperature the postharvest operation has reached its end (see Figure 3.7).

With an eye to the future, farmers in the Lehigh Valley could work on addressing their postharvest operation to sustainably reach full production potential. A successful outline that the Lehigh Valley could learn from is the postharvest program at the University of California–Davis. The program is better known as the UC–Davis Postharvest Technology Center. Its main goal is to educate farmers on how to reduce postharvest losses and improve the quality of the crops they are cultivating. The program believes that providing free information to all farmers about postharvest operating is the most effective method to changing food culture. Another hope the program has is to inspire others to further innovate and work together. The program's website describes this vision: "the organization hopes to catalyze innovative and enhanced collaboration among center members, industry, government, and other academic institutions, nationally and internationally by effectively communicating information and knowledge on postharvest technology that enhances the quality, safety and marketability of fresh horticultural products" (Mitcham, 2014). Even though the program and many of its findings were conceived almost 3,000 miles away, their knowledge can be applied to the Lehigh Valley. Many of the crops grown in California are grown in the Lehigh Valley, but at a far less successful rate. This has to do with the specific climate of California, and it may be attributed to the many benefits the program has provided, but from the success its users have witnessed, the program's site is worth looking into for their database on a range of postharvest issues.

Conclusion

The future economic and social stability of the Lehigh Valley will rely highly on increasing food production through sustainable technologies. Furthermore, keeping within the realms of sustainable ideals like ecological health, economic viability, and community strength is vital to attaining a better food culture in the Lehigh Valley; increases in production will only be effective if they can be replicated without harming the environment. With looming population increases could be around 145,000 people in the next twenty years, keeping hold on humanity's carbon footprint by implementing sustainable technologies is a necessary path the Lehigh Valley's agricultural community needs to walk.

As mentioned in Chapter 2, the Lehigh Valley must overcome the natural limits of climate and accessible farmland to ensure a sustainable food economy; however, those mountainous problems cannot be fixed by production enhancing technologies alone. To look ahead we need to envision innovative, sustainable technologies that seek to increase the feasible production in the Lehigh Valley without compromising its environmental health. While we have discussed land management and post-harvest technologies above, there are a series of other technologies commonly used today. One kind, season extension technologies, is designed around the idea of beginning the growing season earlier in the year and extending farther into the Fall. The next chapter addresses such technologies of season extension.

4

Season Extension Technologies

Chris Castello, Asha Hedrington and Trevor Quiel

Introduction to Season Extension

One important area where sustainable food production and technology come together is season extension technologies. As prior chapters have noted, the Lehigh Valley has a rising population combined with a decline in farm lands, which puts pressure on the existing farm lands to produce as much as possible. Chapter 3 showed that there are many quality techniques and technological systems that can be utilized on the shrinking Lehigh Valley farmlands to produce more food in an environmentally sustainable manner. However, a major limit to the amount of food produced in the Lehigh Valley is the temperate climate. This climate only allows farms to produce food for around 4 to 6 months (half of spring, summer, half of fall) of the year and is dependent on the weather from year to year. The window of opportunity for farmers is tight and they must work extremely hard in order to make sure they produce as much as possible during those constrained times. Also, an anomaly in the weather such as an early or late snow or intermittent temperatures in the early spring and late fall can throw off farming production and destroy certain crops. Farmers can use many techniques and technologies to extend these windows of opportunity, and even allow farmers to produce for an entire year. These techniques and technologies all fall under the category of season extension farming.

People often think of a greenhouse as the standard season extension technology. While a greenhouse is a useful and effective technology (which will be discussed later in the chapter), there are many more types of season extension farming which many people may not know about and could have a positive effect on food production in the Lehigh Valley. Some technologies like the greenhouse would require a lot of planning and up front cost while others could be made easily and economically. It is easier to understand season extension farming with the idea of time. In this chapter we explain a number of techniques and technologies by breaking them up into short-term season extension and long-term season extension. If farmers are more interested in just extending their production window for a few months, many of the short-term season extension techniques and technologies are easy to implement, and will attain the desired results. If a farmer is really looking to extend their production window, the long-term season extension is a great option. These techniques and technologies require more planning, but positive results can be found within the first season. The farmers of the Lehigh Valley face the pressure of keeping up with a rising demand of food, while being limited by the colder climate. Season extension can be a tool in easing the pressures placed on farmers and bringing more local food to the area during a time when local food production is difficult or impossible.

Short-Term Season Extension, 2006

One important technological system used for season extensions is irrigation. Irrigation in general is the technological system in which water is applied to crops. Water is critical to the growth process of produce. However, natural supplies of water to crops like rain are not reliable enough to provide optimal growth for a farmer's crops. In order to provide water to the crops when needed, irrigation systems are used by farmers. With the proper use of irrigation, farmers are able to grow more pastures and crops, lengthen their growing season, and produce higher quality crops. The main way an irrigation system can help extend growing seasons is the timing and technique used to irrigate the crops. Irrigating the crops after initial planting and drought-like conditions improves the germination of the crop (Kelley, 2013). With a higher success rate of crop germination and application of the ideal water needed for the crops to grow, the growing season is extended in the early spring. This gives farmers a head start on their main growing season. However, in order to accomplish this early season extension, farmers must understand and figure out which irrigation system is the best fit for their operation. This requires knowledge of equipment, system design, plant species, growth stage, root structure, soil composition, and land formation.

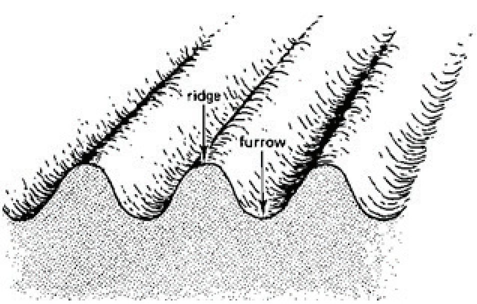


Figure 4.1 A diagram of furrow irrigation (Brouwer, 1988).

There are several different irrigation systems. They include but are not limited to the central pivot, furrow, level basin, and drip irrigation systems. Furrow irrigation systems are suitable for crops that are in rows or would be damaged if water covered their stem or crown. They are made up of shallow channels, which are used to guide water down slopes. They are normally straight and occasionally curved to follow the contour of the land, especially on steeply sloping land. Its advantages are the fact that there are lower initial investments for equipment and lower pumping costs per acre-inch of water pumped. However, the labor cost is still quite expensive.

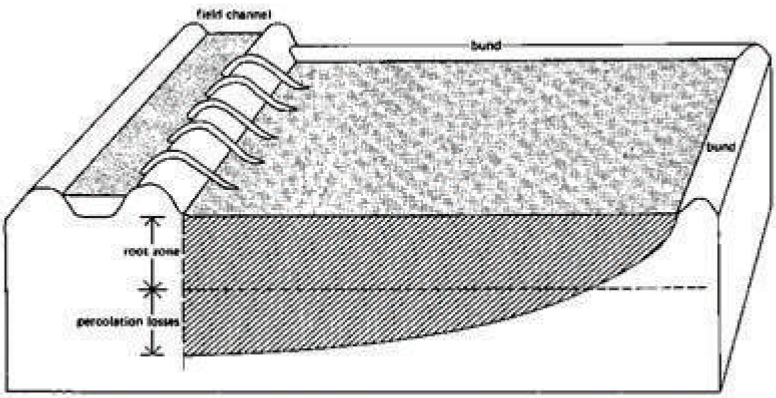


Figure 4.2 *A diagram of basin irrigation* (Brouwer, 1988).

An efficient and economical way for farmers to keep their crops flourishing is drip irrigation. It reduces runoff and evaporation by applying water slowly at the plant root area where water is needed. Some other benefits of drip irrigation are that it "prevents disease by minimizing water contact with the leaves, stems, and fruit of plants; allows the rows between plants to remain dry, improving access and reducing weed growth; saves time, money, and water, and decreases labor" (Food and Agriculture Organization). Overall, it is a technology that continues to grow in use in the Northeast.

Utilizing irrigation systems correctly maximizes farming production, saves water costs, and extends the season. An increase in crop germination can be seen by correctly timed irrigation shortly after initial planting and during drought-like conditions. This higher percentage of crop germination leads to a short extension to the early growing season along with an increase in production. Both are critical to the Lehigh Valley. Proper irrigation is critical to make many of these season extending techniques and technologies possible. It must be kept in mind throughout the chapter, including the next technique, mulches.

Mulches

While irrigation can be a useful method for season extensions, another popular season extension technique is the use of plasticulture. As stated by Penn State's College of Agriculture, plasticulture is the use of plastics in plant and animal agriculture. The uses of these plastic products are supposed to increase productivity by cutting costs and time. One example of this plasticulture is plastic mulches.

Plastic mulches have been used on produce such as muskmelons, tomatoes, peppers, cucumbers, squash, eggplants, watermelons, sweet corn, snap beans, southern peas, pumpkins, and much more since the 1960s. They are supposed to help the crops be ready for harvest earlier, and produce higher quality yields. Because of the much cooler temperatures in the northern half of the United States and high altitudes, these plastic mulches help harvest "heat loving crops". They can also be used as transplants to yield earlier crops.

Unfortunately there are some disadvantages for plastic mulches. For small-scale markets, even though it can be used for multiple seasons, the mulch has a high up-front cost. This type of mulch is not useful without the proper irrigation system, and must be installed with a drip irrigation system. Due to the complexity of the system, plastic mulch is typically more labor-intensive, thus requires machines to implement. Using machines is the more efficient and more widely used way to save time and ensure uniformity. The beds must be level, and the plastic laid tightly with drip irrigation tape in the center of the bed. However, the initial cost of implementations can be offset by the increase in crop value due to a higher quality of crop produced using the superior mulch system.

Figure 4.3 Plastic Mulch Layout (University of Missouri Extension, 2010).

Plastic mulches are also available in a variety of colors with different functions. The most commonly used mulch is the black mulch. It helps stop weeds from growing by "shading them out". It also "reduces soil water loss, increases soil temperatures, and improves vegetable yields" (Fitzgerald, 2012). With the mulch at a depth of two inches, the soil temperature during the day is about five degrees higher compared to regular soil. Clear mulches have a greater capacity to warming the soil than colored ones do. In certain parts of the United States with cooler temperatures this mulch is a favorable pick. With a depth of two inches, there is an eight to fourteen degree temperature increase, however, the clear mulch weeds can grow underneath, which may become a problem, and cause farmers to resort to using weed killers and pesticides such as herbicides and fumigants. It is recommended that farmers experiment with this one before they officially use it to see if the benefits compensate for the weed competition (Blomgren & Frisch, 2012). Red mulches perform similarly to black ones, by controlling weeds, warming the soil, and conserving moisture. White and silver mulches on the other hand decrease the soil temperature in areas where the temperature is too high to produce the desired vegetables. In addition to these there are also blue, yellow, green, and orange mulches. The reflecting radiation patterns affect plant growth and development for different plants. For example, there is an increase in the growth of peppers in silver mulches, cantaloupe in green, and cucumbers and squash in dark blue.

On the other hand there is a different type of mulch that can help with season extension. Biodegradable mulch is made of plastic that comes from plants (corn, wheat, and potatoes). It can be plowed into the ground after harvest or left in the soil after growing season so it will degrade. Unfortunately this form of mulch is more expensive than traditional plastics and does not have the same stretchy qualities as regular plastic.

Mulching and irrigation can be useful season extending techniques. However, used alone these techniques will not extend a farmer's season too long. A longer extension can be achieved through the use of some small-scale, simple technologies.

Short-term Season Extension Technologies

One of these simple technologies is a cold frame. Cold frames are a useful tool for short-term season extension. A cold frame is a miniature greenhouse and shares the same technological principles. It is generally used for seed starting and allows farmers to get their first crop harvested much more quickly than normal. The cold frame requires a small typically wooden frame with a glass covering. The glass allows solar radiation in, warming the plants and soil while trapping the thermal radiation emitted by the plants. The glass door can be opened to different levels allowing for a degree of temperature control and ventilation.

Crops can be started in a cold frame much earlier. The frames allow for a great starting place for crop seeds since it protects the early growth from wind, frost, and pests. Cold frames can be very inexpensive to make as you can recycle old things in your home such as a shower or sliding glass door. Farmers can even get as creative as using milk cartons. The best types of crops produced in a cold frame are arugula, broccoli, beets, cabbage, chard, green onion, kale, lettuce, mustard, radish, and spinach (Pleasant, 2007).

Row Covers are another useful small technology for achieving short-term extension of the farming production window. A row cover is basically a plastic or fabric material laid loosely on top of plants or supported with wire hoops to achieve warmer temperature for frost protection while also providing pest control. There are

Figure 4.4 Cold Frame (Coleman, 2009).

three main types of row covers: floating row covers, heavy row covers, and plastic row covers. A floating row cover is the lightest of the three row cover types. These covers allow for air, water, and 85% of light to pass through its light-weight fabric. The main purpose of these covers is pest protection, but they also have the added benefit of frost protection for a few degrees as well. Heavy row covers allow for greater frost protection (up to 10 degrees); however a downside is less light is able to pass through causing crops to slow growth. The plastic row cover provides a much greater temperature rise (up to 30 degrees) while still allowing for a lot of sunlight to get through. The plastic material is supported by wire hoops to prevent damage to crops. Due to the higher temperatures, the row cover must either be vented out or be made with slits to allow for ventilation and the correct growing temperature (Coleman, 2009).

Figure 4.5 Row Cover (*Organic Gardening*, 2012)

The benefits of these smaller technologies are the low initial cost, smaller risk, and less commitment. Cold frames and row covers allow a farmer to produce a small amount of crops for longer. For example if a farmer had a specific type of crop such as kale that they wanted to produce, one of these smaller technologies would work well. The farmer could produce small amounts of kale in a cold frame and sell those during time which kale is not normally produced for an increased profit on the kale. However these smaller technologies only have a marginal benefit on the supply of food in the Lehigh Valley. This is why it is important to look into more extensive season extension technology.

Long-term Season Extension

Extending the season into the early spring and late fall is great, but these shorter-term season extensions only allow a farmer to take advantage of a few more months of the year. In order for a farmer to produce the most crops possible, year-round farming would be the goal. Year-round farming can help increase the supply of local food in the Lehigh Valley without increasing the amount of farmland needed, supporting a more sustainable system. This can be achieved through a number of long-term season extension technologies including greenhouses and high-tunnels.

Greenhouses

As mentioned earlier, a greenhouse is probably the first thing people think about when the topic of season extension is mentioned. The definition of a greenhouse is an enclosed structure that is used to cultivate plants in a controlled environment. The basic technology of a greenhouse is pretty simple. There is a frame that supports either a glass or plastic shell, which completely encloses the area where a farmer wants to grow crops. Sunlight passes through the outer encasing of glass or plastic. This sunlight provides solar radiation, which passes through the glass or plastic and radiates the inside of the greenhouse. The air, soil, and crops inside the greenhouse are warmed by the incoming solar radiation. The soil and crops then re-radiate heat back out. This heat does not pass through the glass due to a change in wavelength of the re-radiated heat. The warmer temperatures allow for different types of crops to grow during periods otherwise not available for growing.

The basic idea and technology behind a greenhouse is pretty simple. The planning and construction of a greenhouse, however, are more complex. There are a few different variables to think of when planning the construction of a greenhouse. Location, frame materials, frame shape, and covering materials are all important to creating the best greenhouse for the specific size of farming operations and goals for certain farming operations. The greenhouse should be located in an area where it gets maximum sunlight. In particular planning must be thought of for winter sun, when the sun is lower in the sky.

Other than location, frame design is also important to a greenhouse. There are five main frame types are Quonset, Gothic, Rigid-frame, Post and rafter, and A-frame. A Quonset is a simple parabolic-shaped construction with either electric conduit or galvanized steel pipe frame. The typical covering is plastic. The limitation of a Quonset is the height, which restricts storage space and headroom. A Gothic frame is the same parabolic-shape of a Quonset but wooden arches are used and joined at the ridge. This allows for a steeper parabola and more headroom for crops. The Rigid-frame has vertical sidewalls and rafters. To maximize sunlight no trusses or columns support the roof. The roof is connected by glued or nailed plywood gussets creating one rigid-frame. The advantage of a rigid-frame is the large interior space and quality air circulation. A post and rafter frame uses embedded posts and rafters. More material is needed than other designs in order to provide deep embedding and strong sidewalls to withstand outward rafter forces and wind. The post and rafter has similar shape to rigid-frame so also allows for more space and quality air circulation. The A-frame is triangle-shaped but uses the same embedding technology as the post and rafter frame (Ross, 2006).

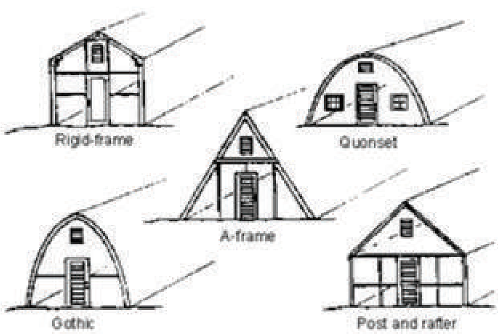


Figure 4.6 Greenhouse Frames (Ross, 2006).

After a frame design is chosen, the greenhouse covering is an important next step. The use of covering is dependent on the desired use of the greenhouse. There are four main covering materials glass, fiberglass, double-wall plastic, and film plastic. Glass is the typical covering. It is aesthetically pleasing, inexpensive to maintain, and has a high degree of permanency. Glass coupled with aluminium framing provides a weather-tight structure that minimizes heating costs and retains humidity. The drawbacks of glass are the initial costs, the necessity for better-constructed frames to support it, and the breakability. Fiberglass is a light-weight and strong material that can be used as a cover. It is important to choose high-grade fiberglass to allow for maximum transparency. The lifespan of fiberglass is 15-20 years. The initial transparency is good but over time it becomes more and more clouded. Double-layer plastic is a two-layer acrylic or polycarbonate plastic. The double layer reduces heating costs. However each layer reduces sunlight by about 10 percent (80% compared to glass's 90%). The life is about ten years. Film plastic is the cheapest cover material. It has similar transparency to glass. It also can be supported by lower-quality (cheaper) frames. The life however is very short (about 1-3 years) (Ross, 2006).

Also important in a greenhouse are the ventilation and heating systems. Heaters, vents, and fans are common things used to control the temperature of the greenhouse to ideal growing conditions for a specific crop. Even on sub 20 degree Fahrenheit days the air temperature can become too high for certain crops to grow. The fans and vents are important to cool the environment to allow for ideal growing temperature. Also the fans and vents help with air circulation, which is important for plant health, because if there is a lack of ventilation the carbon dioxide can become depleted, stunting plant health and growth. One of the largest costs associated with greenhouses is heating. The problem with using greenhouses in the winter months is that the sun goes down and stops radiating heat into the greenhouse. Heat is lost into colder winter nights. This is a massive cost for farmers considering a greenhouse as an option for season extension. Even a smaller greenhouse of 1000 square feet requires similar heating costs to a small townhouse.

The actual farming practices within a greenhouse are similar to that in a field. The soil is clearly an important aspect to expecting successful crop growth. The existing soil can be used in a larger greenhouse. But for a smaller greenhouse sometimes containers, beds, and benches are easier to manage. Both methods require a good healthy mixing of soils. Good soils drain fast, hold moisture well and contain a balanced and slow release of organic nutrients. Soil mixes used in beds should be lighter. A good ratio is two parts soil, two parts compost, one part peat moss, and one part vermiculite. An excellent way to keep the soil fertile naturally is to use vermicomposting, also known as worm compost. The benefits of vermicomposting include improving the physical soil structure, improving water holding capacity, enriching the soil with microorganisms, and improving root strength and growth (Allen, 2010).

As stated earlier irrigation is always an important practice in farming and season extension farming. This holds true for irrigation in greenhouses. Since the greenhouse does not allow outside weather inside of it, rain is no longer able to help supplement the water needs for crops. It is up to the farmer to water the plants to their necessary needs. Going out every day and watering the crops with a hose can become time consuming and water intensive. That is why automated irrigation systems are often utilized in a greenhouse. A popular water friendly system of irrigation, as discussed earlier, is drip irrigation. Drip irrigation can deliver the precise amount of water needed for crops, the correct number of times needed daily. It basically is a tubing system directed to each crop. This saves on water and time costs.

Weeds and pests can still be a problem in greenhouse farming. However, due to the structure keeping out most outside influences of wind and insects, which usually spread the growth of unwanted weeds, the control of weeds is usually not as difficult. Step one is prevention which is much easier. Ensuring that the plants are "clean" when putting them into a greenhouse environment is a key step in ensuring the integrity of the growing process. Screening vents to prevent windblown weeds and pests from flying in is also an important step. Removal has similar practices including manual removal for weeds and traps for pests. Solarization is a way to remove a large amount of weeds but requires removal of the crop as well. Post-mergence herbicides are also available for use. Some options allow for the plants to remain in the greenhouse and only cause mild skin and eye irritation if not properly ventilated out (Neal, 2006).

A huge benefit to producing crops in the winter is the lack of fresh supply to the market. Crops are typically harvested at certain times in the year. Utilizing a long-term, year-round greenhouse allows for farmers to produce crops not typically supplied during that time. This allows for a higher demand and higher price for the crops produced and sold. For example tomatoes grow best in a temperature of 65 degrees Fahrenheit. This is typical of spring and fall in the Lehigh Valley. A greenhouse allows the farmer to control the temperature of part of their production area. They then can produce tomatoes during a period of time when other farmers in the area are unable to produce. With fewer tomatoes on the market the demand rises with the price making each tomato produced more profitable.

Other benefits of implementing a greenhouse include higher yields per unit area, higher quality of production, and minimized diseases. Because a greenhouse is a controlled environment many typical farming problems are not prevalent in greenhouse farming. Pest and weed control is simpler due to a lack of outside variable forces. The temperature is controlled which allows a farmer to keep it at an ideal growing temperature for the specific crop they plan on growing. Both of these factors contribute to higher quantity and higher quality.

High Tunnels: The Blue Collar Greenhouse

High tunnels are a popular lower-cost option to longer-term season extension. A high tunnel is very similar to a greenhouse and is also referred to as a "hoophouse." It usually takes the shape of a Quonset frame. The main difference is a high tunnel does not use heating and electricity systems. Also high tunnels are not considered permanent structures. A high tunnel uses the same technology as a greenhouse with different ways of achieving optimal temperatures.

The incoming solar radiation and trapping of infrared radiation is still the method of heating high tunnels. The typical covering of a high tunnel is 4–6 mm thick greenhouse grade plastic. This allows the solar radiation to pass through and warm the soil, crops, and plants and trap the outgoing infrared radiation keeping the temperature warm. Cooling is achieved through large open doorways and roll-up sides. The heat is trapped in at night by closing the walls and doors. Sometimes a small portable heater is required in extremely cold climates.

Figure 4.7: High Tunnel (Rutgers University, 2003).

The materials for a high tunnel's frame can vary. A metal frame offers the best support while a PVC pipe offers a cheaper more mobile option. The configuration of the frame design must be able to deal with wind and snow loads. As mentioned earlier the covering material is typically a 6 mm polyethylene plastic. Typically the cost of constructing a high tunnel is much less than a greenhouse (Rabin and Vanvranken, 2011).

Location concerns are similar for a high tunnel to that of a greenhouse. Sunlight is obviously an important factor. Choosing a location with a good winter solar resource is critical. An extra issue is ground seepage. The area chosen for the high tunnel should be well vegetated to prevent runoff from rain from seeping into the high tunnel.

Irrigation is again an important factor in high tunnels. The same problem of water use and the time demanding aspect of watering is an issue, as is over or under watering crops. Drip irrigation is also used in high tunnels. This system of small tubing runs throughout the high tunnel structure feeding into the soil around each crop group. This is a slow and less water intensive irrigation system then hose watering or a sprinkler system. A great idea to save on water use and water costs is the installation of a gutter system and water catchment to collect and use rainwater in the drip irrigation system. Basically small gutters are built along the sides of the high tunnel and collect the rain. The water is stored in a tank which then can be pumped by a small electric pump to a drip irrigation system. The drip irrigation system allows for the convenience and precision of automated plant watering (Shouse, 2012).

Farming practices inside a high tunnel are similar to greenhouse practices. The structure helps prevent outside sources, which limits pest and weeds from damaging the crops. Selecting disease-resistant crops and crops which grow well in a high tunnel culture will help prevent unwanted weeds or pests. Also treating plants with hot water treatment prior to planting is a good practice of prevention. Installing insect screens to the doors (when open) is a helpful way to keep out pests.

The general costs of constructing a high tunnel are much lower than that of a greenhouse. The frame and covering material costs are comparable (if not cheaper for high tunnels) yet the huge saving in cost comes from the lack of heating and electricity costs associated with greenhouses. High tunnels see return on investment after the first off-season growing season. They are also impermanent structures. This means that they do not add to the property taxes (as a greenhouse would) (Gu, 2014).

To make high tunnels even more attractive for farmers seeking season extension in the Lehigh Valley, the state of Pennsylvania has a policy that supports the construction of seasonal high tunnels. The USDA sponsors EQIP (Environmental Quality Incentives Program). This program is available to Pennsylvania farmers seeking technical and financial assistance to implement conservation practices to reduce pollution and improve natural resources. There is a specific section in the program for seasonal high tunnel construction. Applications are screened, evaluated, and ranked. The producers with the highest ranking are given funding until all funding is exhausted. This is a great incentive for farmers looking to take advantage of a terrific season extending technology.

As with the greenhouse and all season extension, producing crops in the off-seasons leads to premium pricing. This gives farmers more revenue for each crop sold. After recouping the initial investment (much easier with EQIP and lower operating costs than a greenhouse), off-season farming can become a great source of income for farmers. The Lehigh Valley especially is a great area due to its temperate climate. In the off-season a lot of produce must be imported to the area raising the cost and lowering the quality. A season extending farmer utilizing a high tunnel can capitalize on the long off-season in which its competitors are not producing.

Similar to the greenhouse, high tunnels offer an environment for optimal crop production. Although the climate is not controlled to the same extent as a greenhouse, high crop yields can still be expected per unit area. Also the quality of the crop is much higher in the best growing conditions.

The higher quantity and higher quality of crops help increase the local supply of food. Locally grown food is gaining popularity and its increasing prevalence holds potential for broad social, economic and environmental benefits. Season extension technologies such as hoop houses offer a solution to limited growing seasons, a major constraint in many areas, enhancing efforts to supply locally grown food.

"Consumer demand for local produce at extended season farmers' markets: guiding farmer marketing strategies" discusses research conducted at three Michigan farmers' markets, locations where Michigan farmers utilizing hoop houses currently sell their produce. The research measures consumers' willingness to buy local produce at extended season markets using a set of four complementary methods: dot poster surveys, written surveys, focus groups and experimental auctions. Building upon prior research on attributes that create value for local foods (spatial proximity, food quality and relationships between farmers and consumers), the results inform farmers' choice of marketing mix. They find consumers willing to pay a premium for large quantities of locally grown produce, with many placing highest value on products grown in Michigan. They conclude that extended season farmers' markets supplied by hoop house grown produce creates and opportunity for farm viability and further development of the market for locally grown food (Conner, 2009).

With the demand in local food comes the need of a supply. As stated earlier, the Lehigh Valley is in need of more food to support its growing population. High tunnels can be an affordable way to help farmers increase their production in the off-seasons. However, the best way to maximize season extension is to combine the uses of the techniques and technologies discussed throughout the chapter. Eliot Coleman, a season extension expert, offers a great example to how season extension should be implemented to maximize production.

Maximizing Season Extension

Eliot Coleman has over 40 years of organic farming experience. He is a farmer in Maine who makes a living of season extension farming. Even in the frigid climate in Maine (much colder than the Lehigh Valley), Coleman is able to achieve productive harvests utilizing mostly high tunnels. He also combines the use of many of the shorter-term season extending technologies. In order to prevent frost damage on his crops, Coleman uses row covers within his high tunnels. He also utilizes a similar technology called a low tunnel. This is a technology which provides winter long protection at only 5 percent of the cost of a greenhouse. The choice of crop is important when using low tunnels since these are crops you will not be tending to since you are not able to walk through low tunnels. The best crops for low tunnel growth are beets, broccoli, carrots, lettuce, onions, peas, and spinach. Utilizing multiple season extension technologies like Eliot Coleman is the best way to maximize crop production. To learn how to truly maximize a farm's season extension capabilities, check out Coleman's *The Winter Harvest Handbook* for more details on combining the technologies discussed throughout this chapter and more.

Figure 4.8 Eliot Coleman's Farm (Coleman, 2009).

The use of season extension technologies in the Lehigh Valley is a necessity in order to provide sufficient local food. The nutritional benefits of local food are significant when compared to the produce in supermarkets. This nutritional gap only increases as the mass produced food has to travel farther to reach the consumer. Currently the Lehigh Valley does not produce enough food to feed its entire population. Although it is not possible to grow all of the food locally for the residences of the Lehigh Valley, season extension technologies can help close the gap between what is produced and what is needed. The more farmers that implement season extending technologies in the Lehigh Valley, the more food there is for the local food supply. The six techniques and technologies discussed in the chapter are an excellent place to start increasing food production. Not all of the technologies are appropriate for every growing situation, but any operation could benefit from the inclusion of at least one of the techniques. It is important for not just farmers, but also policy makers and local consumers to buy into the local food movement. Increases in food nutritional quality and availability are a benefit for everyone.

A problem that season extension and farming production in general brings up is food distribution. It is practical to extend the farmers' season utilizing season extension technology, if more food can be produced on the shrinking farm lands in the Lehigh Valley in a sustainable manner year-round; however the food is not useful or sustainable if it never reaches the table. Even if the production techniques are sustainable does not mean the distribution technology is sustainable and feeds consumers in the Lehigh Valley.

5

Distribution

Aaron Bart-Addison and Elise Buffinton

Introduction

What is a distribution technology? And why are distribution technologies important? In a local food system, these questions are extremely important in understanding how the system works as a whole. Without distribution, food cannot move from the farmers and other producers to the consumers that buy and eat the produce. This chapter aims to explore various types of distribution technologies and their implications on local food. To understand what it means to be a distribution technology, we begin by examining the technology known as the Truck Farm.

Driving down the rugged streets of Brooklyn with a casual, old pickup truck, Ian Cheney's Truck Farm delivers and showcases his vegetables and other produce around the city. Although his truck seems to mirror the broken down concrete jungle walkways, the collection of fresh parsley, peas, and even a lavender plant growing on the flatbed of the truck reveal nature in its beauty. Cheney's modified vehicle is set out in the streets, not just as one of the thousands of cars passing by, but also as a source of agriculture. As shown in the figure below, with its planting beds and produce, Cheney's DIY farm project adds more meaning to the American 4x4. The documentary about the Truck Farm project focuses on this mobile farm and helps to bring awareness to the positives of utilizing urban farming in local communities. Even though the documentary touches upon other types of urban farming technologies such as a rooftop garden and window farms, the Truck Farm itself embodies all the features of a distribution technology, physically distributing and delivering fresh produce for local demands.

Figure 5.1 Ian Cheney's Truck Farm (Cheney, 2011).

However, before delving into the intricacies of other distribution technologies, it is important to first discuss the predecessor and model technology we all know and use, known as the grocery store. The conventional distribution technology of grocery stores provides the first stop for where consumers can purchase food. It goes without saying that grocery stores operate on a very large scale and provide much access to consumers when it comes to supplying food needs. Grocery stores and supermarkets are business enterprises that provide services to their customers. Products are acquired by the market, sorted in warehouses, and distributed to consumers by way of local grocery stores. In the grand scheme of things, these local grocery stores are the most convenient way to receive food anywhere, and in addition, embody the largest technology mediation between food and humans.

For food to even be displayed on a grocery store shelf, it goes through much processing and movement. Supermarkets and grocery stores pool food from numerous sources to appeal to the needs of consumers. Although with no real connection to the source of food, consumers are able to pick from a wide range of products on the shelves. This may not seem like such a problem when it comes to store owner production, however it does have negative effects. According to Robert Sommer, who has written about the differences between supermarkets and farmers' markets, the former seems to present less of a social environment and collaboration between producer and consumer (Sommer, 1981, p. 14). Of course, farmers are not present in supermarkets personally promoting their product, social disconnect between who grows the food and who eats it goes a long way in the end. By analyzing the abilities of farmers' markets and other alternative distribution methods, people can learn about how these technologies mediate our relationship with nature and how they can improve various local economies. The best way to fully utilize grocery stores in a local community, such as the Lehigh Valley, is by also investing in other local distribution technology food avenues.

Distribution technologies are a crucial, often overlooked, aspect of food systems. They both physically and metaphorically mediate our interactions with nature. Physically, distribution technologies are the go-between for getting produce from "farm to fork." Yet, it is the social, cultural, and economic aspects of such mediating technologies that merit further analysis.

The organizational, not just material capacity, of distribution technologies may prove more useful in building a sustainable future. The Truck Farm itself can be analyzed from this perspective. The Truck Farm, as a distribution technology, especially in a local community, can help to minimize the amount of food miles. This concept, 'Food miles,' refers to the distance food is transported from the time of its production until it reaches the consumer. For reference, "the average item of food on your plate has travelled 1,500 miles," but by tapping into local food sources, there is room for improvement (Schnell, 2013, p. 615). Food miles are a way of analyzing technologies and are a factor in assessing the environmental impact of food (including the impact on global warming).

It is not hard to imagine a few Truck Farms operating in the Lehigh Valley, delivering fresh produce to consumers in a both quick and efficient manner. The Truck Farm technology allows for change in the food distribution of a community by decreasing the amount of food miles. In completing an analysis, however, it is important to study other distribution technologies as well. The technologies we explore in this chapter include: Veggie Vans, Farm-to-School programs, farmers' markets, CSAs, and food hubs. These technologies, as well as the Truck Farm itself, help provide alternative methods of distribution that promote sustainable food, economic growth, and community stability within the Lehigh Valley.

Veggie Vans

Like a Truck Farm, a food truck also epitomizes food distribution technologies and the role they play in the food system as a whole. In recent years, food trucks have become "all the rage". At a time in America when finances are unsteady, food trucks are "the new incubators of culinary innovation" (Gold, 2012, p. 1). They support the demand for food that is novel, inexpensive, and fast. The food-truck phenomenon has largely exploded due to the success of Kogi, a BBQ Taco truck that originated in Los Angeles and Orange County. In Los Angeles specifically, this vehicle does more than just selling food, it is selling a social experience, one that transcends race, class, and ethnicity (Gold, 2012, p. 1). This craze can be expanded to the local food and farming industry with the development of an idea, known as a veggie van.

A veggie van can be beneficial for many reasons. It provides a convenient way for people to purchase vegetables, promotes vegetable consumption, raises awareness about healthy eating, and is both visually appealing and exciting. Much as an ice cream truck does, a veggie van would transport vegetables from producer to consumer. The figure below shows a veggie van developed by Lafayette College. In its development, students hope the van would be easily seen and recognized. For those that lack access to fresh produce, the van would be a way for residents to receive produce without travelling far or even travelling at all.

Figure 5.2 Lafayette College's Veggie Van (Georgiou, 2013)

The Technology Clinic at Lafayette College conducted a study of veggie vans in 2013. The Tech Clinic is an interdisciplinary course at Lafayette that provides students with practical experience and collaboration opportunities. It brings together students of different majors and backgrounds to design and conduct projects that benefit the community. The students work closely with professors and other professional mentors that help to connect the college to local communities. The Veggie Van Technology Clinic study began with an evaluation of current vegetables in the West Ward in Easton, Pa. The evaluation found a limited awareness of where to purchase fresh and organic produce as well as a general deterrence from doing so due to high costs and inconvenience (Tech Clinic, 2013).

After determining a need in the community, the students planned out the logistics and cost estimates of creating a veggie van for use in Easton. Total expenses were estimated at around $11,000, including the onetime costs, labor, and van operating costs (Tech Clinic, 2013). The clinic also took into consideration when and where the van would be parked and the coordination with other community programs and farmers' markets. Overall, the energy and resources needed to transport vegetables (and possibly fruit) from local farms and community gardens to areas within the city of Easton are low. This means that the number of food miles is significantly lower than that of large grocery stores because the various farmers that would supply the veggie van are all within the Lehigh Valley. On the other hand, the van is also a low scale technology that may not reach as many people as bigger technologies. However, the benefits of decreased food miles and energy used, increased relationship between farmer and consumer, and access to fresher food may outweigh the problem of small scale. As a whole, veggie vans are an excellent distribution technology that can take advantage of local food systems in order to benefit the community in which they serve.

Farm-to-School

In recent years, we have seen an emergence of local farming at colleges and universities. According to the Sustainable Agriculture Education Association, there are over 60 colleges in the country that have nationally recognized college gardens and farms (Parr, 2014). These farms allow students to acquire a greater understanding of the technicalities of farming, as well as the social, political, and economic contexts surrounding the practice. The movement of food produced by these farms into the college dining halls is a type of distribution technology that promotes locally grown food as well as local economies and culture. In particular, college and student-run farms are beneficial in closing the food loop. This means that all produce moves from farm to fork and then back to farm as a means of compost, making the process extremely sustainable. In this way, the technological system is being used to reveal nature rather than control it. Nature is being brought forth through farming in an ecologically friendly way and not treated as a standing reserve. As Martin Heidegger discussed in *The Question Concerning Technology*, the challenging forth view of nature is one that treats nature as subordinate and below that of humans (Heidegger, 1954). In order to orient people to nature in a more sustainable way with technology, they must work with nature and the earth. Closing the food loop with college farms helps to do this. It allows for an intimate relationship between dining services and the produce distribution location. The inclusion of students in the growing process also allows for a steady supply of help and provides various academic advantages.

The Dickinson Farm, located at Dickinson College in Carlisle, Pennsylvania, is a prime example of a student-run farm within the college environment. The farm itself is a 50-acre living laboratory that serves many purposes within the college community. The majority of the harvest produced is delivered to the campus-dining hall while the rest is delivered to local restaurants and donated throughout the growing season (Dickinson, 2014). The large student involvement in the development and maintenance of this farm has made it one of the most successful examples of university farming. The Dickinson Farm acts to support the academic interests of students and faculty, promote renewable energy, and build a greater awareness among students of how food is generated to sustain natural ecosystems. Due to the innovation and success of this farm, setting standards for other colleges and universities, the college has received substantial grants of money from the state government to continue their program. This farm has developed in parallel with many other college farms around the country including Lafayette College's LaFarm.

Figure 5.3 Dickinson Organic Farm produce (Dickinson College, 2013).

Throughout the growing season, student farmers, volunteers and farm staff work to grow quality produce for consumption on campus. The kinds of crops and volume of crops that the farm raises is determined through conversations with the head chef and director of Dining Services at Dickinson (Dickinson, 2014). Factors such as the farm's growing season, holidays, and volume of needs are taken into consideration. After these discussions occur, farm-staff work to develop a crop plan for the school. The College Farm aims to be the main (or one of the main) suppliers of certain vegetables during the growing season. These vegetables include slicing tomatoes, cherry tomatoes, mesclun mix, baby spinach, leaf lettuce, zucchini, summer squash, bell peppers, broccoli, cucumbers, and herbs (Dickinson, 2014). The picture above shows many of these vegetables being sold at the Cowlitz Community Farmers' Market (CCFM) that takes place during the summer months. In 2010 alone, Dickinson Farm delivered over 1,000 pounds of tomatoes to the college dining halls each week.

At Lafayette College, the LaFarm garden and working farm aims to do the same. Various students and organizations work on the farm, learning how to plant, care for, grow, and harvest a wide range of plants. Once grown, vegetables from the garden get transported to the Dining Halls via Sarah Edmonds, the LaFarm gardener, during the growing season. Figure 5.4 below shows the wide range of planting areas at LaFarm that allow for a variety of vegetables to be produced. Changes in the food distribution service this past year have made this process much easier with the switch from the food company Sodexo to Bon Appétit. The food grown on the farm is picked and

Figure 5.4 LaFarm, Lafayette College (LaFarm, 2013)

weighed in boxes to be transported to Marquis Dining Hall. Prices for such food are based on previous years as well as the USDA National retail food price report that comes out weekly with every food and vegetable on the market in the United States.

In addition to Lafayette College, various other colleges in the Lehigh Valley offer community gardens. These include Lehigh University, Muhlenberg College, and Northampton Community College (Prior, 2013, p. 38). The gardens offer opportunities for residents, students, and faculty to plant and grow their own produce, therefore eliminating the need for other types of distribution technologies (such as large grocery stores). In this way, produce is going directly from farm to fork by way of the community members' careful growing and harvesting. At Lehigh University, members of the faculty, students, and staff collaborated with students in a local middle school to learn about community-based agriculture by raising seedlings for their community garden. Various college students have also helped to create school farms at Tracy, Forks, March, and Fountain Hill Elementary Schools, as well as the Easton Academy (Prior, 2013, p. 39). These efforts are additional ways in which students can connect to the land and alter their connections with nature. By learning to sustain this relationship, we are in a much better place for ecological sustainability as a whole.

Farmers' Markets

Farmers' markets are neither new nor novel. Selling food directly from farmers is an idea that has existed for a number of generations. As defined by the USDA, a farmers' market is a "common facility or area where multiple farmers gather on a regular, recurring basis to sell a variety of fresh fruits and vegetables and other locally grown produce directly to consumers" (Prior, 2013, p. 46). Farmers' markets come in many shapes and sizes. They range from large collective markets to farm stands beside a specific farm or group of farms. They are distinguishable from public markets, which are usually housed in permanent structures, open year-round, and offer more packaged food and non-food products. Farmers' markets often reflect the local culture, customs, and economy of the community in which they serve. We think of the farmers' market as a distribution technology, since it offers a way to connect producers and consumers and to distribute produce from "farm to fork" in a direct way. The economic, social, and cultural aspects of the technology help explain the implications and impacts of a farmers' market on a community.

First, farmers' markets have a huge impact on the local economy of the community. A series of studies of farmers' markets in Howard County, Maryland, found that the revenue from shoppers totalled $192,000 annually and direct and indirect economic benefits totalled $307,249 (Brown, 2008). A survey of Oklahoma farmers markets found total gross sales for the 2001 season to be $3.3 million, with $7.8 million in direct and secondary impacts on the local state's economy (Brown, 2008). In addition, in Iowa, farmers' markets consumer data estimated direct sales of over $21 million, $12.2 million in personal income and the creation of 471 full-time jobs. These are huge benefits for the local communities and economy as a whole. In the Lehigh Valley alone, there are currently ten producer-only farmers' markets. Figure 5.5 shows these 10 markets and their distribution throughout the Lehigh Valley. Figure 5.6 shows the growth of the Easton Farmers' Market and its expanding role in the town alone over the past dozen years.

Over 3,000 people visit the Easton Farmers' Market on Saturday mornings, with the average household spending of $31.75 each week (Prior 2013). This equates to a total annual economic impact of $2.6 million. This market, as well as others in the Lehigh Valley, plays a huge role in the economics of the local community. With increases in the number of consumers visiting and purchasing produce from farmers' markets, more revenue will stay within the local economy rather than national companies such as Wal-Mart and Kroger. Furthermore, thinking of farmers' markets as distribution technologies helps reveal that consumers have a better opportunity to engage with local farmers, foods, and growing practices in a more direct way through the mediation of a farmer's market than when they spend money on food at grocery stores.

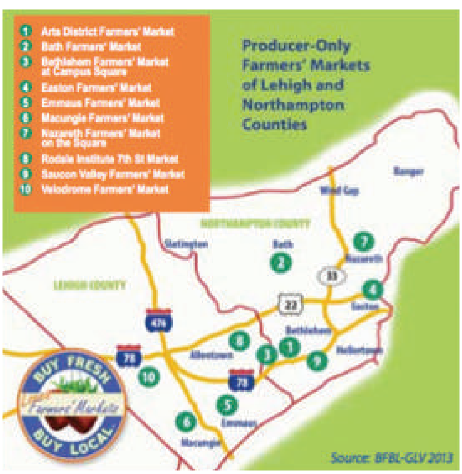


Figure 5.5 Farmer's Markets in the Lehigh Valley (Prior, 2013)

In addition to the economic impacts of farmers' markets, there are also impacts to the society and culture of a community. One study from many decades ago—before the current nationwide boom in the number of farmers' market—compared the social perceptions of farmers' markets to traditional supermarkets. The study was completed by distributing a questionnaire to 171 customers at 28 supermarkets in 12 California cities and to 178 customers at farmers' markets in the same cities (Sommer, 1981). Both types of markets were compared based on cleanliness,

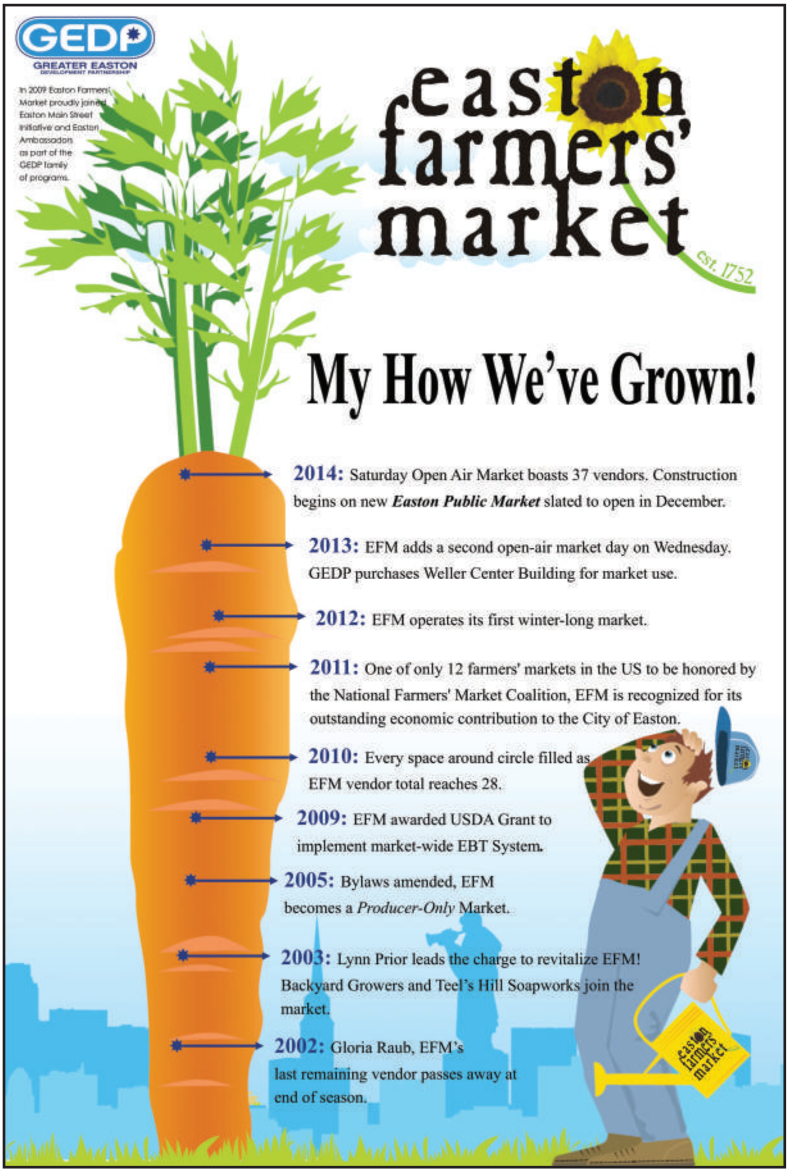


Figure 5.6 Farmer's Markets and Supermarkets comparison (GEDP, 2014).

friendliness, personal attention, time, expensiveness, sociability, size, and happiness. As shown in Figure 5.7, farmers' markets were rated more friendly, sociable, personal, and natural than supermarkets. This study then uses statistical data to conclude that the supermarket is a much less friendly environment than the farmers' market. Interactions between customers are also much higher at farmers' markets as well because of the lack of high shelves and aisle dividers. Customers find the farmers' market an easier place to talk to employees and clerks and feel that the clerk is there to serve the customer rather than the merchandise (Sommer, 1981). These social distinctions between traditional supermarkets and farmers' markets are what draw people towards farmers' markets and the inviting atmosphere they embrace.

Many cultural aspects of farmers' markets come along with its social implications. Farmers' markets provide opportunities for citizen involvement in food policy issues, promote volunteering, and serve as a civic forum for important matters in the community. They are an opportunity for consumers to get to know their farmers and vice versa. Consumers can "talk to farmers and producers about the products offered, ask them questions, and learn more about the agricultural benefits, issues, and concerns that affect their community" (Prior, 2013, p. 46). The USDA also believes in cultural sustainability through farmers' markets. Designated as a melting pot, the United States had prided itself on the complex integration of cultures. For many communities, farmers' markets play an important role in maintaining cultural ties. For example, at Dream of Wild Health (DWH), an American Indian operated farm in Hugo, Minnesota, farmers' markets play an important role in the support of their tribal community. The farm teaches families how to live healthy and balanced lives as well as "emphasizing the connection to the larger community around them" (Prior, 2013). Many other markets around the country include traditional food, music, and local artisans that aim to pass along and share their cultures with people that visit the market. Traditional food, art, and music, are just a few of the many ways in which farmers' markets are building bonds between our past, present, and future.

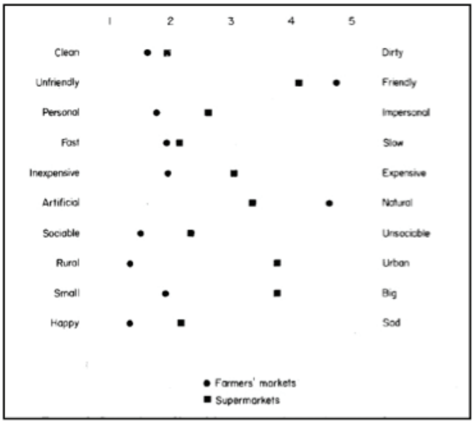


Figure 5.7 Farmers' Markets and Supermarkets comparison (Sommer, 1981)

While there are a number of disadvantages of farmers' markets such as less variety of produce, less frequent openings, and the dependence on weather and seasons, farmers' markets offer great opportunities to connect producers and consumers so that customers receive fresh, local produce, contribute to the local economy, and engage in the culture of the area. Implementing and expanding on current markets could be beneficial for producers, consumers, and the land.

Community Supported Agriculture (CSAs)

Community Supported Agriculture (CSAs) provides another distribution avenue for farmers and consumers to link and connect. Essentially, CSAs eliminate the need for a middleman and directly allow farmers to get their produce to customers. Members or shareholders of the farm pledge to pay the anticipated cost to operate the farm and the farmer's salary (Adam, 2006, p. 2). In return, the shareholders are rewarded with a portion of the produce grown. By taking away the need for a middleman, CSAs promote a great sense of community togetherness, and stability. Serving its purpose of distributing food to consumers in a personal and efficient way, CSAs mediate the relationship between local communities and their food. It goes a long way when a customer knows where their produce comes from and the person cultivating it in the fields.

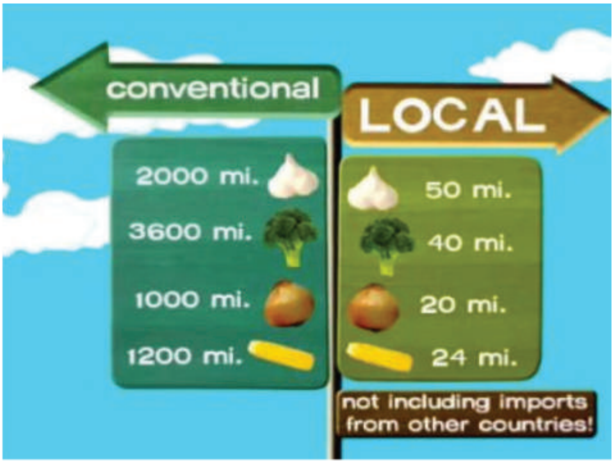


Figure 5.8: Conventional and Local Food comparison (Brown, 2008)

There are two general types of community-supported agriculture available; shareholder CSAs and subscription CSAs. Subscription CSAs, which take up about 75 percent of all CSAs in America, are mostly farmer run, with all managerial duties placed on the producer. On the other hand, Shareholder CSAs are run by a core group of people who then hire a farmer to supply the needs and demands collaborated on. One very impactful effect of using CSAs in a local community is the exposure to all social aspects of produce commerce available. CSAs not only mediate interactions with nature itself, but also focus on using any other type of local community means including food banks, farmers' markets, and internships to allow for growth of food access for all.

At the end of the day, the main focus is how CSAs as a distribution technology can help impact local communities such as the Lehigh Valley. One report from the *American Journal of Agricultural Economics* detailed statistics on how CSAs have impacted consumers and producers alike since their rise in the 1980s. According to the authors, CSAs have been linked to many nutritional benefits for consumers who participate, including a 58% increase in food quantity combined for four CSAs in Pennsylvania (Brown, 2008, p. 1298). The presence of CSAs in the Lehigh Valley allows shareholders to have a more personal connection to where their food is coming from. By investing in these CSAs, consumers also share the risk of what happens to their food. This may pose a positive and negative effect, as many confounding factors, such as weather, can also dictate what eventually happens with food distribution. Nevertheless, a system of CSAs in the Lehigh Valley will allow for the support of locally grown food and the shorting of food miles for local residents.

In a place like the Lehigh Valley where poverty rates are above national averages, the economic ramifications of implementing CSAs into the community would be particularly positive. (Prior, 2013, p. 9). Since CSAs are constructed based on direct farmer and consumer connection, the price of food is more negotiable between the two parties and is not as strict when compared to free-market affairs. One Canadian CSA, for example, saved participants 39% in organic food prices when compared to supermarket values. In terms of bringing wealth to the community, the presence of CSAs in the Lehigh Valley will allow for reduced spending on outside sources of food. Presently, we spend about 50% of our food dollars in the Lehigh Valley outside the home, contributing to more food miles for consumers (Prior, 2013, p. 4). Having a CSA network can reduce this phenomenon and bring more wealth to the community. These effects can run a domino effect, also decreasing fuel emissions and extra packaging for out-of-the-region food.

When discussing how these technologies affect local communities, it is also important to refer to the energy usage at play. 'Food miles' is one of the important aspects of receiving our food agriculture and reducing this can very well assist in sustaining our food. By buying produce from local farmers, CSAs provide an energy efficient model of distributing food and can reduce the average 1,500 miles it takes before food reaches its destination (Hatz, 2013, p. 1). Currently, one-fifth of all petroleum fuel used in the U.S. is attributed to agriculture use. Although the issue is more complicated than simply driving less, investing in CSAs can help the planet reduce fuel emissions and reduce both the energy needed to store food in warehouses as well as the storage areas usually used for moving food over long distances.

Despite providing less costly, sustainable food for consumers, CSAs are a kind of technological system for consumers to operate in and have more control over where they get their food. Just like how Ian Cheney was able to grow and distribute his product directly to customers, the direct connection between consumers and their farmers provide economic benefits for both parties and allow for more input from consumers on how to receive their produce. CSAs are a perfect way for both producer and consumer to mediate their connection to their food.

Food Hubs

The USDA notes that one of the main problems local communities face when trying to expand is a "lack of distribution systems for moving local foods into mainstream markets" (Matson, 2013, p. 5). One of the proposed solutions is a food hub network. A food hub, whose scale can range from small to large, is an organization or business that manages the distribution of 'source-identified' food from local producers and acts as a wholesale deliverer for demand. Essentially, a food hub is the culmination of local farmers produce, accessible through one avenue. A focus of food hubs is to identify the source of its food to consumers, which has been proven to allow for more productivity. This is true because consumers are more willing to buy produce when they know the source of the food. In this sense, food hubs give consumers an extra sense of reliability in where their food is coming from, showing an important reason why the food hub can operate efficiently and effectively.

Food hub structures vary, including structures such as non-profits, privately owned, producer-consumer owned, and virtual food hubs. Although 40 percent of the food hub market seems to be taken up by privately owned ones, they all still offer produce that is easily accessible and more reliable to consumers. Most food hubs work by outsourcing to different producers (farmers) in a local area and bringing all the produce into one area, set to deliver wherever needed. Acting as an aggregator of the produce, the food hub then becomes an extra avenue and convenient source of the fresh local food, available to needs of local individuals or places such as schools, hospitals and shelters. The effects of improved technology today also allow for virtual access and collaboration for locally grown food.

One great model food hub active today in the U.S. is called 'Local Food Hub' located in Charlottesville, Virginia. This food hub offers a multifaceted and advanced approach to the modern food hub. In a *PoliticoPro* magazine article, 'Sustainability Gets The Green Light,' the Local Food Hub was recognized for its efforts of bringing fresh, sustainable food to the community and acting as more than a middleman food hub. To start, the Local Food Hub had "a vision of working with about 10 farms" the first year, but is now working with, "more than 80 individual producers to source everything from fruits and vegetables to honey, eggs, meat and locally milled grain" (Meyer, 2013, p. 2). In addition, the hub monitors a 70-acre wide farm and uses season extension technologies, including a greenhouse that helps to supply farmers with extra starts. The promise of providing fresh food to local residents is what drives the Local Food Hub to reach out and tend to the needs of Charlottesville residents. As part of their mission is forwarding a sustainable food system, the hub also does its part to educate residents on what goes into running the hub and the results. Local Food Hub's 'Farm-to-School' program is one of the many programs that the hub uses to promote and educate people on the inner-workings of the farm work by showcasing the product. Figure 5.9 details the Local Food Hub's "Farm-to-School Week" at Hollymead Elementary, where they showcased the food grown at the farm, and educated kids on what happens before the food reaches them.

Figure 5.9: Local Food Hub's Farm-to-School Week (Meyers, 2013)

The Oklahoma Food Cooperative (OFC), as another example, is a producer-consumer collaborative run network that distributes produce over a 160-mile radius around Oklahoma City. The hub benefits from 125 different producers and as of 2013, reached sales of $65,000 a month delivering produce to the community (Matson, 2013, p. 16–17). Analyzing the effects of the OFC on its bigger scale shows how reliable food hubs can be for a local economy. For comparison, the OFC operates on an area almost four times as big as the Lehigh Valley (42 sq miles). This means that much more economic growth is a possibility by scaling this down to the size of the Valley. One of the many benefits of having the OFC in Oklahoma City was delivering produce to those of low income with no access to transportation. Embodying the attributes of a distribution technology,

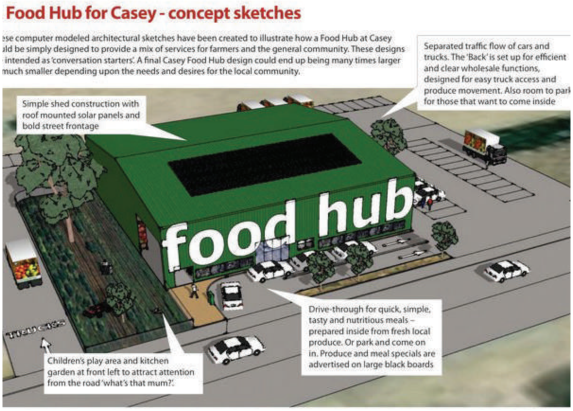


Figure 5.10: Model of a Food Hub. (RMIT University, 2013)

the online food directory that the OFC provided allowed for access to those outside the scope of buying the food at the wholesale warehouse. By having ready to go vehicles to deliver food, the Lehigh Valley can expect to fulfill the needs of all and expand access to food for those who otherwise would not be able to receive it.

Apart from the great features of distribution to consumers, food hubs can also function differently, still offering the same promise of sustainable food. For example, food hubs can operate as season extension (refer to Ch. 4) by bringing more food to consumers year round. If anything, food hubs provide a great deal of information for consumers and farmers alike. The online directory for the various food hubs allow specific farmers to become price takers and market their products to areas they know they can benefit from. This is a win-win for both farmers who are able to gain more profit from their farms and consumers who can enjoy the produce they want. The picture above (Figure 5.10) offers a proposed food hub warehouse for the Casey Cardinia Region in Australia. The image details all the ways the food hub can operate and how the community can utilize its features. This representation of the distribution technology shows how a community like the Lehigh Valley can benefit from its impacts.

Although there are no food hubs currently in the area, the Lehigh Valley Food Hub pilot project was started in hopes of providing sustainable food for consumers. The hub was created to "increase wholesale purchases of locally grown foods by area restaurants, retail stores, and institutions. The pilot Hub involved an online ordering system, an aggregation site in Trexlertown, and weekly deliveries of locally grown foods to wholesale buyers" (Prior, 2013, p. 67). Although just a pilot project, the effects of using the hub were not as projected initially and improvements to the Valley's agricultural distribution did not come about as planned. This was due to scale issues, visibility, and partner buy-in. Despite this result, the Trexlertown aggregation site can help diminish food miles and act as a source of the fresh produce—and the experience of the pilot project will help future efforts toward the same goals.

Bringing food hubs to a local community like the Lehigh Valley can ensure numerous positives for farmers and consumers. The innovations of the food hub allow for people to mediate our interactions with nature. Not everyone in the Lehigh Valley is capable or even able to access all local producers for their food needs. Using food hubs as one of the avenues can be the way of keeping community relationships between farmers, the cultivator of the produce, and consumers.

Conclusion

The Lehigh Valley currently employs various distribution technologies. However, most of these technologies center on the grocery store and supermarket. Through various studies and research, alternative food sources are seen such as "farmers' markets, online markets, Farm Share programs, food cooperatives, and mobile grocers" that play a big role in the availability of fresh food in our community (Prior, 2013, p. 1). Direct agricultural markets which are based on the face-to-face interactions between consumers and producers, present counterpoints to the large scale, industrialized systems of food production that are currently in control. To summarize, Veggie Vans, a small-scale distribution technology, offers opportunities for local food distribution and a chance for residents in areas that may not have access to fresh produce to receive it on a consistent basis. Farm-to-School programs are another small-scale technology that utilize that utilizes the resources that a college or school has to offer by providing produce to both local markets and dining halls on campus. These farms provide social, cultural, as well as economic benefits for the students, workers, and community as a whole.

Various types of mid-scale distribution technologies also exist in contrast to grocery stores and supermarkets. The farmers' market is an excellent example of a distribution technology that serves a variety of purposes within a community. They act as a means of selling as well as being a cultural center and meeting place for residents and visitors. These societal benefits are what make farmers' markets a valuable asset to the community. CSAs also benefit local communities by allowing consumers to receive produce directly from producers. By doing so the number of food miles travelling into the Lehigh Valley is significantly decreased. Lastly, food hubs allow for the collaboration of producers within one organization. They benefit many communities and aid in mediating the relationships between farmers and consumers.

As we noted in the introduction, grocery stores are currently the more prevalent type of distribution technology. The relationships at grocery stores between consumers and producer are both distant and anonymous. In contrast to this, however, are the direct agricultural markets discussed that are immediate, personal, and take place in shared locations. These direct markets promise human connection at the place where production and consumption of food converge. In addition, these markets seem to mitigate growing uneasiness about the social and ecological aspects of large food production and have "been the stepchild of sustainable agriculture" (Hinrichs, 2000, p. 295). The various alternative distribution technologies, within the local food system, are aimed at using ecologically sound production and distribution practices and enhancing social equity for members of the community. A summary of the implications of these direct agricultural markets can be seen in the percent increase in farmers in the Lehigh Valley selling directly to consumers between 1992 and 2007. In 2007, there were 167 farmers selling directly to consumers. This is a 61% increase since 1992 (Prior, 2013). This statistic shows that the demand for local food is continuing to increase and branch out. This demand is occurring in the home, as well as in restaurants, schools, colleges, and other places in which food is sold. It is our hope that local food distribution technologies (such as Farmers' markets, CSAs, Food Hubs, etc) in the Lehigh Valley will continue to increase, bringing more profit to local farmers, sustaining the local economy, and promoting ecological sustainability as a whole.

6

The Consumer Technologies of Local Food

Jeremy Schwed, Erik Tweten and Sean Waters

Introduction

The flip side to the production-focused agriculture many prior chapters discussed is the consumer society that buys, cooks, eats, and disposes of all that food. After production and distribution, consumers' own personal values and practices heavily influence the food system. As such, it is important to consider the major role that consumers play in the Lehigh Valley food system. This chapter will investigate consumer practices by focusing on waste reduction. Waste by consumers constitutes a major loss in resources, and is an area where major improvement can be made on the consumer side of the local food system. Many consumer driven technologies, such as storage techniques and waste management practices, can be adopted to mitigate these losses. These technologies range from phone applications that can help monitor one's eating habits, to food rescue systems that redistribute leftover food from kitchens, to citywide compost initiatives.

It is clear that waste management will require a large individual effort from the members of the Lehigh Valley community. However, it is also important to note the considerable role the consumer, even on an individual level, plays in all facets of the food system. Consumer values include choices such as where to eat, and how to determine the quality of food. Without consumer support, such sustainable practices as organic farming won't gain enough momentum to make a difference in the community. As such, it is necessary to ensure that the appropriate value systems are in place in a community. Through study of various consumer food systems, we will highlight the ways consumers can help decrease our energy dependence and support more sustainable agriculture. The practices and values of consumers are an integral part of any food system.

Consumer Values

One of the most prevalent examples of consumer values amidst the local food movement is the debate over organic and conventionally grown crops. Organic practices are widely considered to be healthier and more sustainable than those of conventional farming. Some of the benefits of organic practices include the facts that organic produce contains fewer pesticides, is often fresher, and is better for the environment. Pesticides are chemicals used to kill fungi, weeds, insects and other crop competitors and include fungicides, herbicides, and insecticides (Paul, 2013). Conventional agriculture has adopted heavy use of pesticides to increase crop yields and these chemicals remain on (and in) the food we eat. Furthermore, accumulated build up of pesticides could lead to health issues especially in pregnant women and small children. These issues include headaches, birth defects, and added strain on weakened immune systems (Paul, 2013). Farming without pesticides is also better for nearby birds, small animals and the people who harvest food (Paul, 2013).

Organic food does not contain preservatives that increase shelf life. Accordingly, organic produce is fresher and is often produced on smaller farms near where it is sold. This locality can lead to an increase in both the taste and the nutritional value of the produce. Finally, there are the numerous environmental benefits of organic agriculture. Organic farming practices reduce pollution in the air, the water, and the soil, in addition to conserving water, reducing soil erosion, increasing soil fertility (Paul, 2013). Furthermore, organic farming practices are less energy intensive than those of conventional agriculture.

Despite the numerous benefits of organic farming, local consumers are interested in organic practices in order for them to be successfully integrated into the Lehigh Valley food system. Since there is no collection of consumer attitudes towards organic farming specific to the Lehigh Valley, we used data from a statewide survey of Ohio to identify attitudes. (Since Ohio is close to Pennsylvania we expect little difference between the food values of the two states.)

A large proportion (75 percent) of the survey's 3500 respondents expressed no, or only modest, interest in organic food. However, specific groups of consumers expressed high levels of interest. These organically inclined consumers shared many food system values and preferences as the respondents who indicated no interest in organic food. These preferences include reasonable food prices and high levels of food availability at the stores that they frequent. However, this demographic differed from the disinclined consumer mainly by their reported concern of issues involving food safety, dietary health and agro-environmental impacts (Bean, 2011). Examining this group shows that a robust education in the dietary and environmental facets of the food system is the motivating factor for those in support of organic practices. This would seem to suggest that consumer education is a crucial component of the organic

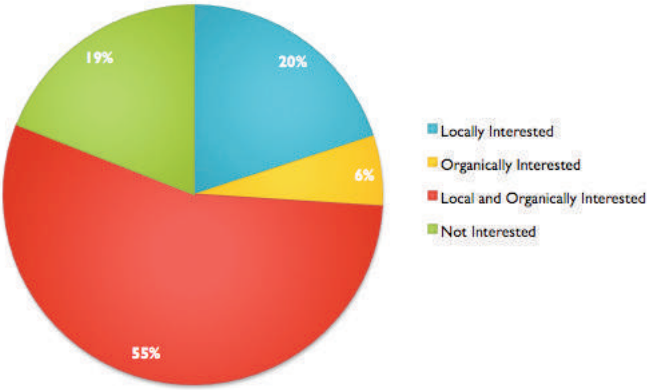


Figure 6.1: Consumer inclination towards local and organic foods (Bean, 2011)

food system. Thus, the importance of consumer education is a factor that should be considered in production, purchasing and marketing decisions of the producers and retailers of organic foods.

The same study can be used to gauge consumer interest in local food. Unlike organic standards, there is no specific definition for local agriculture. In our case, we can define local food as the collection of crops grown in the Lehigh Valley. During large portions of the year it is usually possible to find local food at places such as a Farmers' market and food hubs. The previous survey of Ohio residents found that 20 percent of the respondents supported local agriculture. In addition, 19 percent of those surveyed who expressed high levels of interest in organic foods also supported local foods (Bean, 2011). This is interesting since many small local farmers often use organic methods but sometimes cannot afford to become certified organic. Thus, it could be extremely beneficial to attract a demographic that supports both local and organic food to foster a stronger local food system in the Lehigh Valley.

Establishing a structure that integrates the values of both of these demographics may be instrumental in the effort of forging a strong organic food system in the Lehigh Valley. This would entail combining the organic supporter's value for dietary and environmental health with the values that local agriculture advocates hold. The distinguishing factor that is unique to the locally inclined respondents is a supernormal amount of correspondence with farmers (Bean, 2011). A majority of the members of this demographic were raised in rural areas and were more likely to regularly converse with the local farmers (Bean, 2011). This would support the idea that a strong sense of belonging with the local farming community is a principal social component of any local farming system. Furthermore, shortening the distance from farm to plate can help consumers discover how farmers produce the fruits and vegetables they sell and develop a healthier understanding of their food system. An enriched understanding of food systems empowers the consumer and can lead to widespread support for healthier and more sustainable agricultural practices.

There are many benefits of developing a stronger local food system. One of these benefits is financial. In local agricultural systems, money stays within the community and strengthens the local economy as more money goes directly to the farmer, instead of to processes like marketing and distribution. The area of produce distribution, in particular, contributes to far more than just financial problems. As discussed in Chapter 5, the average distance a meal travels from the farm to fork in the United States is about 1,500 miles. As a result, the distribution process demands massive amounts of fossil fuels and produces a large carbon footprint. To avoid food loss due to spoiling during the distribution process, inorganic produce must be picked while still unripe and then gassed to "ripen" it after transport; otherwise, this food must be highly processed in factories using preservatives, irradiation, and other means to keep it stable for transport (Paul, 2013). This is in stark contrast to local fruits and vegetables, which are harvested when they are ripe and thus full of flavor and nutrients. Ultimately, the benefits of decreased transportation of food show that local food is the freshest food you can purchase and demonstrates the wide variety of benefits that go hand in hand with a deeper consumer connection to food sources.

The increase in consumer food spending in restaurants is a necessary trend to consider when investigating the consumer impacts on the local food system. Consumer spending in restaurants does not have a direct impact on farming practices, but nonetheless is an important practice to study because of the distinct implications on the community, nutrition, food waste and it directly affects the success of food policies. Restaurant consumption is especially pertinent when considering food intake surveys show that between 1977-78 and 1994-96, the share of daily caloric intake from food away from home increased from 18 percent to 32 percent in America. Spending on such foods has also grown to account for about half of total food expenditures in 2004, up from 34 percent in 1974 (Stewart, 2006).

A study performed by Rutgers University in which 700 respondents were asked questions about their dining habits sheds further light on this issue. Form the survey, the researchers found that 71 respondents usually eat out "almost every day", 178 "every 2-3 days", 178 "once a week", 94 "once every two weeks", 86 "once a month", and only 4 respondents reported that they "never" eat out (Stewart, 2006). The survey respondents were asked to rank the level of importance of various food attributes including the importance of taste, nutrition and convenience. It was concluded that stronger preference for convenience increases the probability of dining out at least every few days, regardless of the type of restaurant patronized, by over 8 percent. Furthermore, consumers identified as seeking healthful offerings are associated with a nearly 19% increase in the likelihood of patronizing full-service establishments (Stewart 2006). This means that consumers who are looking for healthful foods and have a limited amount of diet-health knowledge are more likely to patronize full-service restaurants than fast-food outlets.

Lin, Guthrie, and Frazao (1999) show that full-service restaurant meals tend to be higher in fat, cholesterol, and sodium, on average, than meals at fast-food restaurants, although lower in saturated fats. Additionally, away-from-home foods tend to be more calorie dense and nutritionally poorer than foods prepared at home (Lin 1999).

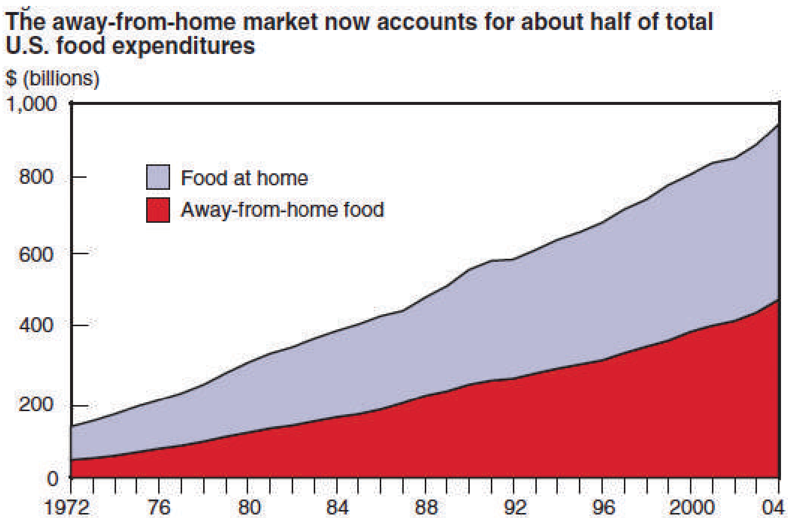


Figure 6.2: United States food expenditures 1970-2004 (Stewart, 2006)

Some studies have further found an association between eating away from home and overweight and obesity in adults and children (McCrory, 1999). Restaurants may be able to sell foods of lower dietary quality than home-cooked foods, on average, because patrons desire the other attributes of restaurant meals, such as convenience (Stewart, 2006). This is exacerbated by the fact that restaurants only have to give nutrition information about dishes that have had nutrient-content or health claims filed against them.

This misconception of the nutritional value of restaurant food is indicative of a disconnection between the consumer and his or her food source. This missing link between the consumer and their food must be resolved to foster a more robust food system. By increasing consumer education on issues of our food system, members of the Lehigh Valley can make informed decisions about the restaurants that they frequent. This can have a profound effect in our consumer-based society and can lead to a shift in restaurant behavior. With consumers making dining decisions that support issues of agricultural sustainability and dietary health, restaurants that operate in accordance to these values will be enabled to thrive in the Lehigh Valley food system.

In addition, consumers must also be aware of the waste management inefficiencies that occur in the average restaurant. Up to 10% of food purchases by restaurants end up in landfills without much consideration from the industry (Barclay, 2012). This wasted food cannot reach hungry citizens and ultimately ends up in landfills. To explicitly quantify the severity of restaurant food waste, a study performed at the University of Arizona in 2005 estimated that restaurants waste over 130 million pounds of food a day (Jones 2005). Food waste constitutes a major loss in our food system efficiency and can lead to problem of food security and greenhouse emissions.

The severity of this problem is further inflated when the waste from our entire food system is taken into account.

Consumer Food Waste

The overall numbers about food waste in the US are powerful. Food consumption is extremely energy demanding; 10% of the US energy budget and 80% of all freshwater consumed is used in the process of getting food from the farm to the consumer's fork. Despite all of these used resources, 40% of the food in the US goes uneaten. All of this waste puts food waste as the number one source of solid municipal waste, which causes major methane emissions (Gunders, 2012). The focus of our food policy on increased production has sent poor messages to the consumers about waste. Currently our food system is using more resources to generate more waste. Somewhere along the path of decreasing inefficiencies in food production we have lost the consumer value of maximizing food utilization. As we will see in this section this process needs a holistic reform, starting with aspects like food date labeling and incorporating technologies that decrease consumer side spoilage. These technologies can't be incorporated without an approach that refocuses the goals of consumer food. Changes need to keep in mind that simply making food available for longer will not solve the undervaluing of food as a perishable and resource intensive commodity.

The looming 40% of farm to fork food waste has many contributing parties. While a large amount of edible food is rejected or thrown away during distribution, production, and retail, a new 2014 USDA municipal waste study shows twice as much food waste occurs on a consumer level (Buzby, 2014). In *American Wasteland*, Jonathan Bloom cautions that this figure may show an under representation of the reported retail waste number, but says the number shows that "we, as individuals, are really wasteful!" (Bloom, 2014, p.1). Clearly, reducing consumer food waste is paramount to reducing the overall amount of food wasted in the US and an important part of fixing our broken food system.

To many, consumer food waste may seem like a problem that is too individualistic to address on the large scale. The European Parliament has recent taken on the challenge by designating 2014 "European year against food waste." They have also set goals for a 50% food waste reduction by 2020. To put this in perspective, if the US reduced its food waste by 50%, over 50 billion dollars of food costs would be saved annually. Food waste initiatives can reduce consumer waste as well. The UK's "love food, hate waste" program has been able to reduce avoidable household waste by 18% after five years of public awareness campaigning (Gunders, 2012). In the 2012 American Resource Defense Council report "*Wasted: How America is losing up to 40% of its food to landfills*" Dana Gunders identifies six important ways that America can reduce consumer food waste and secure a more efficient consumer food environment. These six areas include lack of awareness and undervaluing food, confusion over label dates, spoilage, impulse and bulk purchases, and poor planning.

An estimated 31% of the food available to consumers went unconsumed in America in 2014. This number represents a large amount of overabundance to the consumer. With so many available options and sources of calories it is easy for food to get passed off and not consumed. The amount of food wasted that could be sold to consumers is only going up. The 31% in 2014 is an increase from 29% in 2012 and 27% in 1997 (Bloom, 2014). These percentages indicate that consumers are being offered more and more choices of consumption that they are not choosing. Pair these percentages with the findings that twice as much waste occurs on a consumer level than at retail level and it is clear that most American consumers do not have a high value on the food available to them. Raising awareness with programs like the UK's "Love Food, Hate Waste" would be a helpful step in turning around the public perception on the value of food. Also, raising awareness on how energy intensive and water intensive our food system is could turn public perception around. If the consumer values and demands less waste at the retail level then the industry will respond.

Estimates from the UK suggest that up to 20% of consumer food waste could be corrected through proper food date labeling (Gunders, 2012). This number is just a gross estimate, but would represent a significant chunk of the 40% of the food that goes uneaten in the US. In order to correct this, a joint report conducted by the Natural Resource Defense Council and the Harvard Food Law and Policy Clinic has outlined changes that address the major shortcomings of date labels on food.

The first change would make "sell by" dates that can be seen by consumers obsolete. "Sell by" dates that exist on food offer guidelines for internal stock management of retail stores and do not represent a date when the food will be inedible. The report states that products should "only display dates that are useful to the consumer" (NRDC, 2013, p.1). The second overall change involves establishing a useful and uniform system of food dating. Clear and standardized language is essential in change. The proposal would most likely need to be a federal change so that the labeling system would not vary from state to state. Quality and safety based concerns need to be addressed in the labeling so that the consumer knows the difference between when the quality of a food will be decreased and when the safety of a food will be compromised. Under this method the consumer will be empowered to make choices about how long they will use the food for. In addition a "freeze by" date should be included when it is applicable in order to prolong the shelf life of foods (NRDC, 2013). In order for these labeling techniques to be most successful the method for selecting dates will need to be more transparent and the location of the dates will need to be more predictable on packaging (Leib and Gunders, 2013); these are two areas where the current labeling system is severely lacking.

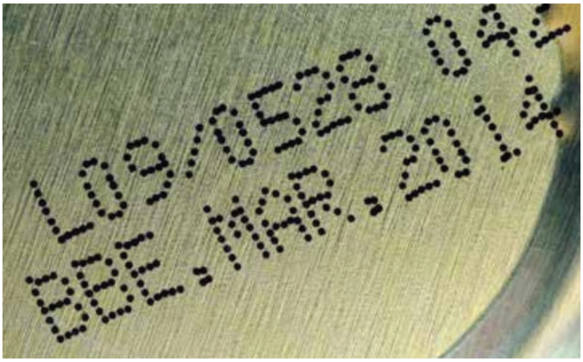


Figure 6.3 An example of a lacking labeling system which does not effectively communicate information to the consumer (Leib and Gunders, 2013)

Spoilage is one piece of the consumer waste reduction puzzle that will never be eliminated, but can be reduced through better technologies. Resources for new innovation in food storage are available. Sites like foodtechconnect.com can connect consumers and restaurants with technology that will help decrease spoilage. Food Tech Connect has recently featured two free consumer applications that let the individual take back control of their fridge. The application, 222 million tons, allows consumers to create menus and shopping lists that are tailored to their household size. This application can help consumers reduce the excess food they buy due to poor planning (Hutcherson, 2013).

As part of the UK's "Love Food, Hate Waste" program discussed earlier, the British government released a free application to help users manage what is in their fridge. The application can help users manage how long their food will be usable and how they will deal with portion sizes and leftovers. Applications that put the user in greater control of their food will help reshape the consumer mindset about food consumption and directly result in the reduction of food waste through the more effective consumption of leftovers.

Consumer awareness about impulse and bulk purchases can help alleviate overconsumption. The effectiveness of avoiding impulse buys may be directly tied to the ability of consumers to plan their meals before arriving at a store. Once again, the consumer must dictate the market by making smart, informed purchases. Bulk purchases often lead to over preparation of household meals. Over preparation of household meals has been a gradually increasing trend in the US. Indirect evidence of this comes from the increase of the surface area of the average dinner plate by 36% from 1960 to 2007 (Gunders, 2012). Properly planned meals need to include planning a proper meal size.

The complexity of problems addressed by the Natural Resource Defense Council and Harvard Food Law and Policy Clinic joint-study show that food waste won't be fixed by simple technological solutions. Food waste needs to first be understood by those that participate directly in the system. Consumers need to know the facts about how much of an impact food waste can have on the whole system. Efforts need to build first around consumer knowledge and then delve into working towards potential technological solutions. These solutions include improved labeling with more accurate information, and consumer application outlets that focus on social issues like proper meal size and impulse buying.

Food rescue

The problem of food waste is especially dire in commercial establishments that serve large numbers of people, like universities, public schools and restaurants. In these settings, food is often prepared in excess in order to avoid running out; this can lead to significant amounts of food not even being brought out from the kitchen, but rather getting thrown out at the end of the day because it won't keep or there is no room for it. It's a terrible waste of time and resources for so much food to be bought and prepared without ever reaching the members of the food system, especially when there are so many hungry people nearby who could really use it.

In an attempt to find a solution to this problem, various organizations around the country have committed themselves to 'food rescue.' These non-profit groups locate various commercial food venues that produce a lot of excess, and create a system for obtaining that food and delivering it to the needy. This all must be done relatively quickly, since food that has already been prepared may not stay good for long; but if it's done well, it can save huge quantities of food that would otherwise end up in a dumpster and feed many hungry mouths. Such a process requires a food system that's able to efficiently coordinate various technologies and practices to achieve the desired results.

One such organization is Boulder Food Rescue, which works with area businesses to sustainably collect and distribute food. The system starts by providing a special bin to each business that is strategically located between the produce department and the trash so that it is easy for employees to make use of the bin rather than put food to waste. Once a day, a volunteer arrives, loads the food into a bike trailer, and delivers it directly to one of roughly 50 organizations scheduled to receive it. This 'direct just-in-time' food rescue allows them to easily make use of perishable foods without any storage or sorting, so that the food can be used within 24–48 hours; the fact that they use bikes also makes the whole system completely sustainable, with very little cost or effect on the environment. Organizations that are part of this system include shelters that feed the homeless, low-income elderly housing, working-poor families, and school food programs.

Figure 6.4 Image of a food bike cart (Denver food rescue)

There are also other larger food rescue systems around the country that make use of large food trucks and storage facilities; this may lead to a larger volume of food being rescued, but with the trade off of providing food that is less fresh and sustainable than can be found in the Boulder system. Despite these minor drawbacks, these organizations are still making a huge difference in reducing food waste and helping to feed the hungry; any effort towards these ends is certainly praise-worthy.

The Lehigh Valley doesn't currently have any such system in place, but there is no reason why a similar system cannot be implemented here. Every business that makes food also contributes to the problem of food waste. All that's needed in the Lehigh Valley is a group of people willing to help redistribute this food. The Allentown Rescue Mission has taken great strides in helping to feed large numbers of people in need, but they rely on groups bringing in food prepared specifically for donating to the program. Rescuing food from local business could help to reduce a lot of needless waste while still providing much-needed help to the hungry.

Compost

Despite the utility of food rescue programs, there is always food waste that can't be redistributed to the hungry for sanitary reasons. Meals that have already been brought out from the kitchen, food that's left unfinished on people's plates, and food that starts to go bad before it can be served all constitute waste food that cannot be reused for health safety reasons. However, these types of leftovers need not simply be thrown away; since all food is organic in nature, it may be usefully composted. Composting is a process where food waste is allowed to decompose over time, and may then later be used as a valuable soil additive that includes high levels of nutrients important for plant growth. Using compost to grow food closes the food loop; food grown in compost-enriched soil is eaten, and then the waste is turned into more compost that is used to grow yet more food. This creates a self-contained sustainable cycle that helps to reduce waste while still providing high quality food.

Compost is also a significant economic resource, with a 5-quart bag of organic compost costing $5.95. By throwing food into landfills, Americans are dumping money in the trash (SARE, 2011). On top of the loss of resources, landfills actually charge extra fees to accept organic material, adding even more costs to the practice of throwing away food. According to the EPA, Americans needlessly send over 30 million tons of food to landfills every year. That's a lot of potential savings that could be brought about by composting. At the same time, the prices of synthetic fertilizers are rapidly increasing. According to the USDA Census of Agriculture, farmers saw an 86% increase in the cost of fertilizer from 2002 to 2007. And of course in addition to hurting farmers' wallets, the runoff from synthetic fertilizers damages society as a whole by polluting water and upsetting entire ecosystems (SARE, 2011).

Many colleges and universities have implemented systems of collecting all of their school's inedible food waste and converting it into compost for use on the school farm. For example, Berea College in Kentucky has been composting for 16 years and using that compost on their farm. They use a special front-end loader composter, in which they combine all food residuals from the dining halls, municipal leaves, and wood chips and sawdust from the college's woodcrafting program. They produce crops on 5 to 8 acres of land, with the compost used as the sole ingredient in the potting medium for almost all of the crops grown there. The compost is applied to the fields at about 5 tons per acre every 2 to 3 years, which shows just how much waste from the school is being utilized. About a fifth of what they produce is then sold back to the college's food service, which completes the cycle of turning a community's waste back into its food. The project was started by a mere $1000 grant from the Organic Farming Research Foundation as part of a collaboration between a student and a faculty member, which is very little especially considering the savings in waste management costs brought about by composting (Sullivan, 2010).

Here at Lafayette, we also make use of composting practices. We have developed the 2-acre community garden and working farm we call LaFarm that uses organic

Figure 6.5 Image of a farmer holding rich compost (Urban Farmer, 2014)

farming. LaFarm works with the school dining services to create a sustainable food loop, using compost from the dining halls to grow food that all goes back to the college. This system, called a Food Recovery Network, helps us make good use of our everyday food waste, while also saving on fertilizer costs at LaFarm. The farm grows a lot of food for the campus, producing over 2,300 pounds of produce from the two-acre plot in 2013 alone. However, this isn't the only function of LaFarm. Various courses at the college work in conjunction with the farm to learn about the food loop and the ways that we can make good use of our waste (LaFarm, 2013).

In the Lehigh Valley as a whole, there has been some initiative to promote widespread composting practices. A steering committee of 6 local organizations and agencies held several meetings in 2011 to establish an economically driven food service to farm composting program in the Lehigh Valley. The committee is comprised of the Lehigh County Conservation District, the Greater Lehigh Valley Chapter of Buy Fresh Buy Local, the Rodale Institute, Cougle's Recycling, Inc., Pennsylvania Recycling Markets Center and the City of Allentown. Under the auspices of the SARE grant, two restaurants, one farm, and one school district benefited from promotional materials and subsidized costs. A workshop was held that encouraged three universities, another school district, one hotel and two other restaurants to participate, without supplemental grant funding. A successful part of the program involved Cougle's Recycling Inc, which charges $8 per 64 gallon tote for a weekly pick-up of compostable material. The material is dropped off at the Rodale institute, which began a composting project as a model operation for farmers in the region (SARE, 2011).

The Allentown Brew Works was the first restaurant to sign on to the program, and they later expanded the system to Bethlehem Brew Works. Between the two restaurants, the composting initiative saved the owners $10,000 per year on trash disposal fees. The Brew Works diverts pre-consumer and post-consumer food scraps, which is a large portion of their savings. Despite initial concerns, no additional labor was needed. The bus boys sort out the compostable materials from the non-compostable material with minimal effort. The Lehigh County Conservation District also provided marketing materials for the restaurant, which has served as a great outlet for public outreach and education.

With the Brew Works enjoying such success, the Lehigh County Conservation District held a seminar in August 2011 to encourage more food generators to participate in the program. The seminar was successful, as interest grew shortly after; to date, several universities, hotels and grocery stores are participating. The Lehigh County Conservation District also approached the Southern Lehigh School District. By leveraging grant funding, the district was interested in participating and now has incorporated composting into their curriculum. The students sort out their own food waste, which is a way to reduce costs as well as providing them with a valuable educational experience (SARE, 2011).

Clearly, getting businesses to participate in composting depends more upon education than anything else. Since the process saves money and isn't very work intensive, this is a very simple, very sustainable choice for companies. The city of Allentown hopes one day to offer curbside compost pick-up, just like we do now for trash and recycling. Although there is currently no space for such a system to be implemented, they're doing all they can to encourage expansion of the existing routes of Cougle's Recycling. This should create an opportunity for businesses that gain interest in composting, so that eventually there is enough demand to invest in significant citywide compost practices.

Conclusion

When viewing consumer habits of food consumption and waste it is important to realize that food waste and overconsumption is not inevitable. For example, individuals who lived through the Great Depression or World War II waste nearly half as much food as other age groups (Gunders, 2012, p.13). The problem facing consumers is not strictly logistical. We need to avoid thinking that the problem can be solved solely with better food technologies that store for longer or compost more easily. While these technologies may be part of the solution there is a large part that needs to address consumer attitudes towards food. An integrated approach towards consumer reduction needs to include a top down approach that first reduces consumption, then focuses on reuse of excess food, and finally looks for ways to recycle or compost food. Hopefully, this approach can be incorporated by consumers with value changes presented earlier in this book. Despite the numerous consumer technical systems mentioned in the chapter, the Lehigh Valley will not see a successful shift in consumer values if the whole system cannot be reformed to include a more hands on approach to food including production and distribution.

PART 3

Re-setting the Table

7

Food Policy

John Paul Bisciotti and Nick Limburg

The technological possibilities of prior chapters are also cultural possibilities. In this chapter, we want to discuss the ways a sustainable future can follow from a stronger understanding of a cultural-technical system. Behavioral scientist Hazel Rose Markus wrote "The Culture Cycle," an essay that suggests what culture is, how culture works, and how culture can change for the better (Markus, 2011). As a key concept of this chapter, the culture cycle will further conversations about the Lehigh Valley food system in particular. It will help citizens of the Lehigh Valley reframe conversations about the production, distribution and consumption of food. The Lehigh Valley food system will be synonymous with food culture. With these in mind, the chapter discusses how policy can be used to influence Lehigh Valley food culture: to strengthen attributes and ameliorate detriments of its food system with respect to economic development, environmental advocacy, and social justice.

How a Food System is a Food Culture

Members of the Lehigh Valley community can discern how local history, resources, and risks forge a constantly evolving identity. The Lehigh Valley is a complex system, an amalgamation of preferences, beliefs, and needs. Naturally, as a constituent piece of the Lehigh Valley community, the food system presents its own complex, cultural identity with its own fundamental components. First, the food system is comprised of individuals who help produce, distribute, and consume. Second, practices and tools—such as mulches, veggie vans and composting—facilitate individuals' respective production, distribution, and consumption habits. Third, agricultural infrastructure—such as community gardens, farmers' markets and food policy councils—institute structure and promote the use of specific practices and tools. Fourth, when a community collectively believes each other's practices, tools, and institutions are good, right, and human, it is evident their beliefs are foundational.

As such, these separate parts of the Lehigh Valley food system are analogous to the four components of Markus' culture cycle: individual selves, everyday practices and artifacts, institutions, and foundational ideas (Markus, 2011). At the root of a community such as the Lehigh Valley, unity depends upon each individual whose identity must align constructively with fellow members to form cohesive foundational ideals. The Lehigh Valley food system is no different. Viewed through this lens, it adopts its cultural significance.

Production, distribution and consumption of food in the Lehigh Valley depend strongly upon the Valley's resources. For example, the presence of land on which mulch can be placed for production, and of fuel, which can be used to power a veggie van for distributive purposes, facilitates the Valley's demand for affordable, nutritious, and culturally appropriate food. On one hand, these means of production and distribution, mulch and van, serve to help sustain the well-being of community members, who require food as ends for subsistence. A means related to consumption such as composting, on the other hand, ameliorates the effects of excessive production and distribution. It helps sustain the well-being of an environment, which aids society with resources such as land and energy. It is a practice that represents a paradigm shift in American culture when society moved away from anthropocentric values related to productivity, efficiency and maximization and when society advocated for the environment, too, via holistic values. As such, Lehigh Valley food culture must adopt contemporary, environmental foundational ideals, governing how the community manages, regulates, and employs its resources.

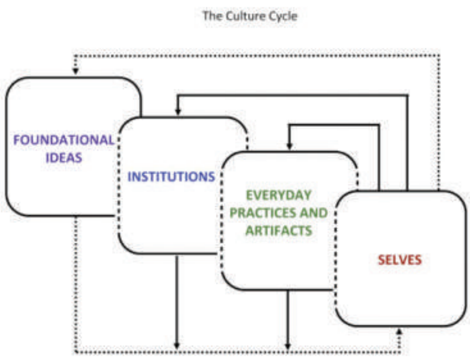


Figure 7.1 The Culture Cycle (Markus, 2011).

It has been a challenge environmentally that for well over a century, older, anthropocentric ideals have been ingrained into American as well as Lehigh Valley culture. These values can be traced back to an age when a prevailing presence of the industrialized model for food production, distribution and consumption, as opposed to other models of humbler scale, was indisputable. Coinciding with industrialized engagements such as those in the domain of agriculture, demographic shifts emerged. "The 1920 census was the first to record a tilt away from rural to urban dominance in the United States, when the population was then 51 percent urban, 49 percent, rural" (Cohen, 2013, p. 15). Due to the demands of American culture, which implored the advancement of transportation systems, cities and national defense, populations emigrated from rural areas and then converged in the Lehigh Valley (Jensen, 2009). Bethlehem Steel, a leading supplier of steel to the American construction industry in particular, founded in 1861, responded appropriately to the demands of American culture by facilitating the production of railways, skyscrapers, and ships. In turn, this steel company, a quintessential institution for the region's workforce, actuated economic development of the Lehigh Valley, perpetuated an idea of industrialization, and expedited the Anthropocene (Goleman, 2013).

In tandem with developments pertaining to demographic and economic realms, "fewer people were producers who made their lives as part of the agricultural world" (Buy Fresh Buy Local, 2013, p. 15). As evidence of this changing food culture, the 1920 census recorded that the population was then 51 percent urban and 49 percent rural, whereas the 2010 census found the United States 81 percent urban and 19 percent rural (USCB, 2010). "Producers became consumers who could purchase food in stores like any other consumer product" (BFBL, 2013, p. 15).

Figure 7.2 Workers at Bethlehem Steel in Early 1900's (Delaware & Lehigh, 2014).

Nowadays, especially because the region has come to be known as a bedroom community to Philadelphia and New York, the Lehigh Valley continues to grow and develop. According to the Assessment Report of the Lehigh Valley Local Food Economy, the population is projected to grow 35 percent over the course of 30 years, from 647,232 people in 2010 to 873,954 in 2040. In a way, history may be repeating itself once again. The Lehigh Valley Regional Planning Commission of Housing and Urban Development stated, "This rapid growth will change the nature of Lehigh Valley municipalities, shifting many from rural to suburban and from suburban to urban" (BFBL, 2013, p. 5).

Development, though tied to damaging ways of the past, is imminent in the Lehigh Valley because of its growing population. Therefore, to foster a more environmentally healthy future, citizens of the Valley should work to replace anthropocentric ideals with newer sustainable ones. That is, values related to productivity, efficiency and maximization, which motivated the unsustainable industrialized food system of the early twentieth century, should not overshadow priorities related to community food security, agriculture and food studies, and environmental health. Citizens of the Lehigh Valley have an opportunity to see the limits of our existing food system. After all, increased specialization of production as well as chemical and fuel dependencies emerged hand-in-hand with early twentieth century developments. These phenomena continue to decrease ecological biodiversity and damage soil (Schutter, 2010). Understanding residents' current food consumption habits is imperative to achieving the Valley's goals, creating strategies to improve diets and health (Prior, 2013).

However, consumerist economic motives upholding the structure of the business economy and sustainable rationale preserving the well-being of one's self, one's land, and the potential for further self-interest should not preclude social justice.

In the past century, the farming force has decreased from 41 percent to about 1 percent of the American labor force (USDA, 2005). A decreased amount of farmers limits the potential for local agricultural production. In one decade, from 1997 to 2007, the number of Lehigh Valley farmers under the age of 35 dropped by 37 percent (BFBL, 2013). This generational gap characterizes a weakening local force, which if otherwise abeyant would indicate improvement. Also constituting cultural fault in the local food culture, "Lehigh Valley farmers…are not representative of the ethnically diverse population living in the Lehigh Valley…[with] only 15% [being] women, no Black or African American operators, and only 10 operators [being of] Spanish, Hispanic, or Latino origin [in 2007]" (BFBL, 2013, p. 27).

Given the rising average age of farmers in the Lehigh Valley, there is a continued need to help young and beginning farmers establish operations and gain access to farming resources. Barriers to farm entry such as land access, capital acquisition and farmer education must be broken down to remedy the nonrepresentational demographic of Lehigh Valley farmers (BFBL, 2013). On the whole, with respect to urban planning, community food security, agriculture and food studies, environmental health and economic development in the Lehigh Valley, improvement is attainable. Markus' analysis of the culture cycle suggests that addressing the institutions of a community such as those in the Lehigh Valley could expedite these desired improvements (Markus, 2011). Ultimately, the best way to change these institutions is by augmenting and expanding food and agricultural policy.

Institutional changes should aim to promote the social, economic, and environmental health of the Lehigh Valley. To do so, thoughts and actions should be directed toward the affordability and accessibility of nutritious and culturally appropriate food. Promotion of agricultural land preservation, maintenance of existing farmland in the Lehigh Valley, and development of urban ordinances as well as middle-ground infrastructure help achieve these goals. According to Michael Kraft and Scott Furlong, the government's role in social welfare has shifted from minimal levels of support to greater ones over the past century. The size, scope, and cost of certain projects mean that only the government can undertake them (Kraft, 2013). Franklin D. Roosevelt "instituted a series of experimental projects and programs, known collectively as the New Deal, that aimed to restore some measure of dignity and prosperity to many Americans." Roosevelt's programs were implemented across the nation (New Deal, 2014). These include programs designed to lift the Lehigh Valley from the Great Depression. An agency of the New Deal, the Works Progress Administration (WPA) provided jobs, some of which were hosted by Bethlehem Steel in the early 1930's (Forging America, 2003). By 1936, the WPA assisted with agricultural improvements and advocated for farmers' wage rights (New Deal, 2014).

> History exemplified the government's role in social welfare through policy, saying this about the New Deal: From 1933 until 1941, President Roosevelt's

programs and policies did more than just adjust interest rates and tinker with farm subsidies and create short-term make-work programs. They created a brand-new, if tenuous, political coalition that included white working people, African Americans and left-wing intellectuals. These people rarely shared the same interests—at least, they rarely thought they did—but they did share a powerful belief that an interventionist government was good for their families, the economy, and the nation (New Deal, 2014).

Figure 7.3 Poster circulated by the New York City Work Projects Administration, between 1941 and 1943. Titled *Grow it Yourself: Plan a Farm Garden Now*. Artist Herbert Bayer (Sidewalk Sprouts, 2008).

The New Deal is a prime example and testament to the power of public policy. The government pioneered institutional changes with hopes of bringing forth benevolent outcomes. Although the government intentions were helpful, the New Deal and WPA that it controlled implemented policies that conform to anthropocentric ideals of the human dominance over nature and, consequently, run in tension with the social and environmental values of the early twenty-first century. For example, the WPA advocated farmers' use of pesticides, which harmed the land, one of the resources vital to a community (Works Progress, 2014). Nevertheless, the New Deal can be construed as an abstract idea to bring about change. It can be transformed to adhere to foundational ideas of the present.

How Food Policy Can Guide the Future of Food Culture

Foundational ideas have shifted over the past century: from development through productivity, efficiency and maximization, to development with context to its effects upon the land. Keeping in mind the existing preferences of consumers, as well as the tools and institutions available to producers, our book supports a notion that augmentation and expansion of food and agricultural policy is a viable solution to improving upon the distinct and collective faults of the Lehigh Valley food system. Subsequently, we will describe existing and potential policy options for the Lehigh Valley.

Food policy is a cultural action to promote the values of a specific culture. Food policy is therefore dependent upon the culture to which it belongs. Furthermore, food policy is no single field of existing policy, but consists of a myriad of factors. In short, food policy refers to any policy that addresses or shapes the food system. Food policies are important because they either promote or demote certain aspects of the food system in accordance with cultural values. From production to disposal, all aspects of the food system are at some point directly or indirectly affected by policies. Direct policies are those that specifically regulate a certain aspect of the system. For example, meat processing laws regulate the manner in which livestock can be slaughtered and meat processed. These laws serve to enforce a standard for suitable meat and reduce the chance of selling of ill or ruined meat. Policies can indirectly affect the food system if they do not expressly forbid certain actions, or exclude certain parties due to feasibility. For example, due to the stringent meat processing regulations, small and mid-sized slaughterhouses do not operate on a profitable scale, which limits the existence of slaughterhouses in local food systems. If the diversity and nuanced effects of food policy were not enough, food policies are created by multiple actors on multiple levels of society.

Figure 7.4 shows various actors in food policy at the national, state, local, public, and private levels. Higher-level policies tend to affect lower-level ones, and likewise with public policy affecting private. Lower level policies are however able to act in areas that are not explicitly addressed by higher-level policy. In the same manner, private policy and action can address gaps and shortcomings in public policy. For the Lehigh Valley, food policy is affected by the higher-level decisions of the USDA, and Pennsylvania Department of Environmental Protection, and Pennsylvania Department of Agriculture. On

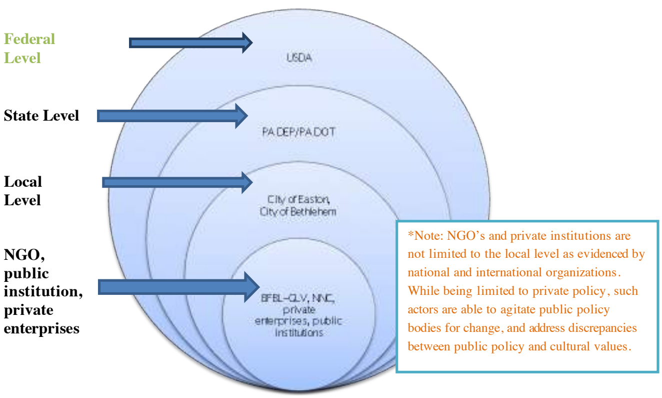


Figure 7.4 Graphic of Actors of Food Policy (As created by author)

the local levels, municipal and city governments decide public policy, such as City of Easton. Included in the graphic are NGO's, public institutions, and private enterprises for the Lehigh Valley. These types of actors in food policy have power over internal decisions and private policy, but are responsible for agitating public bodies to adjust public policy. NGO's and some private enterprises are not adequately described as "local" or "grass-roots" because membership and activity may span several counties or state lines. Within the Lehigh Valley, two main non-governmental actors are the Nurture Nature Center (NNC) and Buy Fresh Buy Local Greater Lehigh Valley Chapter (BFBL-GLV). The NNC works to educate and establish dialogues for people and organizations involved in the environment and food system. The BFBL-GLV is a chapter of a nation-wide organization that attempts to motivate people to engage in the local food system.

A prime example of national-level policy affecting lower levels, and a private solution to a public policy, is the USDA standards for organic farmers. To have products recognized as and labeled organic, farmers need to adhere to comprehensive regulations decided by the National Organic Advisory Committee, which sets standards for production, handling, labeling, and selling of all products. The USDA seal, certifying the product is organic, requires a USDA-accredited tester to determine whether all aspects of the farm meet the organic standard. These elements include non-use of synthetic fertilizers, prohibited pesticides, growth hormones, or genetically modified material (*National Organic Program,* 2013).

The benefits of being recognized as an organic farmer include leverage to sell one's produce at a higher price compared to industrial, agricultural food to reflect the greater amount of effort put into each crop. This is important because organic farming methods are often unable to compete with industrial agriculture output; therefore farmers need to sell at higher prices to support themselves. Furthermore, organically raised foods have significantly less negative impact on the environment than conventionally farmed foods. Therefore, the benefit of organic farming to environmental and consumer health is greater. The disadvantage to having regulations to be certified organic is that the registration process can be daunting for farmers due to fees and the paperwork itself. Some farmers bypass this issue by relying on direct sale purchases in which the farmer-customer relationship is more a matter of trust than branding. Despite this exclusionary aspect, the advantage to a national-level policy regulating organics is that it minimizes opportunities for products to be falsely labeled and sold as organic, and sets a standard minimum for food to be organic.

In the Lehigh Valley, organic farm production has risen over the past decade. One reason for this rise is the increase in commitment from consumers for less environmentally harmful and healthier foods. Because of consumer willingness to pay higher prices, conventional farmers have converted to organic farming systems to provide for the discerning consumer. In 2008, the average organic farmer in the Lehigh Valley had $45,697 in profits as opposed to the average conventional farmer profit of $25,448. As noted above, the requirements to being USDA organically certified could be a barrier to farmers that already adhere to an organic model. To counter this, several farms in the Lehigh Valley are certified by the non-profit organization Certified

Naturally Grown (CNG). The CNG certification process is not accredited by the USDA, but it is based upon USDA guidelines (BFBL 2013). Therefore, while the CNG farmers and their goods are not officially certified as organic by the USDA, they are certified by a third party to fulfill the USDA guidelines to be organic. This CNG process is a non-governmental solution to overcoming barriers caused by national level policy.

Like all policies, food policies are motivated by diverse reasons. In the Lehigh Valley and other regions, two main motivating forces are food health and food justice. Food health refers to the concern placed upon the accessibility and consumption of nutritional foods. Food justice refers to the inequality of access to nutritional food usually due to socioeconomics, a topic we explore further in Chapter 8. In our region, advocates have recently been focusing on food access. Food access refers to "the availability and affordability of healthy, high-quality, culturally appropriate food options within a reasonable distance from where people live" (BFBL, 2013, p. 42).

Based upon USDA Economic Research Service standards, there are eight food deserts in the Lehigh Valley. A food desert is defined as an area with low-income and low access to conventional food retail services (BFBL, 2013). In order to improve the food accessibility for the residents of these areas, creation and adjustment of policies and programs enabling residents to access food, such as farmers' markets, community gardens, and institutional commitment should be pursued. As presented in the organic certification example, a challenge to farmer certification was overcome by an alternative approach without changing the overall policy system. However, not all negative aspects of current food policy toward the newly desired food system ideal can be corrected so easily.

As discussed in Chapter 1, the policies controlling agriculture in America shifted over the past century to conform to productionist goals. One of the highlights of this time period was the nixing of the New Deal Policies by then Secretary of Agriculture, Earl Butz, in the 1970's. As discussed previously, the New Deal policies created a price floor for crops to ensure farmers received high price for their products while at the same time limiting production. This style of management assisted to keep smaller farms afloat and to stymie large agricultural expansion. When the price floor was removed, farmers had to grow more and more food to try to cover their expenses. The government also supplied incentives for maximum production. This spurred the rise of large agricultural businesses and accelerated a decline for small farmers (Philpott, 2008). In order to stay in the business, farmers needed to "get big or get out."

The result of this cultural shift toward productionist laden policies was the food system we know today: industrial agriculture, widespread planting of corn and soybeans, and cheap, highly processed foods. This policy shift also reduced the number of small farmers. Consequently, one of the greatest areas of development in food system infrastructure was the facilitation of processing, storage, and selling by large industrial agriculture to wholesale buyers, such as large organizations, public institutions, and food supply chains. Similar infrastructure did not arise for individual farmers in local food systems to sell wholesale. The Lehigh Valley is no exception to this occurrence.

Beyond simply focusing upon preserving and expanding production sites, the Lehigh Valley must establish outlets for its local food economy. In other words, the Lehigh Valley must address its missing middle, particularly for promoting wholesale purchases in low-income areas. The missing middle refers in this case to infrastructure that facilitates movement from production to purchase and consumptions sites. An example of a lively, successful middle in the Lehigh Valley is the Easton Farmers' Market, which allows for direct sale from farmers to buyers. The Farmers' market is however small-scale with individual sellers providing products to individual buyers. This limits the type of consumer at farmers' markets by desired volume of goods and location. The Lehigh Valley has a dearth of facilities to aid local farmers in reaching wholesale buyers and low-income area residents.

One type of infrastructure that would aid farmers in reaching wholesale markets is an aggregation site. As discussed in Chapter 5, aggregation facilities are those that compile products from various farmers to reach adequate volume ranges for mainstream market use, such as wholesale buyers. Aggregation centers need to have sufficient storage capabilities to reach such capacity, and a developed distribution system to receive products from the farm and deliver goods to the buyer. The majority of such commercial aggregation facilities act on the large-scale because it is more cost-effective than small-scale sources. However, "food hubs" have been developing to facilitate the aggregation and distribution of food for local food systems (BFBL, 2013). Within the Lehigh Valley there are no major aggregation facilities, but there are three in surrounding areas. BFBL-GVL ran a food hub pilot project in 2013, but the project was discontinued because of its cost-ineffectiveness. (Again, see chapter 5 for more discussion of this.)

While food aggregation sites are not necessary for wholesale purchases, they are more efficient for the buyer to make a single stop than to do business with multiple farmers. If the local food system wishes to engage more with the wholesale buyers in the Valley, then it must build its related middle ground infrastructure. Providing better service to wholesale purchases is only one facet of the missing middle for the Lehigh Valley food system. The other is sufficient access for low-income residents. For an increase in access to quality food across the region, growing and purchasing sites need to be strategically placed throughout the Valley. Placement of such sites for underserved areas, the food deserts, will be aided by policies motivated by food health and food justice.

Food Policies in the Lehigh Valley

The Lehigh Valley has been successful in food policy administration for several portions of the local food economy. Three main areas of successful policy are agricultural land preservation, urban ordinance, and public institution commitment. Over the last 80 years, there has been an 80% decrease in farms in the Lehigh Valley, mostly due to expansion of residential housing (BFBL, 2013). This reduction in farmland adversely affects the production ability of Lehigh Valley output capability. In order to prevent further loss of farmland, local governments and non-profit groups have been working with farmers in agricultural conservation easement programs. An agricultural conservation easement program is an agreement between the landowner and partner organization to protect the farmland from non-agricultural development. In order to ease loss of land value caused by this approach, farmers are financially compensated. Both Lehigh and Northampton Counties have been preserving farmland through this method since the 1990s. Another approach is through agricultural protection zoning ordinances. The downside to this approach is that while it does protect against non-agrarian development, it is not a permanent agreement, and is subject to change with land ordinances (BFBL, 2013).

A particular aspect of land and zoning ordinances are those that pertain to farmers' markets, community gardens, and urban farms. Depending on a locality's zoning regulations, farmers' markets, community gardens, and urban farms may be banned. If they are not necessarily banned, then ordinances may inadvertently restrict or make such venture non-viable or more expensive. An example of such ordinances is disposal regulations, which may prohibit composting in cities. Fortunately, the Lehigh Valley is receptive to the above-mentioned enterprises and has shifted policies to enable them, including the indoor Easton Farmers' Market, the future Easton Public Market, and the West Ward community gardens.

Figure 7.5 Projected front elevation of the Easton Public Market (GEDP, 2014).

While community gardens have been approved, small-scale animal husbandry, such as chicken raising, is still off the table. There is currently a ban on raising chickens in city limits for all three cities of Lehigh Valley (BFBL, 2013). This is a potential avenue for further urban agricultural development. Pursuit down this path is unlikely, however, based on a recent committee meeting in the city of Easton. The committee met to decide whether or not to repeal the ban on poultry raising within the city limits. While opposition forces to the lifting of the ban arrived to voice their reasons, there was a considerable lack of citizens in favor of repealing (Malone, 2013).

The allowance of farmers' markets, community gardens, and urban farms by zoning regulations is especially important for underserved communities that lack access to conventional food outlets. Pursuit of zoning regulations or policies that assist or promote the formation and function of community gardens, farmers' markets, and the like should be a priority to expand the middle infrastructure of the local food system into underserved areas. This will require support from community members at council meetings to push for strategies to bring local food into the food deserts.

Apart from urban ordinance changes to promote urban farming, another manner through which underserved communities may be served by policy is institutional commitment to purchase local foods. While land preservation and urban ordinance fall under the public policy sphere, institutional commitment exists within both public and private policy spheres. In public policy, local governments or schooling boards could require public institutions like hospitals and schools to purchase a certain amount of local foods for meal times. Private institutions or private food providers may make similar commitments internally without being prompted by public policy. Such internal decisions will be more reflective of an individual organization member's ideals of a food system. Institutional commitment will provide an outlet for local farmers' produce, and serve as a motivation for aggregation of local foods. Furthermore, it may allow lower-income children to have access to healthier foods that otherwise would be outside their grasp due to distance or monetary expense. Currently in the Lehigh Valley, food providers for local colleges' have made a commitment to have a certain percentage of food supply be locally sourced. Lafayette College recently underwent a transfer in food service providers in the hopes that the new provider would promote healthier, more organic, and more locally sourced foods (BFBL, 2013).

In addition to policies and programs already contributing to the local food economy well-being, several planned and proposed actions can be taken that rely upon or emphasize citizen involvement. Two examples are the Bethlehem Co-Op, which will start operating next year, and a Lehigh Valley food policy council, which has been proposed to aid the local food system.

The Bethlehem Co-Op is intended to be a community owned and operated grocery store for downtown Bethlehem. The store will focus upon providing nutritional, high-quality food to community members at affordable prices. The store hopes to emphasize locally grown foods in its selection. The store is expected to open during the spring of 2014 (*Bethlehem Cooperative,* 2013).

The co-op is not a local government program. It is a cooperative effort by community members to provide better access to food for their community. Being community based does not mean it is not involved in food policy. The co-op is an actor in food policy because of its membership rules and food procurement objectives. The membership rules restrict who exactly may access the store, which is important for store operation costs and limiting the pool of clients to the community members that want to improve the community. The intended goods the co-op wishes to showcase are a manifestation of the value system the community members have for food. The most inspiring and hopeful aspect of the Bethlehem Co-op for food policy is that it is a community effort.

In order for the community to gain support and act for this cause, enough members in the community will need to be concerned with their food system. This is significant because it indicates the willingness of people to engage in their food system. This willingness will impact future decisions about the food system for Bethlehem. People who are willing to act can reach for tools within their grasp to shape the system as they wish. One tool can potentially be laws and regulations that can be enacted or altered to promote change to the food system and community.

From health codes to land ordinances, market prices to public school lunch programs, the food system is directed by many goals. Due to this wide range of policies, it is often difficult for policy makers to know exactly what can be changed. Often, the decision makers of such policies do not communicate amongst themselves, resulting in conflicting or at least non-complementary policies. One countermeasure to this dilemma is a food policy council (FPC). A food policy council is composed of parties invested in the local food supply that support government and communities in developing plans and policies associated with the local food system. This approach is highly effective for food policy reforms and designs because of the sheer breadth and reach of the policies that influence the food system (BFBL, 2013). The FPC objective is to look at all relevant information in the food system and make decisions for the entire integrated system. Lehigh Valley currently has no food policy council, but the Lehigh Valley chapter of Buy Fresh Buy Local has advised the formation of one.

Conclusion

The Lehigh Valley has made great strides in pursuing a path toward invigorating its local food system and providing quality food for all residents. However, based on the average American diet, the Lehigh Valley is only able to produce food for 24 percent of its current population. That being said, the Lehigh Valley population is expected to rise by 35 percent over the next 30 years. While the goal of the Valley could not be providing all of the food for its citizens, much more needs to be done for the future since challenges—not limited to the growing population—will further strain the already under-supplied region. Accompanying this rise in population is the expected expansion of urban development, particularly residential housing. There are already pockets within the Valley that suffer from lack of food access. Local sourcing of food may help to alleviate this problem, but not if the population expands with less available land for agriculture. To confront and stay ahead of this imminent issue, policies must be set in place to conserve agricultural land and promote urban agriculture, and build the infrastructure of the local food system (BFBL, 2013).

Lehigh Valley has an exemplary record of setting aside funds for agricultural land preservation, but being complacent in this field will result in a loss of production sites to urban sprawl. Local governments need to ensure protection for these main agricultural sites. Apart from protecting strictly agricultural land, local governments should review their land ordinances and zoning codes to find and ameliorate any codes that may infringe upon the ability to operate community gardens and urban farms. In order to expand the local food system, Lehigh Valley must focus upon developing its middle ground infrastructure. To facilitate this development, the Lehigh Valley can enact policies that 1) ease transport of produce for farmers, 2) subsidize sites of processing and aggregation, 3) guarantee a purchaser by public institution commitment, and 4) enable market sites in under served areas. This strategy will coincide with revisions to urban ordinances if certain sites are restricted from becoming part of the food system.

The Lehigh Valley has a promising local food system future, but it must build and maintain momentum to perpetuate that system. We, as citizens, must recognize that our food system is part of the economy, environment, and cultural identity. We must participate through "voting, joining interest groups, and contacting government officials directly" to benevolently affect cultural institutions such as the food system (Kraft, 2013, p. 44). Institutional structure, after all, tends to reflect the prevailing political values and culture of a community. It will be the choice of the residents of the Valley as to what identity they wish their policies to reflect and preserve. Together as a single, cohesive force, the Valley must create policies that support the goals of the local system.

8

Building a sustainable future for food beyond technology

Drew Beyer and Julia Seidenstsein

Introduction

Stewart Udall, a politician who was greatly involved in environmental issues, wrote that "True conservation begins wherever people are, and with whatever trouble people are in" (Forbes, 2003, p. 69). Environmental issues tend to be about humans getting in trouble for mistreating nature and those effects coming to light. The failing of the modern food system is one of these issues. Environmentalists, communities and others have criticized the modern food system, but this book is meant to be a reference for possible steps and bold ideas that can make a more sustainable food system in the Lehigh Valley possible.

There are many aspects of creating a more sustainable food system for the Lehigh Valley, but none of the arms of the project can have the same effect if they work separately. Rather than individual technologies being stand alone things, they are part of a greater cultural system. Implementing new technologies at local farms is not just about increasing the production, growing season and efficiency. Creating new food policy for the governments of the Lehigh Valley is not just about making it easier for farmers to get more fresh food out to willing Lehigh Valley buyers. It would be against the goal of bettering the food system in the Lehigh Valley if more food is produced, but those of lower income level are left out. Or if more food is produced, but there is no political infrastructure to support the distribution of the food. Every part of the local food system is connected to all the other parts as with the intertwinings of an ecosystem, and this is vital to the success of improving the food system in the Lehigh

Valley. Not only are all the parts of this project connected, but building a sustainable food system is about much more than just food.

As Wendell Berry, an environmental activist, farmer and poet, said, "eating is an agricultural act" (Berry, 1990, p. 145). That idea sums up the reasoning behind aiming for sustainability in the Lehigh Valley food system. Berry recognized the radical idea that what one eats connects people back to the farm. And even more than that, it is deeply intertwined with the politics, economics, ethics, technology and esthetic that go into growing food. Berry (1990) goes on to say that "how we eat determines, to a considerable extent, how the world is used" (p. 149). Technologies have a role in this since they connect people to the land. It is the technologies that open this awareness to nature and one's surroundings that will be more sustainable.

And of course, as Berry reminds the reader, eating is also a pleasurable act. Understanding the complexities of the food system that create the food deepens that pleasure. Most people do not feel connected to the processes that bring food to their table in the Lehigh Valley and elsewhere, but we, with Berry, consumers to recognize the whole interrelated system of food and how technology plays a vital role in this system. Though food and farming is at the core of this book, a sustainable food system also depends on health, fostering communities' economies and social structures as well as enhancing humans' connection to nature. We discuss these aspects in this final chapter.

The Health of Sustainable Food

In *The Omnivore's Dilemma*, Michael Pollan (2006) explains the history of America's mindset towards food. In 1977, Americans began changing their dietary goals, which meant less beef because scientific research supported the claim that too much beef is unhealthy. Later, Dr. Robert Atkins, a food scientist, educated the population about carbohydrates and weight gain. His research showed us that fat does not necessarily make you fat. This breakthrough changed the mindset of many Americans, says Pollan. He goes on, "So violent a change in a culture's eating habits is surely the sign of a national eating disorder" (Pollan, 2006, p. 2). The fact that diet fads hold so much sway over the population when it comes to food choice shows that Americans have a weak intrinsic understanding of what it means to be healthy. This demonstrates that Americans' values are disconnected from nutrition as well. If people wish to be healthier, they must rid themselves of laziness and cheapness in their easy-access grocery shopping. To have a food system that promotes health, people must look inwardly, moving their mindset toward food in a holistic direction. They must gain a better understanding of sustainable, healthy food production processes.

Creating a more holistic approach to the way people feed themselves has several advantages. First and foremost is physical health. If humans eat natural, unprocessed foods, they will be healthier. Consider the obesity problem in the United States. As quoted in an ABC News article about *King Corn*, a documentary about the current industrial agriculture system, which is widely comprised of corn, "Corn is in everything we eat and drink, from soda to beef, and it's fueling the nation's obesity epidemic" (ABC News, 2008). High-fructose corn syrup is a high calorie liquid—which comes from corn—that leads to health problems like diabetes and obesity. Other contributing factors to the obesity epidemic in America are toxins and pharmaceuticals (Guthman, 2011).

Taking a step back, it becomes clear that Americans have a generally cheap, industrial, efficiency-based approach to food. Pesticides and toxins increase crop output while high-fructose corn syrup is a cheap additive that makes processed foods and drinks sweeter. In addition to these obesity-causing chemicals, America has an overconsumption problem. Mark Winne, a leader in advocating for more food justice, says citizens "eat too much of the wrong things and too little of the right things" (Winne, 2008, xvi). This is another root cause of America's obesity problem.

In an effort to combat this problem, many researchers have written about the merits of naturally grown foods. For example, Berry (1990) writes that "the pleasure of eating should be an extensive pleasure, not that of the mere gourmet" (p. 151). He means that, as a consumer of food, humans should have an intimate connection to their food in order to get the most pleasure out of eating it. He elaborates, "A significant part of the pleasure of eating is in one's accurate consciousness of the lives and the world from which food comes. The pleasure of eating, then, may be the best available standard of [human] health" (Berry, 1990, p. 151-152). His connection between the pleasure of eating and people's standard of health is a profound metric. Berry's oft-quoted line, "Eating is an agricultural act," insists that we must understand food beyond simply the plate and fork. He implores people to think about where their meal comes from in order to fully comprehend and appreciate it.

A more concrete explanation on how people should eat comes from Michael Pollan. In his *New York Times* article, "Unhappy Meals," Pollan (2007a) urges readers to, "Eat food. Not too much. Mostly plants" (p. 2). "Food" in his quote means natural, non-processed foods, which are untouched by chemicals, and "Not too much" addresses America's overconsumption problem. Seven words, which seem easy to abide by, are much easier said than done for most people.

It is unethical for economic standing to inhibit one's ability to find healthy foods. Everyone deserves to be able to eat healthily. Unfortunately, even with the local food movement, this inequality is prevalent. Wealthier communities commonly have more healthy food options than impoverished ones. For one thing, healthier foods are more expensive than unhealthy fast food. The name for such an occurrence is a 'food gap.' Mark Winne writes, "A food gap can be understood as a failure of our market economy to serve the basic human needs of those who are impoverished. But poverty contributes to this gap, creating a situation in which a person or household simply doesn't have enough money to purchase a sufficient supply of nutritious things" (Winne, 2008, p. xvi).

It is unfortunate that America's dominant economic system is getting in the way of peoples' basic human needs to access healthy foods. In fact, our heavily consumerist market economy has led to a variety of social problems that affect health food accessibility. Teresa Marie Mares and Alison Hope Alkon, two food studies scholars, argue in "Mapping the Food Movement" that "The food movement's privileging of market-based strategies makes the alternatives they create and endorse less accessible to low-income communities and communities of color while conversely ignoring the ways that racial and economic privileges pervade both conventional and alternative food systems" (Mares and Alkon, 2011, p.69). These problems with local food highlight an elitist undertone to the movement, which is disheartening for poorer Americans who care about their health. In fact, a contributing factor to this problem is the issue of food deserts, mentioned in the last chapter. (Winne, 2008, xvi). Seemingly adding insult to injury, food deserts exclude destitute families from this food movement, in effect, widening this food gap further.

Enhancing communities through food justice and social connections

Obesity, food gaps, food deserts, and broader socio-economic problems highlight the health challenges of our domestic food system, one that is not just unsustainable environmentally, but culturally, too. Fortunately, a number of advocates are working to build systems to overcome these problems. First, there is the Community Food Security (CFS) approach, which Mares and Alkon (2011) summarize. They write, "CFS broadens the unit of analysis from individuals to communities, inviting more structural perspectives on the need for and value of alternative food systems… [Also] arguing that all communities should have access to safe, culturally acceptable, nutritionally adequate, and sustainably produced diets" (p. 69). CFS attempts to remedy the problem through improvements to food access and availability. Next is the food justice movement. "Food justice speaks to the multiple ways that racial and economic inequalities are embedded within the production, distribution, and consumption of food" (Mares and Alkon, 2011, p. 69). There are a number of actions these groups are taking, including creating alternatives such as farmers' markets, CSAs, urban farms, and co-op grocery stores in low-income communities.

Mares and Alkon, however, write about one caveat that many scholars have pointed out with these types of movements. Such movements "seek transformation through changes in individualised consumption practices rather than broader and more collective efforts" (Mares and Alkon, 2011, p. 69). This has been inadequate for altering individual food choice, so these authors point to communities' choices as a whole as a more effective target in improving the health of those too poor to afford expensive health foods individually. Similarly, Julie Guthman argues that "the current policy environment is a result of political choices, not consumption choices. Therefore, to make different political choices requires much more attention to the broader injustices that the cheap food dilemma rests on and perhaps less attention to what's on the menu. We cannot change the world one meal at a time" (Guthman, 2008, p. 194). Although consumption decisions have more impact than Guthman seems to suggest, our food choices today are a byproduct of a variety of political decisions, or decisions of our national community. Mass corn subsidies have led to the proliferation of corn-infused foods, which fuel the obesity epidemic in America. If we are to move forward in a healthy direction, we must change policies to allow this movement to happen.

Thus far, the food justice movement has been a grassroots one. As Mares and Alkon (2011) note, "Scholars argue that [we need to] invite citizens to reform or even transform the food system itself" (p. 69). This will ultimately happen, however, with the grassroots movement from beneath in conjunction with political policy reform from the top. Even so, there is one more factor that plays a role in the success of such food movements. This is the community itself.

As chapter 2 outlined, the community of the Lehigh Valley has a demographic with a variety of economic statuses, so it makes sense for food justice to be part of striving towards a more sustainable food system in the Lehigh Valley. A better food system would enhance the Lehigh Valley economically, while enhancing our region's social connections.

If the modern unsustainable food system is based on convenience, then a sustainable food system is based on community. Strong social ties are a vital part of sustainability, especially when it comes to food systems. Towards the end of his life, the scientist and environmental ethicist Aldo Leopold wrote that "there are two things that interest me: the relationship of people to each other, and the relationship of people to the land" (Forbes, 2003, p. 60). Leopold recognized that the way people interact with each other is tied to how people interact with the land. Strong community ties are necessary for a more sustainable food system to be put in place. And a more sustainable food system would foster a stronger community.

But what really is a community? Wendell Berry writes that "a community is the mental and spiritual condition of knowing that the place is shared, and that the people who share the place define and limit the possibilities of each other's lives" (Berry, 1969, p 61). The theme here is that community is about sharing. Sharing a common place brings a community together. For us, that common place is the Lehigh Valley. And it is the people within a community who set the rules and expectations for each other to live by so a community should share common principles and ideas.

A more sustainable food system would make social ties in the Lehigh Valley stronger because people would have to be more reliant on each other. For example, farmers would have to share technology in order to use it more efficiently and share ideas to provide food for the Lehigh Valley in a sustainable way. Before advanced farm equipment, neighbors used to come together for tasks like barn raisings and corn husking bees. These were things too difficult to do alone but for a community, the work was quick. Many food related technologies are discussed in earlier chapters, but for them to be implemented requires strong community support. For example, the community could come together to build greenhouses in the way the community of the past came together for barn raisings.

For a community looking to build a more sustainable food system, social ties between the people in the community are a strong asset. Another vital asset is the ethics that define the culture of the community because like community, ethics and culture are also vital parts of creating a sustainable food system.

Ethics and the relationship between humans and nature

Where does food come from? It comes from the land, which is fertile from the nutrients of other plants and animals. There are bees that pollinate, birds that eat pests and worms that enrich the soil. Food comes from the earth and it would not be possible without many other processes in nature that take place out of the sight of humans. Food comes from the hands of the people that work the land, pick the fruits of their labor and process or sell their raw goods. Nature has the systems for growing food in place, but it is humans who must use technology to work within nature to bring food to the table. A conversation on sustainable food systems would be lacking without including the biosphere and how humans interact with nature.

Though farming in the Lehigh Valley has diminished dramatically in recent decades, the Valley has long been a great place for farming and farmers' markets. It would not be impossible to move towards more emphasis on farming and food issues, but it must be done in the right way. Food issues in the Lehigh Valley cannot be solved with technology alone, but it is possible if people think about how technologies relate to the connections between humans and the land. And this, along with an understanding of health, economics and society, must also come with an understanding of nature and the interactions of humans within and as part of their environments. As chapter 7 discussed, this requires cultural and policy changes brought about by ideas and ethics.

There are technologies that hold up the modern unsustainable food systems, but as Berry points out, "food is a cultural product; it cannot be produced by technology alone" (Berry, 1977, p. 43). Problems with the technologies of big agriculture that relate to producing, distributing and consuming food are not simply problems of design. These technologies are set up by a system that aims to make food more convenient by increasing humans' control of nature too far. David Orr proposes that Americans have become "technological fundamentalists" because of an unwillingness and inability to question these assumptions about how technology relates to larger purposes (Orr, 1994, p. 2). Technology must be seen as part of a larger system, even as the modern food system has innate flaws because it makes it harder for humans to connect with nature. In addition, these flaws of health problems, inefficiency, and reliance on fossil fuels lead to other environmental problems. The problems might be considered technological side effects but are actually quite significant. Orr comments that technological side effects are the result of "buying only convenience, speed, security, and affluence" (Orr, 1994, p. 3). It is these characteristics that are celebrated in modern American culture, but that does not have to be the case.

Technology is a major part of how humans interact with nature. However technology is not necessarily the cause of environmental problems since technology is created by a society and a culture rather than the other way around. of the modern food system cannot be solely blamed on the technologies that have made modern farming possible. But with that said, the way technology is designed and used is a choice and choices can be made to allow technology to be part of the solution of creating a more sustainable food system in the Lehigh Valley.

Nature has intrinsic value. The environmentalist Aldo Leopold argued in his essay "The Land Ethic" that there should be an ethic relating humans to how they interact with the land. Leopold proposes the idea of a land ethic which "enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land" (Leopold, 2013, p. 172). This ethic, from the 1940s, was and still is a radical proposal because what he really means is that humans are wrong to consider themselves as conquering and reigning over the land. Instead, humans are mere members and should show respect for the rest of the community. This land ethic is necessary because environmental problems and food issues reveal flaws in the status quo relationship between humans and the land.

A century before Leopold wrote his land ethic, Henry David Thoreau spent two years at Walden Pond exploring similar issues. He built himself a one-room cabin, toiled on the land growing beans and searched for a deeper relationship with nature. Walden had a great influence on Thoreau and influenced his idea that: "In wildness is the preservation of the world" (Thoreau, 1861, p. 13). Though Thoreau created this radical lifestyle for himself at Walden, he was not exactly living a life in the "wild." He was less than a mile from town, close to train tracks and near farmland and other landowners. Here Thoreau worked to strengthen his connection with nature without completely removing himself from society and culture. However, Thoreau recognized that wildness was not a place with certain characteristics, but rather an idea.

Walden could have been just another little pond in Massachusetts, except that it was here that Thoreau allowed himself to develop a relationship with the natural world around him. He found wildness in Walden, a seemingly non-wild place. When Thoreau calls wildness the way of preserving the world, he is promoting a way of thinking that puts humans as part, rather than controllers, of nature. Years later, Leopold wrote his land ethic proposing a similar idea.

The results of missing the lessons of Leopold's land ethic and Thoreau's idea of wildness are that Americans have forgotten how to live in and as part of nature. One result of this is that Americans tend to be "eating thoughtlessly," to quote Berry (1977) again (p. 38). This means eating without understanding everything it took to produce that food. This is a crisis of a culture that ignores the land ethic and wildness.

It is possible to make changes towards a more sustainable food system in the Lehigh Valley based on technological and infrastructure changes, but for the food system to really be changed, there must be a cultural shift to some degree.

Scott Nearing, an early supporter of the back-to-the land movement, wrote in 1965 that "It is no more possible to separate humanity from its environment than it is to separate trees from the earth in which they grow…Man and his environment are two parts of one totality" (Forbes, 2003, p. 68). Those who live in the Lehigh Valley are citizens of the nature of the region as well as its governments. In working towards a more sustainable food system, we should recognize the deep cultural ideas holding in place the modern food system and all its environmental, health and social problems. As we have shown in chapters 3 through 6, many technologies relate to the growing, distribution and consumption of food, as well as infrastructure putting economical and political support systems in place that can help strive for a more sustainable food system in the Lehigh Valley. For a lasting and successful change, though, we will require more than that. We will have to make a shift of emphasis, one that goes away from consumerism, convenience and affluence and towards health, relationships between humans, and humans' relationships with nature.

Residents of the Lehigh Valley can benefit from Berry and Leopold's ideas for creating a culture that could better support a sustainable food system. Their ideas can teach the Lehigh Valley community how to build a healthier relationship with food and nature. In the end, a cultural shift is worth it because eating is indeed a pleasurable act.

Conclusion

As Michael Pollan writes in *Second Nature,* "the gardener does not take for granted that man's impact on nature will always be negative" (Pollan, 2007b, p.193). Being a gardener of the land is about finding balance between the needs of humans and the realities of nature. A good gardener will take advantage of technologies to aid in food production, efficiency and distribution. A good gardener will advocate for policies that build infrastructure to support these technologies and make sure that the benefits of healthy sustainable food reach all of her neighbors. And a good gardener understands that a cultural shift within her community would be a main driver in ensuring that the technologies and policies are put in place as best as possible to support a sustainable food system.

The Lehigh Valley has the benefit of having many good gardeners, farmers and stewards of the land already. Gardening and farming are also states of mind. Some of these gardeners and farmers grow food while others grow community, businesses and education. The tables have been turned in the Lehigh Valley as more people are coming to demand a sustainable food system. Now with everything that we know, the question is, how are we going to set the table?

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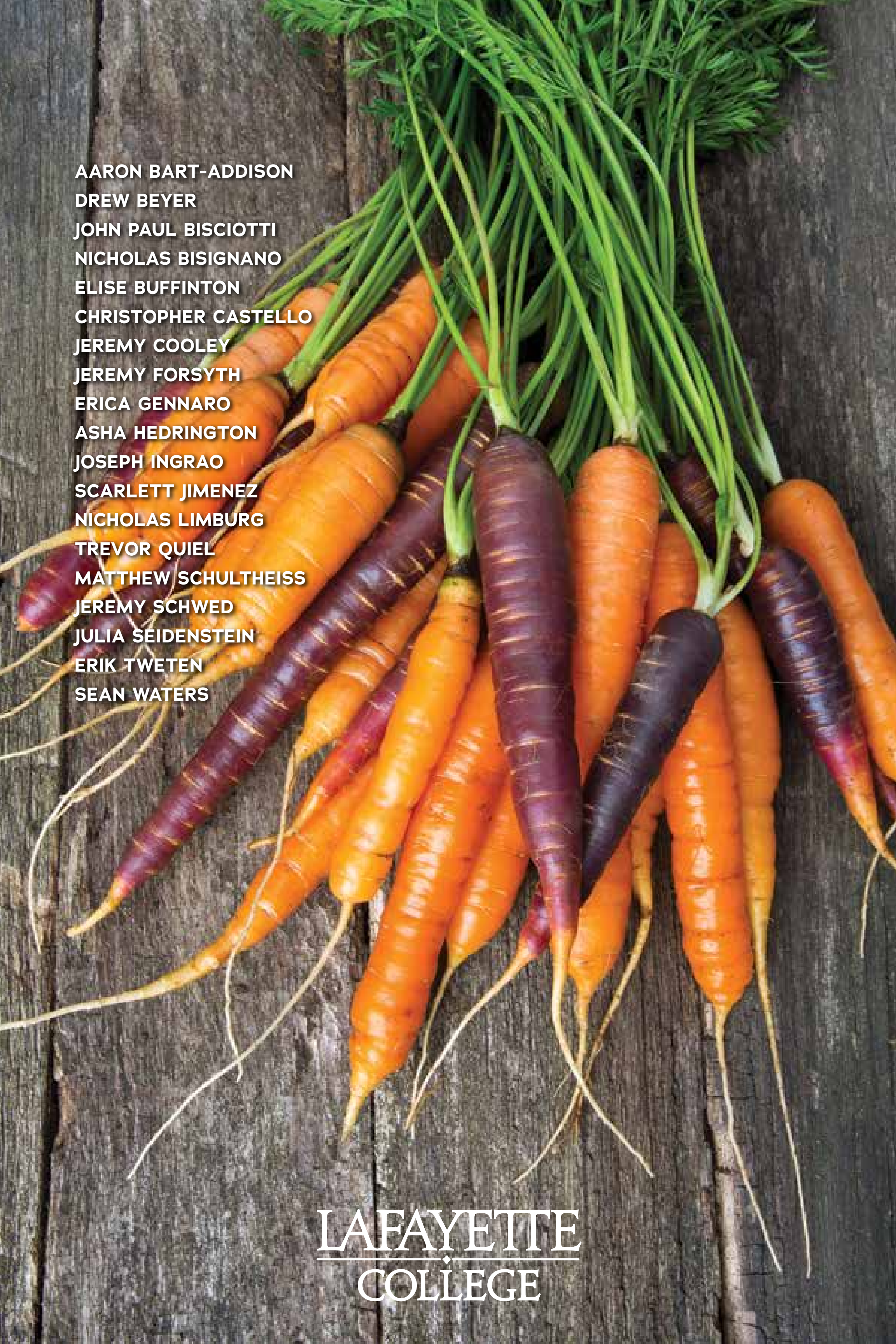

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