

**Local Farmers and Food Distribution in North Carolina:
A Three-Pronged Approach in Support of the
Southeastern North Carolina Local Food Systems (SENCFS) Program**

Laura Cloak, Deidre Ledford and Nicole Tocco

Dr. Chantal D Reid, *Dept of Biology and Nicholas School of the Environment*

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Abstract

Local food production has the potential to decrease environmental impacts of the modern globalized food system, stimulate local economic development and strengthen communities. To enhance SENCFS's ability to foster such economic and community development through a regional food system, our team examined key barriers encountered by farmers and institutions to engage in a regional food system. First, we surveyed farmers and examined the current certification process to identify the main barriers small, limited-resource farmers face in acquiring the Good Agricultural Practices (GAP) certification. We recommend that SENCFS provide informational guidance and resources to small farmers throughout the entire GAP process. Second, to advance successful farm to school programs, we interviewed area Child Nutrition Directors to identify barriers between farmers and schools and reviewed successful programs around the country. Given these barriers, we recommend that SENCFS provide informational guidance to Child Nutrition Directors and focus lobbying efforts on increased federal and state funding for local produce purchases. Lastly, as a possible recruitment tool for food service companies operating in the area, we used Life Cycle Assessment (LCA) to quantitatively compare environmental impacts of sourcing options for sweet potatoes. The results of the LCA demonstrate the vast potential a local food system has to assist Food Service Companies meet their stated social and environmental goals when conservation agriculture is supported.

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Part 1. Introduction

Within the mainstream American food system, farming communities, particularly those comprised of small farms, are suffering economically. This is a result of many factors, including falling food prices and lack of access to markets. In addition, the current food system contributes significantly to current environmental problems through intense fossil fuel dependence, homogeneity and use of synthetic chemicals. Farming communities serve as a potential source of rural and urban revitalization in difficult economic times, as well as the foundation for an environmentally sound food system.

1.1. History and Trends of the Mainstream American Food System

As the food industry has grown regionally, nationally, and globally since the early 1900s, the economics of the industry as well as Americans' relationship with food and farming have changed significantly. One hundred years ago, much of the food bought and consumed in the United States was grown within the local community or region. The amount of money spent on food returning to the farming community was 40 cents per dollar. Communities gained knowledge of and confidence in the quality of foods through direct relationships with farmers, as nearly 40% of Americans lived on farms. Today, however, this figure has dwindled to 1% (Martinez, et al., 2010). Consumers now receive most information about the food they consume through packaging and third party certifications. Food is increasingly processed between farmer and consumer to increase the shelf life of products and allow for long distance transportation. Within the United States, food travels an average of 2,500-4,000 kilometers from the farm to consumers' plate; furthermore, the amount of food shipped between nations has grown fourfold over the last 40 years (Halweil, 2002). Money spent on food products is spread thin along this growing supply chain. The amount of money spent on food that returns to the farming community has since plummeted to 7 cents per dollar. The remainder goes to middlemen such as processing, shipping, brokerage, advertising and retailing firms that continue to consolidate and develop control over the industry (Smith, 2002).

In search of efficiency, fewer and larger producers work with fewer processors in this global industry, thereby isolating small farms. Unable to remain economically viable due to the increasing concentration of the industry, small and mid-sized farms are rapidly going out of business (Winne et al., 1997). Between 2002 and 2007, the number of mid-sized farms in the US decreased by 80,000 and it is predicted that mid-sized farms could disappear within a decade. Simultaneously, the largest farms are increasing in size. One estimate suggests that 6% of US farms now produce 75% of agricultural products (Harvie & Steffey, 2010).

Many proponents defend the current food system because of its efficiency and resultant low prices. However, it is important to consider the difference between price and cost. The current system is economically efficient and offers the lowest price to the extent that environmental and social costs are ignored. Food shipped around the world in refrigerated transportation units, packaged in layers of plastic and grown on huge-scale, industrial farms is artificially cheap. Subsidies for fossil fuels, transportation infrastructure, and commodity production are not included in the price of food. Additionally unaccounted for are a number of environmental externalities, such as pollution.

Perhaps the most notable environmental cost is the current food system's use of fossil fuels, which contributes to emissions of greenhouse gases. Fossil fuel use is rampant in the production of farm inputs such as fertilizer and pesticides, as well as farm machinery. In addition to mechanization on the farm, food travels an average of 1,546 miles from conventional farms to its destination (Pirog et al., 2001). Perishables, including fruits and vegetables, constitute the fastest growing segment of the food cargo business and are increasingly shipped by refrigerated planes, the least energy efficient form of transportation. A transcontinental head of lettuce shipped from California to Washington, D.C. requires 36 times as much fossil fuel energy for transport as it provides in food energy to the consumer (Halweil, 2002).

1.2. Local Food Systems

The potential for increased economic activity through local or regional food systems is enormous. Local food systems are developing in response to concerns about the negative economic, cultural and environmental impacts of America's mainstream food system. They seek to utilize small-scale agriculture to strengthen communities and develop local economies. Collectively, local food systems are part of a broader local food movement, "a collaborative effort to build more locally-based, self-reliant food economies – one in which sustainable food production, processing, distribution, and consumption are integrated to enhance the economic, environmental, and local health of a particular place" (Feenstra, 2002). The movement is gaining momentum with support from a wide range of people and interest groups, including those interested in food security, environmental issues, the slow food movement, and public health (Petrini, 2005; Hinrichs & Lyson, 2007; DeLind, 2010).

Demand for local food is increasing, particularly through alternative marketing channels. "Local food" is typically defined by factors such as geographic proximity, population density, political boundaries, and farming practices. In addition to these factors, local foods are often available through alternative markets. These markets include community supported agriculture, farmers' markets, roadside stands, u-pick operations, community gardens, and direct sales by farmers to local restaurants, grocery stores and institutions (Hughes et al., 2007). Demand for local food within these markets in the US has increased over the past two decades. This is demonstrated in part by the increasing numbers of farmers' markets and farm to school programs. The number of farmers' markets rose to 5,274 in 2009, up from 2,756 in 1998 and 1,755 in 1994 (USDA AMS, 2010). The number of farm to school programs increased from 2 in the 1996-97 school year, to 400 in 2004 and to 2,095 in 2009, according to the National Farm to School Network (2011). Data from the 2005 School Nutrition and Dietary Assessment Survey, sponsored by USDA's Food and Nutrition Service, showed that 14 percent of school districts participated in farm to school programs, and 16 percent reported having guidelines for purchasing locally grown produce (Martinez, et al., 2010).

Consumers are motivated to support ‘local food’ for various reasons. Some motivations include the food looking and tasting fresher, being of higher quality, and containing higher nutritional value (Zepeda & Leviten-Reid, 2004). Consumers also associate local foods with enhancing the local economy while also benefitting the environment, which preliminary research supports by demonstrating that the expansion of local food systems can increase employment and income in a community (Martinez, et al., 2010).

When food stays within the region in which it was produced, less fossil fuel is required in its processing and distribution. Therefore, an additional benefit of a local food system is a reduction in transportation-induced greenhouse gas emissions. (Pirog et al., 2001) found that a regionally sourced meal uses 4 to 17 times less petroleum consumption and creates 5 to 17 times less carbon dioxide emission than a meal sourced from a conventional food chain. Another study found that a basic diet consisting of meat, grain and produce with ingredients from domestic sources reduces energy usage and greenhouse gas emissions four times over those of an equivalent diet with ingredients from imported sources (Halweil, 2002). Local food systems can, therefore, help counter the ecologically destructive global trends associated with monoculture and long distance transport.

1.3. Quantifying Benefits of Local Food Systems

The economic benefits of strengthening communities and local economies through local food systems are beginning to be quantified. For example, a statewide task force in Illinois set out to estimate the potential economic impacts of their local “farm-and-food development strategy.” The taskforce determined that a 20% increase in the amount of Illinois-grown food purchased within the state could potentially create thousands of jobs and trigger \$20 to \$30 billion in new economic activity each year. The taskforce felt confident that the new jobs would be secure over time because "the business of creating and maintaining all the links in the local supply chain - aggregating, processing, packaging, storing and transporting products - translates into jobs that cannot be outsourced" (Community-Minded Enterprises, 2009).

Other studies have demonstrated that the expansion of sourcing and processing of local foods can fuel economic development in rural areas (Ross et al., 1999; Marsden, Banks, & Bristow, 2000); Swenson, 2009). Additionally, communities able to do some of the processing and distribution of food under local ownership will multiply the economic benefits of those efforts. When food is shipped distantly, only a small amount of the economic value of the food itself is maintained in the local community. The more that these intermediary services (i.e. processing, packaging, etc.) are provided within the community, the higher the economic benefits to that community will be. Communities that maximize the supply of locally sourced foods and internalize processing and distribution of local foods show improvements in their local economy, which include creating jobs, raising incomes and supporting farmers (Halweil, 2002).

The local food movement continues to gain momentum and this recent growth is encouraging for its future. However, difficulties exist in developing and maintaining each component of a food system to build a strong local economy.

1.4. Barriers to Economic Viability

Barriers to economically viable local food systems exist for both small producers and institutional purchasers. Capacity of local food systems is constrained by a lack of infrastructure, limited farmer expertise in some aspects of business and marketing, and regulatory restrictions. Small-scale farmers also often have difficulty fulfilling large orders demanded by mainstream markets. Additional challenges include: providing consistent quality throughout the seasons and making regular deliveries (Martinez, et al., 2010).

Direct-to-consumer channels for food sales, such as farmers markets and community-supported agriculture, are growing but remain an extremely small market segment (Martinez, et al., 2010). Institutional and other wholesale buyers are a potential source of consistent, substantial demand but there are many factors that prevent them from sourcing from small, local farms. For example, Good Agricultural Practices (GAP) certification is a voluntary program increasingly required by institutional buyers, including all public schools. Obtaining GAP certification currently serves as a serious challenge for small farms when trying to reach mainstream markets.

In addition, given the lack of infrastructure able to support a food system with many small farms, it is currently easier and more efficient for food service companies to source from fewer, larger farms. Small farms are often not able to aggregate their products and lack the time to communicate with buyers and get their product to market. In 2009, small and limited resource farmers in North Carolina reported that marketing was one of the areas where they need the most assistance (Bullers et al., 2009).

1.5. Client and Project Objectives

1.5.1. Southeastern North Carolina Food Systems Project

The Southeastern North Carolina Food Systems (SENCFS) Project was established in 2006 to address economic development in Southeastern North Carolina through support of a regional food system. The eight counties in the “Down East” region shown in Figure 1- Robeson, Bladen, Columbus, Brunswick, New Hanover, Pender, Duplin and Onslow – could benefit from expansion of the regional food system, as high unemployment and poverty rates exist alongside strong agricultural traditions (Bruno R. H., 2009a; Southeastern North Carolina Food System Council, 2010).

Through a regional food system, the SENCFS project will connect small and medium sized, limited resource farmers to local markets. This will aim to increase the production, distribution and consumption of local foods in Southeastern NC and, thus, increase the economic viability of small farms in the region. In pursuit of this mission, SENCFS has developed into a partnership with public and private institutions and agencies within the aforementioned counties (Bruno R. H., 2009b).

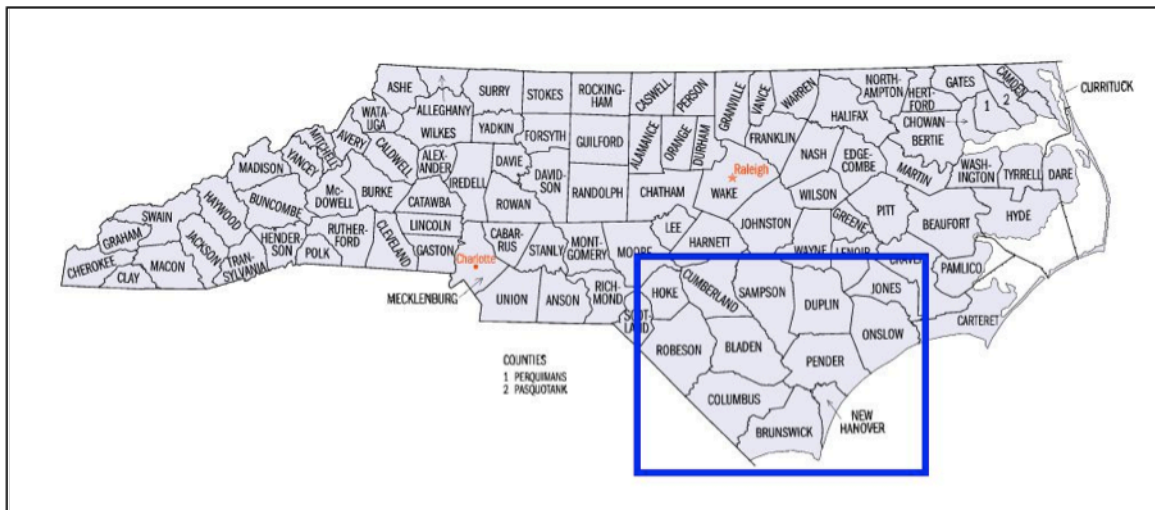


Figure 1. Map of North Carolina, highlighting the 8 counties in SENCFS target region in box insert (CarolinasGolfCourses.com, 2010)

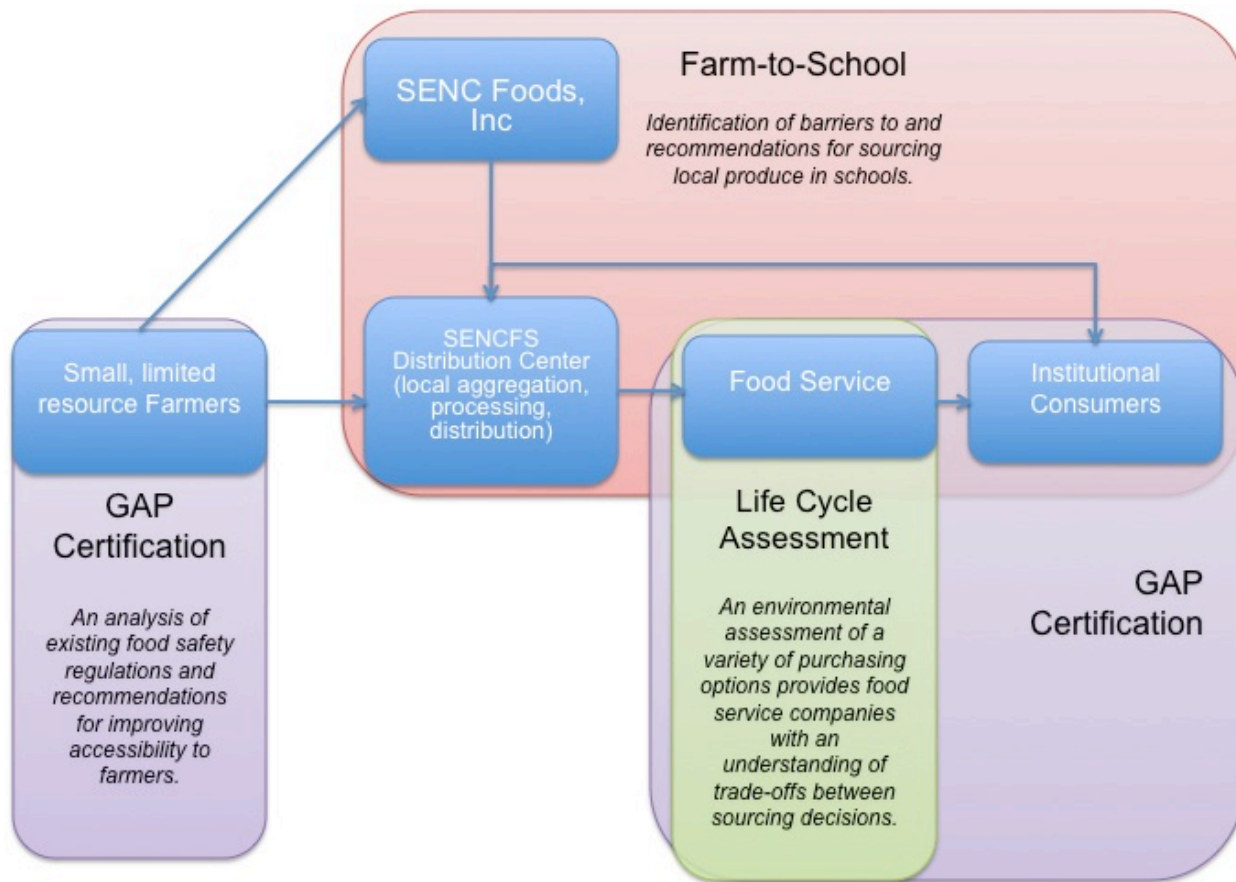


Figure 2. Project Framework. This figure shows the connection throughout the supply chain of the SENCFS regional food system. Red, purple and green boxes represent the three major themes of this project in the context of the portion of the supply chain to which they apply.

Figure 2 shows a simple version of the food supply chain as it relates to SENCFS and to the major themes of this project. This figure depicts the movement of food from small farms, through SENCFS's distribution, production, and aggregation center, to food service companies and lastly as it reaches institutional consumers. In order to be effective, SENCFS and its allies must provide support to each link of this chain within the region. The role that SENCFS seeks to play in this system is as a facilitator, helping farmers gain access to mainstream, local markets, which is currently difficult and cost prohibitive for small farmers to do.

One of the channels through which farmers reach these institutions is via food service companies serving schools, universities, hospitals and army bases in the region. One barrier that small farmers face when trying to break into mainstream markets is lack of access to an affordable processing center that meets government standards. Small farms also need a mechanism to combine their products with those of other farms so that the quantities are large enough to fill orders for these buyers. In response to these barriers, much of SENCFS time and resources over the last 3 years has gone towards the launching of a regional distribution and processing center opened March 2011 and is available to farms and small businesses. In addition, SENC Foods is a farmer cooperative that SENCFS founded to facilitate the relationship between farmers and buyers. The cooperative will be particularly helpful to schools, an institutional consumer that does not necessarily need to source through food service companies.

Our project provides support to SENCFS along many different points within this system. First, we examine the options that food service buyers have at their disposal and quantify the environmental impacts and tradeoffs between those choices. This analysis demonstrates some of the potential environmental benefits that a local food system offers. Secondly, we examine the role that food safety regulation plays in this system. Food safety regulations often serve as a barrier that small and limited resource farmers face when trying to reach mainstream markets. In particular, our research focuses on GAP certification, a voluntary standard increasingly required by wholesale buyers and a serious challenge for small farms. Lastly, our project closely examines at the relationship between SENCFS distribution center and schools. Our research

identifies barriers that schools face in sourcing locally and addresses those barriers with recommendations for future action.

We believe the information and recommendations on these three important issues, based on extensive analyses and research, will be useful to SENCFS in focusing their efforts where significant potential exists to strengthen the regional food economy. These particular areas of focus were selected due to their potential to multiply benefits to the regional food economy.

1.5.2. Objectives

SENCFS is working towards a tipping point or threshold at which the barriers are sufficiently decreased for all parties to participate in a local food economy. This project provides an in-depth understanding of barriers faced by three different participants and recommendations to alleviate these barriers. Given that (A) Good Agricultural Practices (GAP) protocols were written principally for large farms, and barriers exist for small farm operations to achieve the same certification; (B) consumers and institutional buyers of food need to evaluate tradeoffs between local sustainable and industrial organic attributes in their purchase making; and (C) local school institutions are ideal partners for local sustainable food consumption and education about nutrition, our project seeks to:

- A. Quantitatively compare the environmental impacts of a variety of procurement scenarios for sweet potatoes using Life Cycle Assessment (LCA) for use as a marketing tool;
- B. Determine barriers to small farms to pursuing and obtaining GAP certification through analysis of data collected through farmer interviews, existing food safety guidelines, and the currently available resources to educate farmers, and recommend solutions to improving resources to educate and guide farmers through the process;
- C. Identify barriers and develop recommendations to implement Farm to School initiatives in the 8-county southeastern NC region to incorporate institutional buyers who have a consistent demand for food into the community food system.

Part 2. Life Cycle Assessment: Sweet Potatoes

To address the environmental impact of food production and explore the potential environmental benefits of a local food system, we conducted an evaluation of environmental tradeoffs between procurement options from the perspective of a food service provider. Given that North Carolina produces near 45% of U.S. sweet potatoes and many of the top sweet-potato producing counties are located in and near the SENCFS region (North Carolina Sweet Potato Commission, 2010), the evaluation focused on procurement options specifically for sweet potatoes.

2.1. Methods

Studying the environmental impact of products and processes has become increasingly important to consumers and businesses; over time, a number of useful frameworks have emerged. Life Cycle Assessment (LCA) is one such tool that assesses the environmental impact of a product beginning with raw materials and ending at the time those materials are disposed of or recycled. This approach, often referred to as “cradle-to-grave,” evaluates the many stages of a product life. As a result of its inclusivity of the entire life cycle, it often includes indirect impacts not considered in other assessments (Scientific Applications International Corporation, 2006).

LCA provides an environmental assessment of the impacts associated with a product, process, or service through: the compilation of an inventory of energy and material inputs as well as environmental “releases”; an evaluation of the environmental impacts associated with those inputs and releases; and an interpretation of the results to aid in informed decision making. Using this tool, I compared the environmental impact of a sweet potato from sourcing options that vary based on farming practices and farm location. This life-cycle assessment was developed with consideration of issues and background information described in (Mogensen et al., 2009).

2.2. Purchasing Decisions: Local versus Organic

Environmental and socially conscious consumers and businesses have much to consider when attempting to supply food from responsible sources. One debate within the alternative food community is the decision between prioritizing local food items or USDA certified organic food items. The issue is extremely complex; the debate is full of positive social and environmental intentions but has proven difficult to quantify.

SENCFS is in the process of engaging food service providers in the regional food economy. The results of the assessment will serve as a foundation for understanding the tradeoffs between different sourcing decisions in terms of environmental impact. As food service companies seek to meet stated social and environmental goals through its operations, the assessment will serve as a useful tool for SENCFS to demonstrate the potential environmental benefits of local sourcing.

2.2.1. Local Foods

Advocates for local foods claim a plethora of environmental, social and economic benefits of purchasing food grown within the region of consumption. The environmental components of this argument are vast and interconnected with other social aims. First, shorter transportation distance and less processing of food products reduce energy use in the system. Secondly, farmers that own small to medium sized farms and sell to nearby markets are more likely to be better stewards of the environment. Small farms often use environmentally friendly practices, such as integrated pest management techniques, but do not have the resources to meet all the requirements of or obtain official organic certification. Lastly, the shorter supply chain associated with local foods addresses increasingly pertinent food safety issues. Many of the other benefits of local foods are discussed throughout this paper.

One argument against the validity of the benefits of local foods utilizes the concept of “food miles” as one that should bear much weight. Often, this argument is based around research demonstrating that greenhouse gas emissions associated with food are dominated by the production phase of food product, contributing 83% to the average US household’s footprint for food consumption. Transportation as a whole represents on average 11% of life cycle greenhouse gas emissions and final delivery from producer to retail contributes only 4% (Weber

& Matthews, 2008). Therefore, decreasing the distance that food travels from “farm to plate” may not make a significant impact on that food’s environmental footprint.

However, it is important to consider that local foods are not valued solely for their proximity, but also for other attributes associated with them. Farms that sell to local markets tend to be small- to medium sized farms and produce a diverse variety of appealing foods – distinctly different from the massive amounts of commodity crops such as corn and soybeans that take up an increasing percentage of American farmland (Martinez, et al., 2010). The term ‘ local’ in and of itself does not capture these attributes. Increasingly, many other attributes are associated with local foods. One study done by the Institute of Grocery Distribution found that food service and retail professionals thought the most important reasons for buying local were freshness, supporting local producers, environmental concerns, and taste (Institute of Grocery Distribution, 2006). Similarly, Edward-Jones et al. (2008) agree that food miles are a poor indicator of the environmental and ethical impacts of food production but that many interests of consumers, such as supporting local farmers and supporting their regional economy, are difficult to quantify into a ‘food miles’ approach to the issue.

2.2.2. Organic Foods

Farms certified under the USDA Organic certification do not use any synthetic chemicals, fertilizers, hormones or antibiotics (USDA, 2010). Because the production of fertilizers and pesticides are a substantial contributor to the ecological footprint of some farm products, this is likely to have a noteworthy impact on any quantitative environmental assessment. In addition, organic certification guarantees that no synthetic chemicals are applied onto farmland, which translates into the potential health benefit of not consuming pesticide residue inadvertently.

During its growth over the last 10 years, the USDA Organic certification has become part of the long-distance, industrial food system in many ways. The organic movement sought to an array of ideals, such as small-scale production, community engagement, and ecological stewardship. Over time, the certification has shifted toward one that focuses primarily on one aspect of ecological stewardship: elimination of synthetic chemical use. As a result, much of the organic sector today has changed significantly from its original intentions to a corporate model of large industrial farms serving distant markets. Many of the original small companies focused on

organic ideals have since been purchased by some of the largest food processors (Johnston et al., 2009).

Economic and environmental tradeoffs between organic food products and local food products are difficult to quantify. My literature search did not reveal any studies attempting to compare industrial organic to small-medium local farm products through quantitative analysis. There are, however, a number of studies that used life cycle analysis (LCA) as an environmental assessment tool for farm products. The findings of each of these studies differed depending on the authors' focus, but served as a foundation for understanding methods for quantifying agriculture production. These studies included life cycle assessments of sugar beets (Tzilivakis et al., 2005), potatoes (Mattsson & Wallen, 2003), apples (Jones, 2002; Mouron et al., 2006; Canals, et al., 2005), soybeans (Knudsen et al., 2010), pears (Liu et al., 2010), and lettuce (Hospido et al., 2009). Some focus on comparisons between organic and conventional agriculture, while others focus on identifying the "hotspots" or high impact areas of one agricultural supply chain.

2.3. Goal and Scope Definition

This life cycle assessment is intended to address some of the options that buyers face when attempting to make environmentally responsible purchasing decisions. Life Cycle Assessment is increasingly popular environmental decision as the private sector attempts to quantify the benefits of purchasing decisions or generally understand the environmental impact of the company's supply chain.

Given the prevalence of sweet potato farming in North Carolina, the assessment will evaluate four purchasing options for sweet potatoes. Therefore, this assessment seeks to address the following question: as a food service provider in New Hanover County of North Carolina, what is the environmentally preferable choice between the following four scenarios: a sweet potato grown conventionally within state; a sweet potato grown organically 3000 miles away; a sweet potato grown conventionally 3000 miles away; and a sweet potato grown in state on a diverse farm using a variety of low-input, sustainable agriculture techniques.

2.4. Specifications of the Model

In comparative studies, the choice of functional unit is crucial because it is used as a basis for comparison. The functional unit for this study is a hundred-weight (cwt) of sweet potatoes. This was chosen as the functional unit based on its use by the North Carolina Sweet Potato Commission in describing commercial growing recommendations.

2.4.1. Scenario 1: Local, Eco-efficient, Small, Diversified Farm

This scenario represents a small, sustainable farming operation that prioritizes low environmental impact and conservation of natural resources. The scenario is inspired by the farming practices of Fickle Creek Farm (2010), a 145-acre farm in Orange County, North Carolina. The farm is extremely diverse and includes vegetable gardens, laying hens, broiler chickens, sheep, steers and pigs. The farm management is focused on nutrient cycling, agroforestry, water conservation, rotational grazing of farm animals, native plants and permaculture.

This scenario incorporates the aforementioned positive aspects of small scale farming as well as potential downsides. For example, one potential environmental downside of a food system in that sources food from many small farms instead of fewer, larger farms is the difference in transportation. Many small farms require many small trucks to move the farm products from the farm gate to an aggregation location. Thus, the fuel consumption per unit sweet potato is higher in this situation (assuming mostly full trucks) than when sourced from fewer places in larger trucks, which have higher fuel efficiency per unit of weight. This assessment compensates for that consideration by using a significantly smaller truck (16 ton) in Scenario 1, which incorporates the lower carrying efficiency of the smaller vehicle into the analysis.

Table 2.1. Scenario 1: Detailed Description and Assumptions

	Description	Assumptions needed	Reference
Location	Sampson County, NC		
Yield	Estimated to be the same as the average North Carolina sweet potato farm	Yield for sweet potatoes is not measured on Fickle Creek Farm; this assumption based on estimation by Ben Bergman (2011)	Email correspondence with Ben Bergman, Fickle Creek Farm (2011) NCDA&CS (2010)

Fertilization	Crop and animal rotations, compost application. Compost made on site from discarded biomass and farm animal manure. The manure and other materials are passively composted in the farm's greenhouse and spread on fields before planting and twice during the plant's growth. Cover crops are strategically planted in order to restore nutrients to the soil and to conserve organic matter in the soil during non-cultivation periods.	Total Compost: 1.85 lbs per cwt Based on fertilizer application rates recommended for conventional farms in North Carolina. Assumes 80% P, 90% K and 50% N are available in the compost the first year after application.	Nutrient management on farm information: interview with Stancombe & McGill (2011). Fertilizer recommendations: North Carolina Sweet Potato Commission (2010) Nutrient availability: Rosen & Bierman (2005)
Pest Management	Integrated Pest Management techniques utilized; manual labor used to remove weeds in and around the sweet potato fields. Crop rotations used to minimize the transfer of disease.		
Machinery Use and Fuel	Machinery is used minimally on the farm. Tillage is performed on fields before planting to remove rocks and a small cart is used to bring sweet potatoes from the field to the curing area after harvesting. The farm machines are fueled by Piedmont Biofuels, which creates biodiesel using recycled vegetable oil from local restaurants.	Assumed to be approximately 10% of fuel use of average US potato farm; The biofuel type is assumed to be reused vegetable cooking oil from waste, converted to biofuel. The conversion is accounted for.	For machinery fuel use: Pimentel & Pimentel (2008) 10% assumption based on interview with Stancombe & McGill (2011)
Watering	Drip irrigation is used as a method to maintain a steady supply of water to the sweet potatoes while conserving local water resources. Drip irrigation is one of the factors responsible for the comparable yield of this farm as compared to the convention North Carolina farm, without the use of pesticides.		Interview with Stancombe & McGill (2011)
Curing	Sweet potatoes are cured	The materials used to	Interview with Stancombe

	passively in the farm’s greenhouse after cultivation. This requires no electricity or energy use except for direct solar energy.	build the greenhouse were not included in this assessment.	& McGill (2011)
Transport (Farm to Aggregation)	Sweet potatoes are transported from the farm to the aggregation point in a 16 ton truck; total distance 51.7 miles.		

Table 2.2. Bill of Materials for Scenario 1, showing inputs that constitute the scenario. The following show the basic inputs to SimaPro 7.2 software, divided into Materials and Processes.

SimaPro 7.2		product stage	Date: 3/16/2011	Time: 3:09 PM
Project		Nicole's final project		
Assembly:				
Name				
Scenario 1: Local, Eco-efficient				
Materials/Assemblies				
Compost, at plant/CH without energy input U		1.425 lb	Undefined	
Vegetable oil, from waste cooking oil, at plant/CH WITH US ELECTRICITY U		2.88733 oz	Undefined	
Processes				
Truck 16t		1.6254 tkm	Undefined	
Truck 40t		5.0694 tkm	Undefined	

2.4.2. Scenario 2: Domestic Organic Farm

This scenario is based on a large farm that operates by USDA Organic Certification farming standards. These practices prohibit use of synthetic fertilizers and pesticides and are intended to integrate “cultural, biological and mechanical practices that foster cycling of resources, promote ecological balance and conserve biodiversity” (USDA AMS, 2011). The practices of farms certified under the USDA Organic standard differ significantly. However, this scenario assumes

a large farm that abides by the standards of the certification but does not perform environmental stewardship beyond what the standard requires.

Table 2.3. Scenario 2: Detailed Description and Assumptions

	Description	Assumptions needed	Reference
Location	Merced County, CA		
Yield	25% less than a conventional sweet potato farm in California	Data on yield of sweet potatoes on organic farms in California was not available. Given that data on differences in yield between conventional and organic sweet potatoes was not available, the differences in yield between sweet potato production and potato production are assumed to be comparable.	Difference in yield: Maggio et al. (2008) Based yield taken from California average: USDA NASS (2011)
Fertilization	Nutrients from a mixture of crop rotation and composted organic material. Compost is assumed to be a mixture of farm animal manure and other biomass, heated to the appropriate temperature using electricity, from a US Life Cycle Assessment Database (US EI 2.2).	Total Compost: 1.46 lbs per cwt Based on fertilizer application rates recommended for conventional farms in California. Assuming that 80% of P, 90% of K and 50% of N are available in the compost the first year after application.	US EI 2.2 database (through SimaPro) Rosen & Bierman (2005)
Pest Management	No synthetic pesticides are used on this organic farm. Integrated Pest Management techniques and hand weeding are assumed.		
Machinery Use and Fuel	Machinery use is similar to that of a large, conventional farm. This includes the use of diesel and gasoline in farm machinery. Diesel: 10.26 oz per cwt Gasoline: .55 Liters per cwt	Data was unavailable for sweet potatoes, so it was assumed that sweet potato farming includes a similar amount of machinery use as potato production, for which this data was available.	Pimentel & Pimentel (2008)
Energy Use for	Curing requirements are	All sweet potato farms	Curing and storage

curing and storage	assumed to be 4-7 days at 80-85 degrees and 90-95% relative humidity with sufficient ventilation. Sweet potatoes were cured for 5 days and storage was assumed to be for a period of 6 months.	(in the US) use similar curing practices.	information: North Carolina Sweet Potato Commission (2010) Energy consumption of buildings information: Energy Information Administration (2003)
Transport (Farm to Aggregation)	Sweet potatoes are transported in a large (40 ton) truck across the country to the point of aggregation; total distance 2777 miles.		

Table 2.4. Bill of Materials for Scenario 2, showing inputs that constitute this scenario. The following show the basic inputs to SimaPro 7.2 software, divided into Materials and Processes.

SimaPro 7.2		product stage	Date: 3/16/2011	Time: 3:09 PM
Project		Nicole's final project		
Assembly:				
Name				
Scenario 2: Domestic Organic				
Materials/Assemblies				
Diesel B300		8.0494 oz		Undefined
Compost, at plant/CH WITH US ELECTRICITY U		1.4624 kg		Undefined
Processes				
Truck 40t		5.0694 tkm		Undefined
Truck 40t		224.6644 tkm		Undefined
Electricity, medium voltage, production SK, at grid/SK WITH US ELECTRICITY U		6.0415 kWh		Undefined
Gasoline equipment (gal)		0.43166 l		Undefined

2.4.3. Scenario 3: Local Conventional Farm

The farm in Scenario 3 is located in Sampson County, North Carolina, which is one of the top producing counties of sweet potatoes in the country. This scenario was built upon the recommendations for commercial growers of sweet potatoes on the (North Carolina Sweet Potato Commission, 2010) website.

Table 2.5. Scenario 3: Detailed Description and Assumptions

	Description	Assumptions needed	Reference
Location	Sampson County, NC		
Yield	200 cwt per acre	Average yield for sweet potatoes for NC	NCDA&CS (2010)
Fertilization	N- Fertilizer: .25 lbs per cwt P-Fertilizer: .3 lbs per cwt K-Fertilizer: .875 lbs per cwt	Recommendations are for Beauregard Variety of sweet potato	North Carolina Sweet Potato Commission (2010): Commercial Growing Section 4: Soils and Fertilization
Pest Management	Pesticide application (unspecific mix): .1435 lbs per cwt	Comparable amount of pesticides as used in California	Kegley et al. (2010)
Machinery Use and Fuel	Machinery use is assumed to be similar to that of an average large, conventional potato farm. This includes the use of diesel and gasoline in farm machinery. Diesel: 10.26 oz per cwt Gasoline: .55 Liters per cwt	Data was unavailable for sweet potatoes, so it was assumed that sweet potato farming includes a similar amount of machinery use as potato production, for which this data was available.	Pimentel & Pimentel (2008)
Energy use for Curing and Storage	Curing requirements are assumed to be 4-7 days at 80-85 degrees and 90-95% relative humidity with sufficient ventilation. Assumption made that potatoes were cured for 5 days. Storage was assumed to be for a period of 6 months.	All sweet potato farms (in the US) use similar curing practices. Assumed that the energy use to heat the buildings is from electricity.	Curing and storage information: North Carolina Sweet Potato Commission (2010) Energy consumption of buildings information: Energy Information Administration (2003)
Transport (Farm to Aggregation)	Sweet potatoes transported in a large (40 ton) truck to the point of aggregation; total distance is 51.7 miles.		

Table 2.6. Bill of Materials for Scenario 3. Shows the input for the software that constitutes each scenario. The following show the basic inputs to SimaPro 7.2 software, divided into Materials and Processes.

SimaPro 7.2	product stage	Date:	3/16/2011	Time:	3:09 PM
Project	Nicole's final project				
Assembly:					
Name					
Scenario 3: Local Conventional					
Materials/Assemblies					
Fertiliser (K)	0.875 lb				Undefined
Phosphorous fertilizer, production mix, at plant/US	0.3 lb				Undefined
Nitrogen fertilizer, production mix, at plant/US	0.25 lb				Undefined
Pesticide unspecified, at regional storehouse/RER					
WITH US ELECTRICITY U	0.1435 lb				Undefined
Diesel B300	10.263 oz				Undefined
Processes					
Truck 40t	1.6254 tkm				Undefined
Electricity, medium voltage, production SK, at grid/SK WITH US ELECTRICITY U	6.0415 kWh				Undefined
Truck 40t	5.0694 tkm				Undefined
Gasoline equipment (gal)	0.55037 l				Undefined

2.4.4. Scenario 4: Domestic Conventional Farm

This scenario is based on a variety of resources available to farmers growing commercial sweet potatoes in California. Resources used to develop the farming assumptions made include a publication from the University of California Division of Agriculture and Natural Resources (May & Scheuerman, 2011), and the Sweet Potato Council of California (2010).

This farm is located in Merced County, CA, one of the largest producing areas of sweet potatoes in the state (USDA NASS, 2011). The scenario was created using California state averages for fertilizer use, pesticide use and machinery fuel use derived from data about potato production.

Table 2.7. Scenario 4: Detailed Description and Assumptions

	Description	Assumptions needed	Reference
Location	Merced County, CA		
Yield	340 cwt per acre	This farm reaps the average yield for sweet potatoes for the state of California	USDA NASS (2011)
Fertilization	N- Fertilizer: .36 lbs per cwt P-Fertilizer: .294 lbs per cwt K-Fertilizer: .323 lbs per cwt	These amounts are only applied once. Guide says “as needed by taking soil test.”	May & Scheuerman (2011)
Pest Management	Pesticide application (unspecific mix): .0844 lbs per cwt	A comparable amount of pesticide use as those used on the average sweet potato farm in California.	Kegley et al. (2010)
Machinery Use and Fuel	This includes the use of Diesel and Gasoline in farm machinery. Diesel: 10.26 oz per cwt Gasoline: .55 Liters per cwt	Machinery use is assumed to be similar to that of a large, conventional farm. Data was unavailable for sweet potatoes, so it was assumed that sweet potato farming includes a similar amount of machinery use as potato production, for which this data was available.	Pimentel & Pimentel (2008)
Energy use for Curing and Storage	Curing requirements are assumed to be 4-7 days at 80-85 degrees and 90-95% relative humidity with sufficient ventilation. Potatoes were cured for 5 days; storage was assumed to be for a period of 6 months.	Energy use to heat the buildings is from electricity.	Curing and storage information: North Carolina Sweet Potato Commission (2010) Energy consumption of buildings information: Energy Information Administration (2003)
Transport (Farm to Aggregation)	Sweet potatoes transported in a large (40 ton) truck across the country to the point of aggregation; total distance is 2777 miles.		

Table 2.8. Bill of Materials for Scenario 4, showing input to the LCA software that constitutes the scenario. The following show the basic inputs to SimaPro 7.2 software, divided into Materials and Processes.

SimaPro 7.2		product stage	Date: 3/16/2011	Time: 3:10 PM
Project		Nicole's final project		
Assembly:				
Name				
Scenario 4: Domestic Conventional				
Materials/Assemblies				
Fertiliser (K)		0.323 lb	Undefined	
Phosphorous fertilizer, production mix, at plant/US		0.294 lb	Undefined	
Nitrogen fertilizer, production mix, at plant/US		0.36785 lb	Undefined	
Pesticide unspecified, at regional storehouse/RER WITH US ELECTRICITY U		0.084411765 lb	Undefined	
Diesel B300		6.037 oz	Undefined	
Processes				
Truck 40t		5.0694 tkm	Undefined	
Truck 40t		224.6644 tkm	Undefined	
Electricity, medium voltage, production SK, at grid/SK WITH US ELECTRICITY U		6.0415 kWh	Undefined	
Gasoline equipment (gal)		0.32375 l	Undefined	

2.4.5. Flow Chart

Figure 3 (below) lays out the basic steps in the life cycle of a sweet potato, beginning with raw material extraction and continuing through production on the farm and through transportation to aggregation and processing.

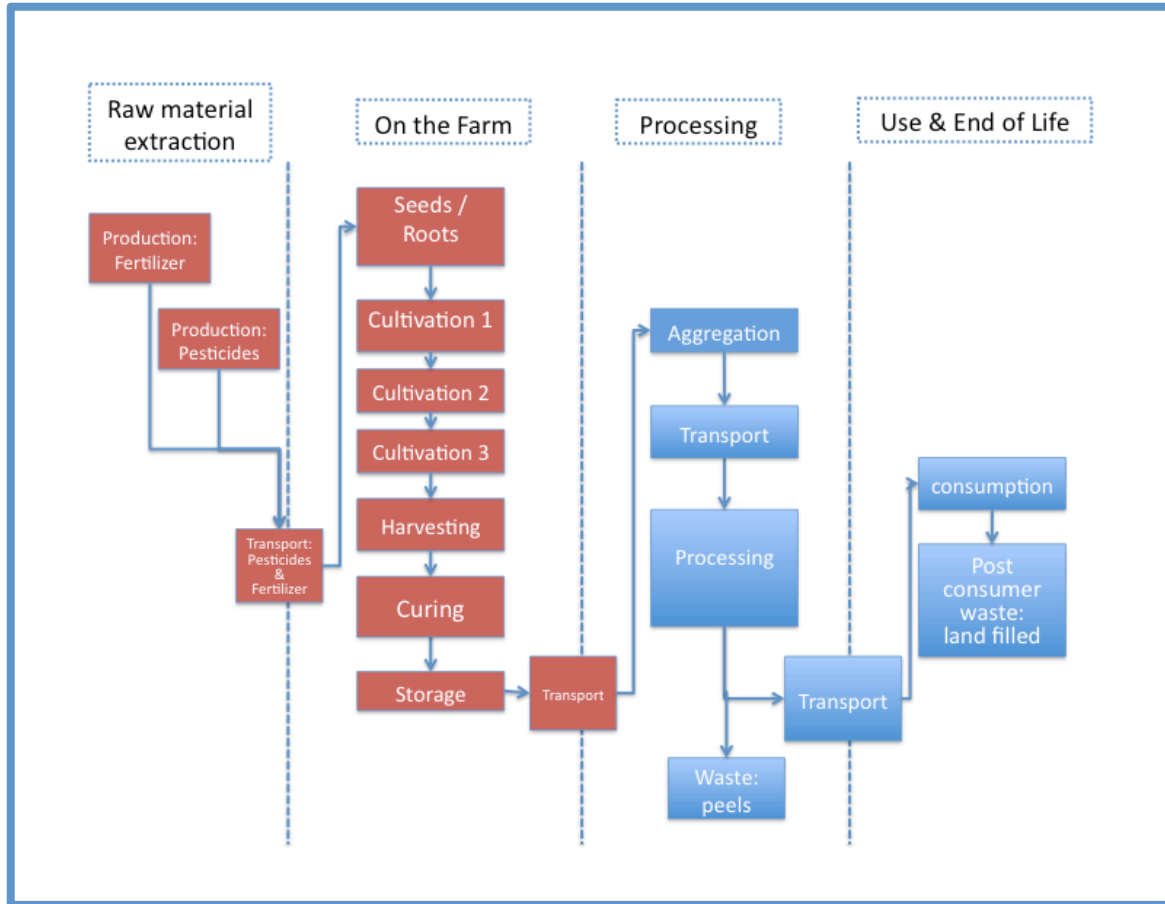


Figure 3. Basic life cycle steps of a sweet potato. The figure is divided into four basic life stages which are connected by transportation.

The red boxes in Figure 3 show where inputs differ between scenarios. From production of farm inputs through delivery at the aggregation center, each scenario differs from at least one other at every point along the way. Our analysis captures the majority of these differences, and stops at the entrance to processing, assuming that all sweet potatoes are handled similarly from this point forward.

2.4.6. Impact Assessment

The impact assessment of an LCA aims to describe the environmental impacts quantified in the inventory analysis. The impact categories I chose to examine are freshwater eutrophication, climate change (i.e. greenhouse gas emissions) and human toxicity (ReCiPe, 2011). These were

chosen because they demonstrate a diverse array of environmental impacts and are issues of great interest to the public.

Table 2.9. Major Contributors to each Impact Category. The SimaPro software uses these components, among others, to measure the environmental impact of each scenario and categorize that impact into categories.

Climate Change	Methane (CH ₄)
	PFC 9-1-18
	Ethane, 1-1-1-trichloro, HCFC-140
	Methane, monochloro, R-40 (CH ₃ Cl)
	Ethane, 1,1-difluoro-, HFC-152a (C ₂ H ₄ F ₂)
	Methane, dichloro-, HCC-30 (CH ₂ Cl ₂)
	Butane, nonafluoroethoxy, HFE-569sf2
	Methane, bromo-, Halon 1001 (CH ₃ Br)
	Carbon dioxide (CO ₂)
Human Toxicity	Arsenic (As)
	Arsenic, ion (As ⁵⁺)
	Barium (Ba)
	Beryllium (Be)
	Cadmium (Cd)
	Dioxins, measured as 2,3,7,8-tetrachlorodibenzo-p-dioxins
	Mercury (Hg)
	Molybdenum (Mo)
	Selenium (Se)
Freshwater Eutrophication	Phosphate
	Phosphorus (P)

2.5. Results

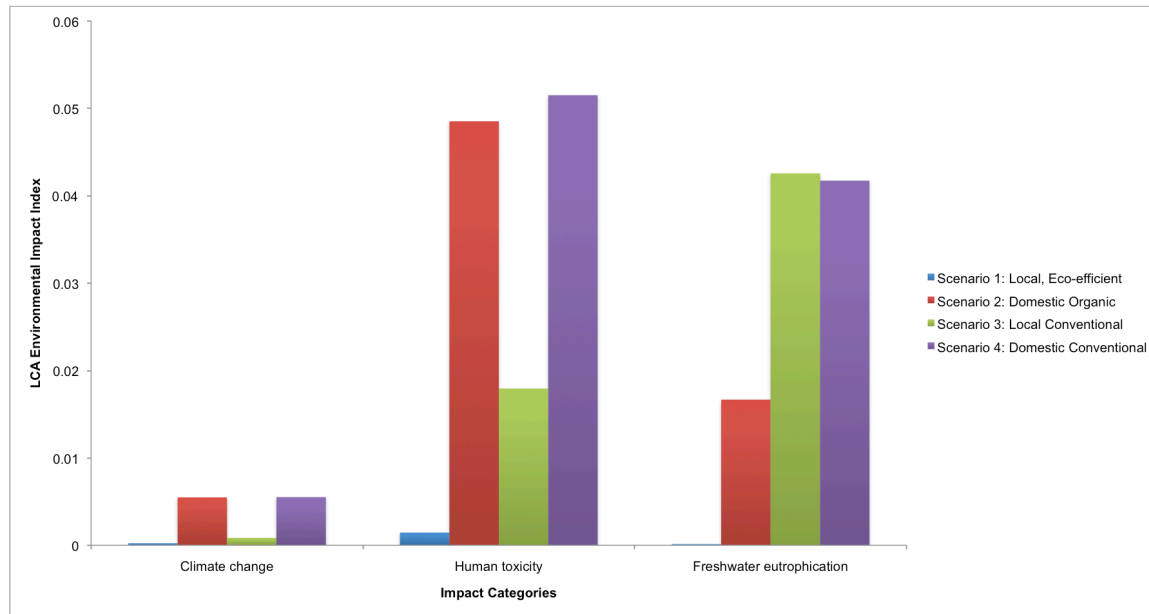


Figure 4. Life cycle assessment results comparing the four scenarios for sourcing sweet potatoes

Figure 4 shows how each scenario compares in terms of its negative environmental impact on climate change, human toxicity and freshwater eutrophication. Scenario 4 has the highest environmental impact in the climate change and human toxicity categories and nearly the highest in the freshwater eutrophication category. This result is consistent with predictions for the scenario because it includes impacts of production and application of synthetic fertilizers and pesticides, as well as longest distance transportation between production and point of consumption. The fact that freshwater eutrophication was slightly lower in Scenario 4 than Scenario 3 is also logical given that fertilizer application per cwt of sweet potatoes is lower in Scenario 4.

Scenario 2 has a similar impact in terms of Climate Change (i.e. greenhouse gas emissions) than Scenario 4. This result is a reflection of to the role that many trucking miles play in this model in comparison to the role of the production and application of fertilizers and pesticides. This result was surprising; I expected the fertilizers and pesticides to be responsible for a larger portion of the impact.

Transportation played a significant role in the overall environmental impact of each scenario. This contrasts with Weber & Matthews (2008), who concluded that transportation plays a small role in the life cycle of most food products. This discrepancy is explained primarily by the fact that this assessment was performed on an agricultural product and did not include minimal processing of that product. Studies that call attention to the minor role of transportation in the entire life cycle refer to transportation in the context of a longer food supply chain with more intense processing. This assessment includes raw material extraction through the beginning of the processing stage (i.e. arrival at the commercial kitchen). The assessment, therefore, did not include processing, use or end of life. For these reasons, it is logical that the transportation would be a larger proportion of the impact of this product as compared to other food products.

Further explanation for this discrepancy is a reflection of the possibility that differences between the two scenarios may be caused by factors other than transportation. The transportation portion of the assessment is relatively simple compared to that of agricultural production. As a result, I am confident that the transportation section is an accurate representation of the phase's environmental impact, while the other phases have clear gaps in data that I was unable to include. These gaps in data prevented the use of a few critical inputs, including: water use, which is an increasingly important issue in agriculture but was not able to be included in this study; human labor, a form of energy critical to farm functioning; and the use of electricity for irrigation and industrial pesticide application.

Lastly, I assumed that the sweet potatoes are transported across the country through large trucks for this assessment. It is possible that another form of transportation across the country would be a more appropriate assumption and would significantly decrease the environmental impact of both domestic scenarios. These serve as primary examples of information that, if included, would make the environmental impact of the rest of the life cycle larger and the transportation phase smaller in comparison.

Another observation derived from the four-way comparison is that Scenario 3 has a significantly lower impact on human toxicity, but has the highest impact on freshwater eutrophication. This is a reflection of fertilizer application rates, which were similar per unit area in California and

North Carolina. However, given that the average sweet potato yield was much lower in North Carolina, the amount of fertilizer needed per cwt of sweet potatoes is higher.

Finally, it is important to note that the local, eco-efficient operation has almost no impact on each of the categories. This farm, due to its small size and array of crops is most likely to face serious challenges in surviving economically in the current industrialized food system. The low impact on environmental and human health goes unrewarded financially and current policy and infrastructure favors large, industrial farms.

2.5.1. Scenario Analysis

A closer look at each scenario provides insight into the drivers behind each scenario's negative environmental impacts.

2.5.1.1. Scenario 1: Local eco-efficient

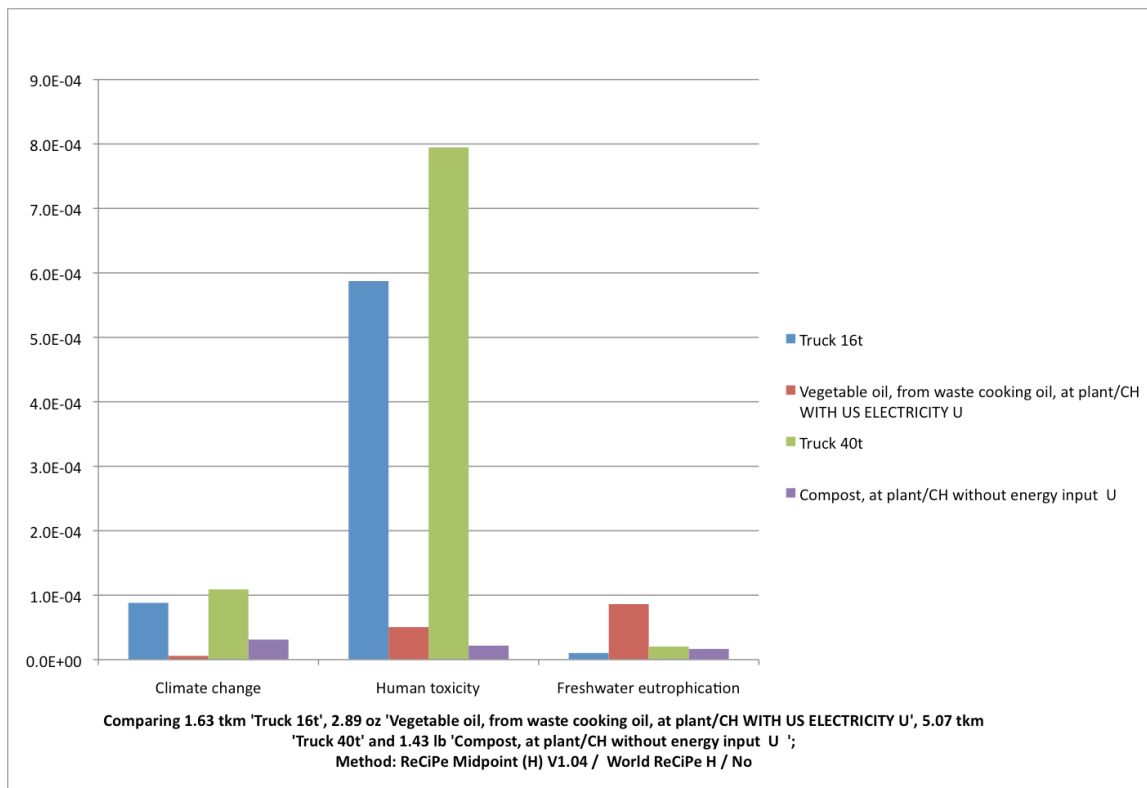


Figure 5. Life Cycle Assessment results showing the influence of Scenario 1's inputs on each impact category

Overall, Scenario 1 shows a low impact on the environment in terms of climate change, human toxicity and freshwater eutrophication. The low-input, conservation focused farming practices and short transport distances keep impact to a minimum and are extremely impressive. This situation is nearly ideal in terms of environmental impact, particularly when examined in comparison to the other purchasing options.

The truck transporting food from the aggregation center to processing is the origin of the most emissions of greenhouse gases and effects detrimental to human health. Similar emissions originate from the 16-ton truck that transports food from the farm to the aggregation center. Composting organic waste on the farm causes the release of some greenhouse gases but it seems to be a negligible amount compared with the other inputs. Biodiesel used for farm machinery accounts for a very small part of the green house gas emissions of this scenario. This is because the farm uses mostly human labor and minimal mechanization. Furthermore, the fuel used in the farm machines is vegetable oil recovered from local restaurants and processed into biodiesel.

Surprisingly, the highest impact that this scenario has on freshwater eutrophication is through the use of the biodiesel in farm machinery. However, the overall contribution to freshwater eutrophication is extremely low in this scenario compared to the other purchasing options. This reflects cycling of nutrients within the farm and careful attention to avoiding any synthetic nutrients to the system or excessive organic nutrients. Given that one of industrial agriculture's largest impacts is nutrient overload in bodies of water that cause eutrophication, this low contribution is significant.

2.5.1.2. Scenario 2: Domestic Organic

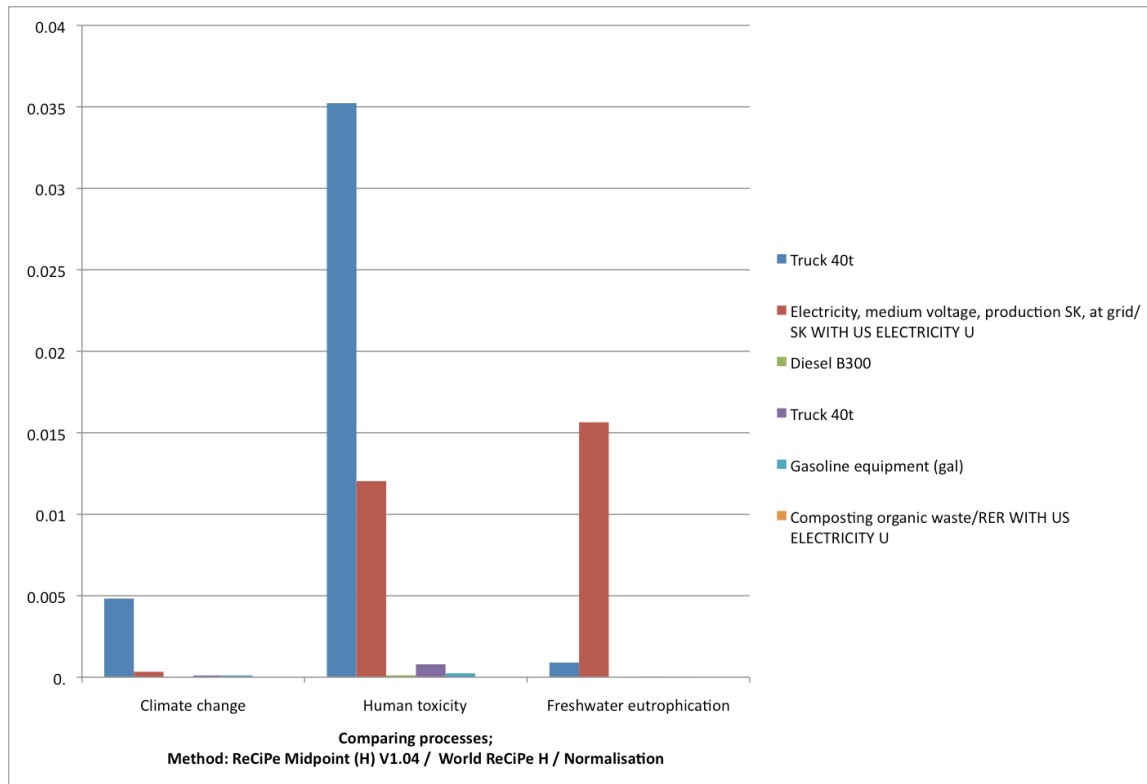


Figure 6. Life Cycle Assessment results showing the influence of Scenario 2's inputs on each impact category

Scenario 2 is the domestic, USDA Organic sweet potato farm. As Figure 6 shows, the vast majority of its impact on all three impact categories originates from the transport of the sweet potatoes from California to North Carolina via a large truck. In order to decrease the impact of this purchasing option, less resource intensive transportation options, such as train or ship, should be considered.

2.5.1.3. Scenario 3: Local Conventional

Scenario 3 has a relatively small level of greenhouse gas emissions but significantly contributes to human toxicity and freshwater eutrophication in North Carolina. Because this scenario is most relevant to SENCFS mission, look more closely at the negative environmental impacts of this scenario by looking individually at each impact category.

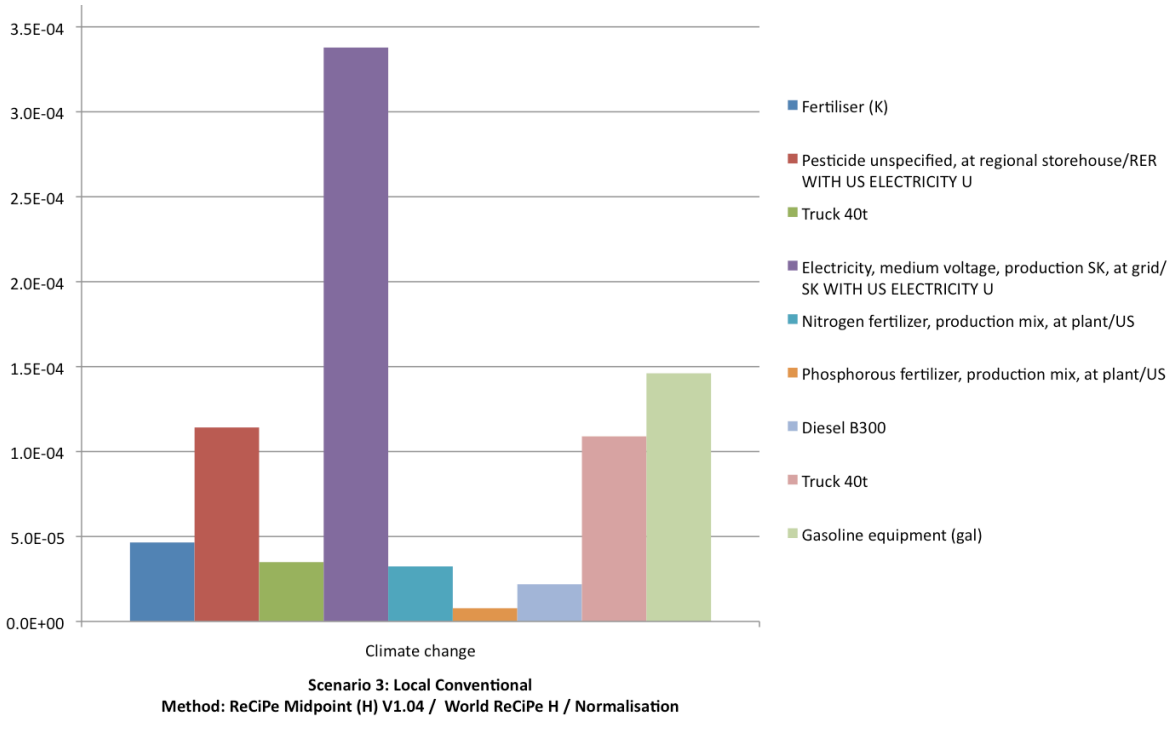


Figure 7. Life Cycle Assessment results showing the influence of Scenario 3's inputs on Climate Change

In terms of contribution to climate change through the emissions of carbon dioxide and other greenhouse gases, Scenario 3 was relatively low. A close look at this impact, however, shows that it differs significantly by input. Electricity use on the farm contributes most heavily to the emission of green house gases. Other significantly contributors include transportation from the farm to the aggregation center and from there to processing. Lastly, the production and transport of pesticides contributed somewhat significantly to the emissions of greenhouse gases in this scenario.

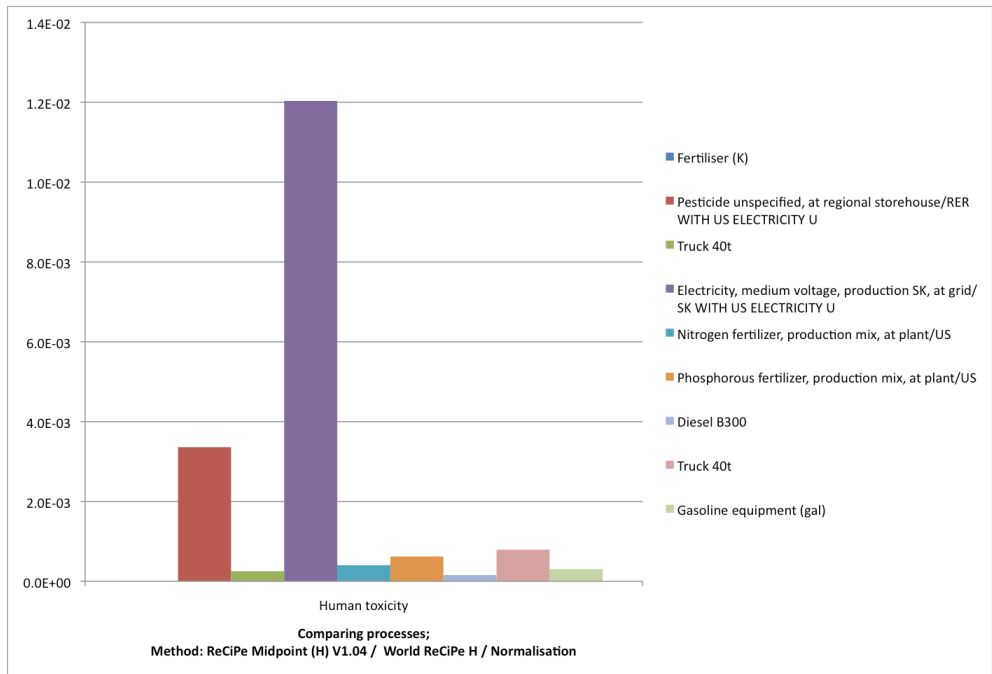


Figure 8. Life Cycle Assessment results showing the influence of Scenario 3’s inputs on Human Toxicity

Human toxicity impacts from Scenario 3 are mainly from the use of electricity for curing and storage of sweet potatoes. Another significant contributor to human toxicity is the pesticide production and application. The remaining inputs played a negligible role in Scenario 3’s contribution to human toxicity.

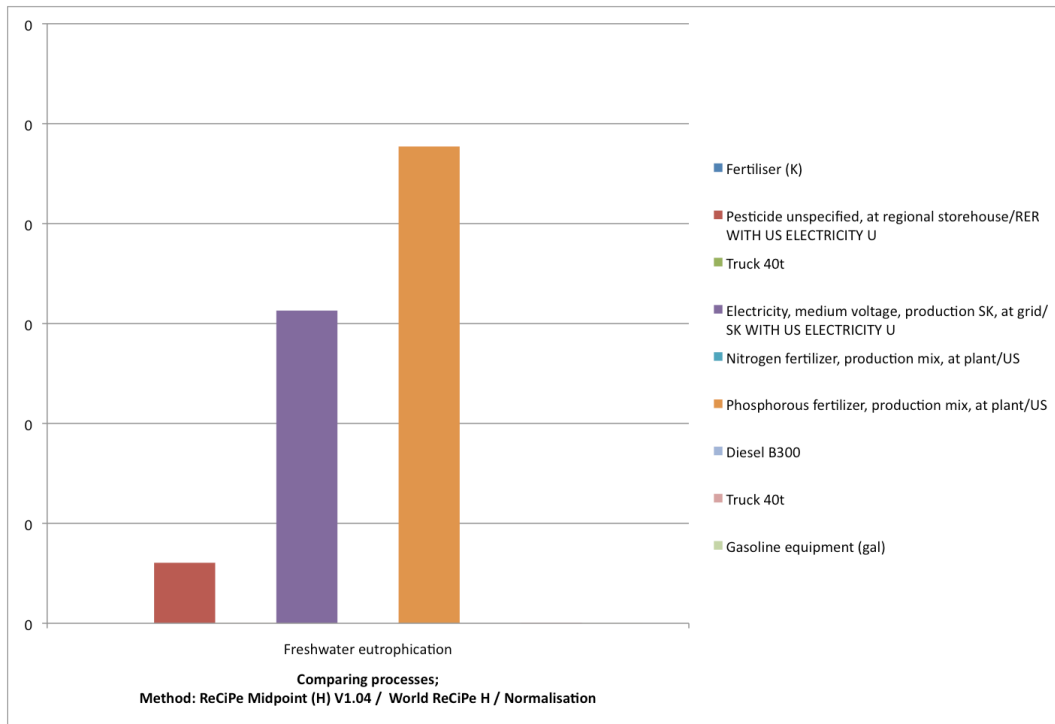


Figure 9. Life Cycle Assessment results showing the influence of Scenario 3’s inputs on Freshwater Eutrophication

In terms of Freshwater Eutrophication, Scenario 3 had the highest environmental impact of all of the purchasing options. Fertilizer application on North Carolina conventional sweet potato farms is similar to that of farms in California per hectare. However, because the average yield of a sweet potato farm is significantly lower in North Carolina, the fertilizer application rate is higher per cwt of sweet potatoes. A close examination of the inputs that contribute to freshwater eutrophication in this scenario shows that the phosphorous fertilizer is the largest contributor. This is followed by electricity use on the farm and lastly, pesticide production (likely through the electricity used in pesticide production and transport).

2.5.1.4. Scenario 4: Domestic Conventional

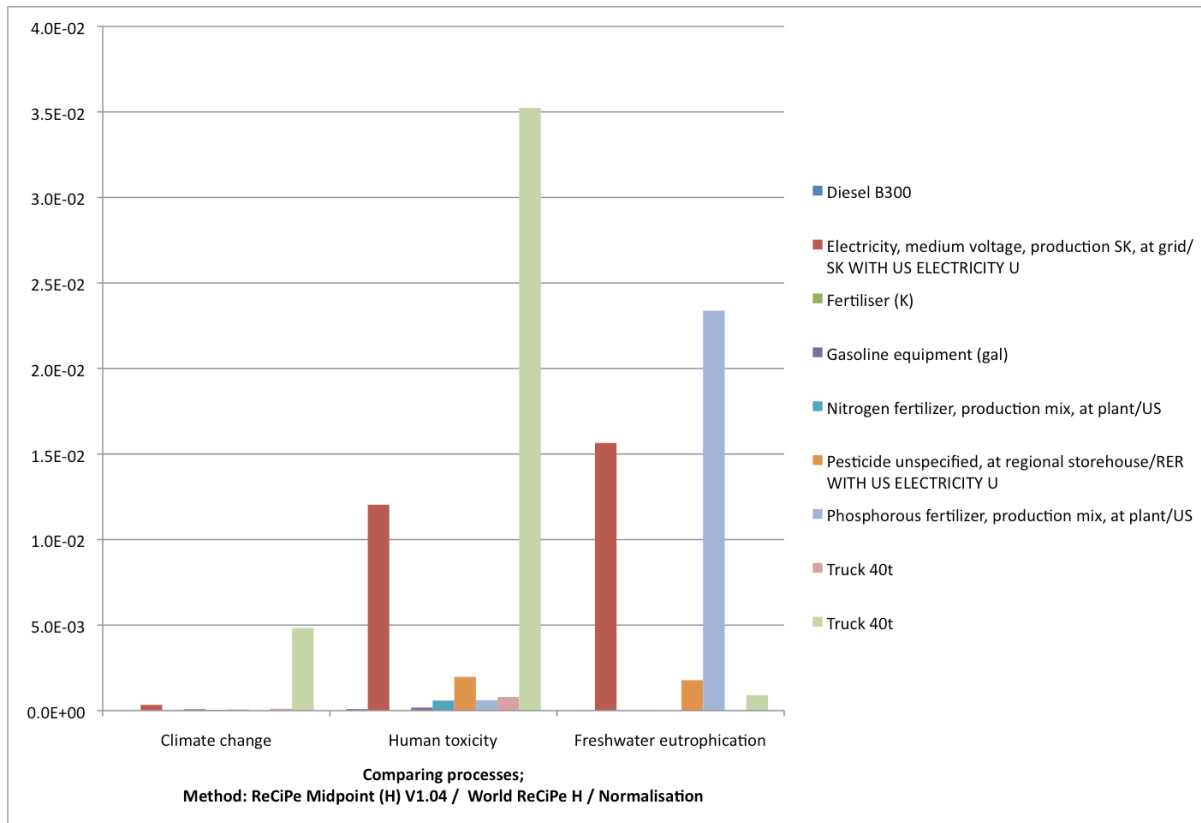


Figure 10. Life Cycle Assessment results showing the influence of Scenario 4's inputs on each impact category

Scenario 4 had the most detrimental environmental impact overall. In terms of this scenario's contribution to green house gas emissions, the production and application of potassium fertilizer played the largest role. Surprisingly, electricity use played a relatively small role in this impact category in comparison. Human toxicity effects are similar to those that influenced the Climate Change impact category: the vast majority of the negative impact originates from potassium fertilizer production and application and electricity use. In addition, pesticide production and application play a considerable, but relatively small, role in human toxicity impacts of this scenario.

Phosphorous fertilizer played the most substantial role in this scenario's contribution to freshwater eutrophication, as expected. Electricity use and production and application of

pesticides also played important roles in this impact category and could be targeted for reductions.

2.6. Recommendations

To create an economic and environmentally sustainable future for this region around food production, we recommend that SENCFS focus its efforts on opening mainstream markets to small farms while helping those farms transition towards low-input, conservation oriented farming, as modeled in Scenario 1. In this future for the region, sourcing from small local farms could serve to meet dual goals of food service companies (i.e. both social and environmental) and that joint justification will help overcome the many barriers that building this system will surely encounter. By coupling environmental and economic goals, SENCFS can truly have an effect on the sustainability of the region and can motivate institutional buyers to source locally.

We recommend that SENCFS use this assessment to inform and influence food service companies' purchasing decisions in favor of small, environmentally focused farms. In addition, it should be used to assist food service companies in understanding the potential that a local food system holds for decreasing its environmental footprint and meeting environmental and social goals. Lastly, the assessment can be used to assist food service companies in understanding the environmental footprint of their supply chains in order to either change purchasing decisions or request changes from their current suppliers. For example, if purchasing organic sweet potatoes is a priority, food service companies could use the information in this assessment to inform their actions and recommendations. Knowing that the transportation across the country plays a significant role in the environmental footprint of this product, the food service company might investigate alternative transportation options such as trains or shipping the sweet potatoes.

In this analysis, the local, eco-efficient operation has almost no impact on each of the impact categories and exemplifies what we recommend SENCFS move the area towards. If small farms in the area alter their farming practices to be low input and conservation oriented, they would be the clear environmentally friend sourcing option. In attempting to meet stated environmental

goals and support the local economy and community, the best choice would be clear to food services companies and other institutional buyers.

2.7. Limitations

This study has several limitations and is intended to develop an understanding of Life Cycle Assessment as a potential tool to understand environmental tradeoffs between purchasing decisions. Limitations include the following:

- *Labor.* The assessment does not include manual labor data. The impact of the lack of manual labor data on the results is unclear, but is important to consider, particularly in evaluating the economic side of these research questions.
- *Data.* As an initial analysis for understanding the differences between scenarios without conducting primary research, I used state wide and national averages. As a result, the scenarios are hypothetical situations and are not necessarily reflections of actual choices from the perspective of a food service company.
- *Water.* A significant limitation of the study is the fact that water use is currently not included in the analysis. While the agricultural production's impact on nearby bodies of water is considered as an impact category (as a result of nutrient and pesticide runoff, among other factors) the use of water resources is not. The inclusion of water use would likely benefit the local, sustainable farm (scenario #1), in which the farmers use water conservation practices such as drip irrigation. As the availability of freshwater decreases worldwide, water use will become an increasing critical issue and should be included in future study.
- *Ecosystem Services.* This analysis covers as much of the environmental impact of farm inputs and processes as possible. In addition to the negative impact that most conventional farms have on the environment, much of the land used for farming has the potential to provide crucial ecosystem services. This assessment, however, does not include ecosystem services provided by each scenario. Current, LCA software and databases do not include the option of including ecosystem services. In my opinion, this is a reflection on the lack of data and general knowledge about ecosystem services. It is also a reflection of a lack of appreciation for the fact that agricultural land has the potential to play a significantly role in protecting natural resources. The addition of

ecosystem services, such as pollinator habitat, would greatly benefit the local, sustainable farm in Scenario #1 and the USDA organic farm (scenario #2).

- *Micronutrients.* Fertilizer use on the farm is a rough estimate based on statewide recommendations for sweet potato production. Nitrogen, Phosphorous and Potassium fertilizers are included, but micronutrients that are essential to plant growth are assumed to be included in the production of those fertilizers, or negligible differences.

Each of these limitations can also be viewed as opportunities to improve the assessment in the future. Through primary research or access to data on these subjects, the addition of any of this data to the assessment will improve its accuracy and relevancy.

Part 3. GAP Certification and Small Farmers in North Carolina

3.1. Topic Overview

Food borne illness is a major public health problem in the United States. The Centers for Disease Control and Prevention estimated that 76 million cases of food-related illness occur in the United States each year (Mead, et al., 1999; Lynch, Tauxe, & Hedberg, 2009). Of all the foods regulated by the FDA, produce has been linked to the largest number of outbreaks, roughly one quarter of all food borne illnesses (Scharff, 2010). Cases of contamination have been overwhelmingly documented to originate from large-scale, industrial processing operations (Starmer & Kulick, 2009). The shorter food chain, or a more direct connection between producer and consumer, offers community and economic benefits as well as health benefits.

Existing food safety protocols were developed to accommodate large farms, often having low crop diversity. Small, limited resource are often at a significant disadvantage when trying to comply with the same safety programs as large farms, that require expensive testing, auditing, and extensive documentation, which could ultimately jeopardize their place in a food system. Additionally, it has been suggested by some that farming and management practices common to smaller, more biodiverse and conservation-oriented farms are actually a net benefit to food safety (Starmer & Kulick, 2009).

Here we examine the current status of one food safety certification system, Good Agricultural Practices, or GAP. This analysis will provide the basis for SENCFS to provide support to farmers in southeastern North Carolina by considering how to appropriately respond to their needs in order to be prepared for certification. Focus is given to the reasons that support for and attention to GAP is needed, such as the complexity within the structure of the audit itself. A critical look is given to the current information accessible to farmers through the existing sources of information, especially the North Carolina Cooperative Extension website, ncmarketready.org.

3.2. Methods

This part of the project was divided into three phases. First, in the summer of 2010, interviews were conducted with 17 small, limited resource farmers within the SENCFS region. Before conducting the interviews, an exemption was obtained from the Duke Internal Review Board in following the guidelines for research with human subjects. In accordance with this protocol, each of the 17 interviewees were required to sign a ‘consent for personal interview’ form, on which they could either agree to or decline from being photographed, filmed, and/or to allow his/her name and/or the name of his/her farm to be used later in the research, either by SENCFS or in the Master’s Project described on the form. These interviews were dual-purpose; in addition to providing background information for this report, they were also used to create ‘farmer profiles’ for SENCFS’ new website (www.feastdowneast.org). These online profiles are an attempt by the organization to allow the public to ‘meet’ some of the small farmers in the area.

Second, information was collected from a number of sources. Whenever possible, information gathered was specific to southeastern North Carolina. Internet sources included several online databases including Agricola and Web of Science, the North Carolina Cooperative Extension Service’s website, www.ncmarketready.org and the data primarily consisted of journal articles and educational pieces regarding food safety and current resources available to small farmers. USDA and FDA reports were consulted for the majority of the information regarding the government addressing the issue of food safety. Several experts in the field were contacted for information about specific issues. Additionally, a survey was conducted with all certified water-testing laboratories in southeastern North Carolina.

The third phase of the project utilized information collected from the first two phases, in compiling a report containing analysis and synthesis of the information. The report contains several informational sections, including a broad background exploring food safety in the United States, an analysis of GAP with focus on the embedded challenges and complexities, an exploration of one resource targeted to farmers, and finally recommendations to SENCFS for assisting farmers with this important food safety certification system.

3.3. Food Safety: An Overview

In a January 26, 1997 article, the Chicago Tribune reported that President Clinton's 1998 budget was to propose \$43 million for a program to detect outbreaks of food-borne illnesses to prevent widespread outbreaks, and to improve food safety. President Clinton's action was the government's first attempt at early detection and prevention of outbreaks such as those that have occurred in increasing frequency over the last several years.

“We must continue to modernize the food-safety system... The proposed program will attempt to remedy a problem that has persisted for years: the difficulty in determining whether outbreaks of food-borne illnesses are isolated or part of a nationwide pattern.”

President Clinton (Chicago Tribune, 1997)

In 2006, almost ten years after this statement, an outbreak of illness due to *E. coli* contamination in bagged spinach originating in California brought the issue of food safety to the forefront of public attention again. Until this event, the FDA had never had cause to make an announcement as sweeping as advising consumers not to eat any bagged spinach, due to the possibility of microbial contamination. This outbreak was defined by a high disease incidence; in the days following the announcement, 204 people had become ill across 26 states and Canada, and 3 people had died (Calvin, 2007).

Foodborne illnesses are very costly. Scharff (2010) looked into the economic burden of these illnesses, both at the aggregate level and at the pathogen-specific level. Scharff defined the health-related cost of foodborne illness in the US to be the sum of medical costs (hospital services, physician services, and drugs) and quality-of-life losses (deaths, pain, suffering, and functional disability). At the time of the study, Scharff's estimate for the cost of foodborne illness in the United States was \$152 billion a year .

The issue of food safety is inextricably linked to every step along the food production ladder, from seeds to store. The longer this ladder, the higher the potential is for contamination.

Shortening this food ladder is an easy way to minimize the number of steps food products must take, thus minimizing the spread of contamination should it occur. Food borne outbreaks are a convergence of several factors. For example, increased consumption of fresh produce has led to changes in produce production and distribution, most notably the increase in scale of both processing and distribution facilities as well as a globalized supply system. There has been a growing awareness of the problems linked with food safety on the part of public health officials who are better able to identify and then target outbreaks quickly to reduce effects of an outbreak than was possible ten years ago (Lynch et al., 2009).

The biological hazards most likely to affect produce include *E. coli*, *Salmonella spp.*, *Vibrio cholerae*, *Shigella spp*, *Cryptosporidium parvum*, *Giardia lamblia*, *Cyclospora cayetanensis*, *Toxoplasma gondii*, the Norwalk virus and Hepatitis A (Baldwin & Grabow, 2009). The biology of pathogen contamination of and on plants continues to be examined. Research by plant pathologists and food biologists shows that pathogens can survive on plants, even though they are well adapted to life in the “vertebrate gut” (Lynch et al., 2009). For example, in one study *Salmonella* applied to leaves of young coriander plants grew quickly. In a short period it took up 80% of the leaf surface and could then persist indefinitely in greenhouse conditions (Lynch et al., 2009). Research has also shown the ability of pathogens to enter the interior of a plant, such as through a wound, bruise, or even root. The following example illustrates the ability of *Salmonella* to persist over time once inside a tomato plant after being applied to the stamen.

“After [enteric bacteria (originating in the intestines of an organism)] are applied to the stamen of [a] tomato flower, some strains of *Salmonella* can be recovered from the internal tissues of the mature tomato a month later, suggesting that they can pass via the pollen tube and colonize the new fruit” (Lynch et al., 2009).

Adhesion of pathogens to leaf and/or fruit surfaces and internalization within a plant limits the usefulness of conventional processing and chemical sanitizing methods in preventing transmission of pathogens from contaminated produce (Lynch et al., 2009). The ability of pathogens to survive on exterior surfaces of plants is exacerbated for crops with high surface area, such as leafy greens and melons with netted rinds, which have been associated with a

significantly higher number of food borne illness outbreaks. Human pathogens can be more difficult to eliminate from melon netted rind surfaces (FDA, 2009b), or from “nooks and crannies” on leafy greens where wash water may not penetrate (FDA, 2009a).

Martinez, et al. (2010) suggest that decentralization of production via local food systems could reduce food safety risks. Purchasing groceries directly from a farm would greatly reduce the number of stops a consumer’s carrot (or egg, or melon) makes on its trip to the refrigerator, thereby reducing the potential for contamination.

It is clear that outbreaks linked to fresh produce from specific production areas have occurred and affected a large number of people (Suslow & Harris, 2009). In addition to the spinach outbreak in 2006, in 2008 over 900 people became ill from what turned out be *salmonella* from jalapeno and Serrano peppers from Mexico (Union of Concerned Scientists, 2010). Thus, industry groups began developing a set of food safety protocols for voluntary self-regulation. These protocols were most often based on guidelines issued by the FDA in 1998 and were intended to decrease the occurrence of produce-related outbreaks as well as restore consumer confidence.

Over the past 20 years, a growing body of evidence supports a link between fresh produce and illness outbreaks. During this time, pressure for increasingly specific and preventative food safety programs and associated standards has come from multiple directions (Suslow, 2010). Industry sponsored certification programs were the beginning of a growing system of food safety regulations, paralleling the growth of the global food chain.

On-farm food safety guidelines developed by the USDA and FDA, “Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables,” issued in 1998 (USDA, 1998). These guidelines were issued solely as guidance and thus were not required by federal law. Although producers are still not yet required by law to follow the guidelines, many retailers, wholesalers, and government institutions are increasingly making GAP compliance – verified by an audit – mandatory for any producers wishing to supply them (Starmer & Kulick, 2009). The

1998 guidelines are the basis for the audit criteria for the majority of industry-developed audits, including GAP.

E. coli O157:H7, a particularly virulent strain of *E. coli*, has been identified as the cause of many outbreaks of haemorrhagic colitis, with 75,000 cases estimated to occur in the United States each year (Perna et al., 2001). The *E. coli* O157:H7 outbreak in spinach and processed lettuce in 2006 accelerated the efforts of produce industry leadership to define practical, meaningful, and measurable prevention practices and standardized audit criteria, beginning as the Leafy Greens Products Handler Marketing Agreement in 2007. These prevention practices represent the current ‘metrics’ associated with GAP and Commodity-Specific Guidance documents. The prevailing approach was to adopt science-based standards anchored to a recognized authority wherever possible. For the parameters set by the lettuce and leafy greens industry, Suslow (2010) describes the following:

“Though not universally embraced, eventually microbial limits, compliance criteria, and a decision-tree for corrective actions were adopted. Though surrounded by uncertainty as to the validity or applicability of the approach, these metrics were acceptable to their customers (fresh processors or foodservice and retail buyers). The hope was that having a system in place would also help restore confidence among consumers. Several foodservice and retail-led groups adopted the same or parallel standards for irrigation water.”

3.4. Good Agricultural Practices

Good Agricultural Practices (GAP) are a set of guidelines that were created by the FDA in 1998. Most commonly, the term refers to a food safety certification system established by the food production industry but based on these guidelines. The overarching purpose of GAP is to avoid contamination of produce from any potential source, thereby avoiding outbreaks of food borne illness. The system is currently in a transition from a voluntary, private program to a government-regulated set of practices, existing at both state and federal levels. The North Carolina Cooperative Extension Service defines these practices as “the basic environmental and

operational conditions necessary for the production of safe, wholesome fruits and vegetables” (NC MarketReady, 2009).

Many options are available when seeking a GAP certifier. A number of third-party companies conduct audits. These include NSF Davis Fresh Technologies, PrimusLabs.com, Scientific Certification Systems, Silliker and Steritech, in addition to a number of international companies. Also, the USDA Qualified Through Verification Program is run through the USDA’s Agricultural Marketing Service and 16 state departments of agriculture. The auditors that conduct the federal GAP audits are either USDA employees or state department of agriculture employees operating under a cooperative agreement with the USDA (Starmer & Kulick, 2009). The analysis of GAP certification below is based on this USDA audit.

The USDA GAP audit is divided into six sections that include a farm review, field harvesting and field packing activities, house packing facility, storage and transportation, wholesale distribution center/terminal warehouses, and preventive food defense procedures. Each of these six sections has a number of subsections within them. For example, water usage is one subsection in the farm review section. Within water usage, is a sub-subsection, irrigation. Preparing for an audit can be a daunting task for farmers, especially if facing the process for the first time. Table 3.1 shows additional questions on the audit, not included in the six main sections.

Table 3.1 Additional USDA GAP audit questions (USDA, 2009)

1	Did the auditee participate in GAP and GHP (Good Handling Practices) training?
2	Is there a map that accurately represents the farm operations, including fields, water sources, restrooms, buildings, etc.?
3	What is the number of total acres farmed?
4	Does the company have more than one packing facility?
5	Is there a floor plan of the packing house facility(s) indicating flow of product, storage areas, cull areas, employee break rooms, restrooms, offices?

3.4.1. A Farmer's Experience with GAP Certification

In 1997, Susie Newberry and her family bought a farm outside of Burgaw, North Carolina, about 30 miles north of Wilmington. The sandy, loamy soil of the land was ideal for growing blueberries. Since then, the family has turned the farm into a very successful blueberry operation. Susie Newberry describes her 50-acre farm as a very “hands on” family farm. Much of the year is spent preparing for the small window between mid-May and late-June when their southern highbush variety of berry is producing and ready for harvest.

In the past, their markets have included ‘direct to consumers’, Wilmington restaurants, the Wrightsville Beach farmer’s market, and Tidal Creek, a food co-op in Wilmington. As the farm has grown significantly over the past five to ten years, their market has shifted away from the local market as they have needed to direct all their resources to preparing for the wholesale market. “We put ourselves in that strange position, we’re almost too big for our [local] market and too small to go wholesale. We’re truly in the middle. And it’s a tough market to be in right now,” (Newberry, 2010).

Because of the farm's success and rapid growth, they have had no choice but to mostly leave the local markets, shifting almost solely to selling to wholesaler American Blueberries. This company buys from many blueberry farms, most of which are 200 to 300 acres. Because blueberries have such a short season, the price decreases toward the end. Still, Susie relies on the wholesaler to provide a home for a major portion of their crop, selling much of it out of state. She has deep reservations about selling wholesale.

“They sell to grocery stores. The size we are, it's a shame in a lot of ways, because we're packing in their box. So even if we have some of the best berries you've ever tasted, they're going to have someone else's name on them, and that's sort of crummy. And that's the position we're in. We on our own can't sell our berries at any farmer's market or local stores, we have enough to do that and some, we just don't have the manpower” (Newberry, 2010).

In addition to not being able to receive retail prices for the berries, selling wholesale has introduced some other challenges; one of which is GAP certification. Susie had known about the certification for several years, but hadn't pursued it since she had no need for it at that time, when selling solely to small, local markets. Several years ago, after beginning to sell the majority of their berries to American Blueberries, that changed.

“Our wholesaler wanted us to do it. It is a huge pain, and it cost a good chunk of money. But we've been encouraged to do it for years, and my husband sort of put me in charge of it, because I can do the minutia details, which is what it takes. And I spent probably 6 weeks getting it, we've done stuff every year, but to get all the paperwork in order. It's a lot of work” (Newberry, 2010).

Susie used the third-party auditing firm Primus for the auditing process, per her wholesaler's request. Several months before the actual audit, a Primus employee comes to the area to conduct a training session for any farmers about to begin the certification process. Trainings cover the basics of each topic in the audit, such as product traceability, storage and handling of chemicals, water requirements, employee training – many of these protocols are the same requirements as

they are for a 500-acre farm. In Susie's case, the wholesaler paid for her to attend the training. However, they did not cover the actual audit that was \$600 in addition to an auditor traveling fee of \$80.

Susie expressed aggravation with the deep complexity of the whole auditing process. She described the auditing requirements as essentially a book. "Different topics are broken down into much minute detail, seems ridiculous for a small farmer," she said. Preparation for an audit is a significant investment in time; Susie estimated that her first year of certification, it took about a month and a half. The first step is to create 'Standard Operating Procedures' that will document the protocol for absolutely everything that could happen, such as chemical spills, human or animal contamination, etc. Evidence of the presence of animals or untrained human personnel in the field also must be checked and recorded on a regular basis, with plans in place for removal or remedial action. The presence of chemicals, require the farmer to have a hazardous chemical suit on hand. Susie created hers with a raincoat, rubber boots, goggles, and rubber gloves, showing that there is a degree of flexibility with some aspects of the audit. One advantage of the Primus auditing process is that criteria are graded on a point system, whereas the USDA audit is on a pass/fail system.

To prepare for the water quality testing section of the audit, Susie looked in the yellow pages to find a water testing company and found two or three companies in the area. She chose Environmental Chemists, who came to test the source of water used for irrigation and how it came out. For Susie, this involved two ponds and a well, used for overhead irrigation for the blueberry bushes. "The main thing is that you have to prove you're doing it [every detail on the audit form], you're keeping your eyes on it, and you have written steps to take if anything in your wildest dreams goes wrong."

Summer 2010 was the first year of GAP certification for Newberry's Blueberries, but as of February 2011 Susie is already beginning the necessary work for summer 2011 certification since the certification lasts for only one year. Susie said that she always worries that the next auditor could be pickier than the first, or will notice and will judge factors differently than last year's auditor.

Of the GAP certification process, Susie said:

“My favorite organization, as far as philosophically, is foodalliance.org [an organization with its own voluntary certification system based on standards that define sustainable agricultural practices (foodalliance.org)]... They look at the whole picture. How you’re treating the air, the soil, the water, the animals, and what I’m doing for my crops. It’s not saying that you have to be certified organic, they’re looking at the big picture. That’s the kind of certification I’d prefer over GAP, but I had to put my energy into GAP this year, because that’s where it looks like it’s going. You’re going to have to have it” (Newberry, 2010).

3.4.2. Problems with GAP Regulations

There is considerable criticism of GAP within some segments of the agricultural community, particularly on the side of smaller scale farms. Criticisms are largely based on the high degree of specificity of some requirements, especially in addition to the high costs involved.

Scientific evidence suggests that practices required to achieve some GAP food safety metrics could actually produce worse food safety outcomes rather than improving them. A report by Starmer & Kulick (2009) on behalf of Food and Water Watch and the Institute for Agriculture and Trade policy discusses the most significant problems with current food safety protocols. These issues, summarized in Table 1, are briefly discussed below.

Table 3.2. Problems with current food safety protocols

“One-size fits all”	Risk level varies across different products and production systems. <ul style="list-style-type: none"> • Some products are more susceptible to contamination than others, and some types of production systems may be more complex than others, introducing more possible entry points for contamination.
Scale	Contamination could affect more products in large-scale processing and production facilities as products are more widely dispersed.
Unnecessary targets	One example: audit targets all wildlife and all other animals as a major potential source of contamination.
Inconsistency and confusion	Multiple protocols exist, sometimes having differing or conflicting requirements.
Harm to conservation efforts	Participation in certain conservation programs could jeopardize meeting GAP certification criteria.
CAFOs	Farmers penalized for close proximity.

*CAFOs: Confined animal feeding operations.

The GAP certification system was developed by the food industry and intended for the large-scale, industrial farming operations that supply them. As a result, most protocols are designed as a “one-size-fits-all” approach, which does not consider that types and levels of risk vary in different products and production systems. In particular, small to medium-sized farms pay a much higher cost, in time and money, when working towards achieving the same certification as larger farms. Risk exists on farms of all scales, but the consolidation of food production and processing into the hands of fewer and larger operations, and the national and global supply chains that bring much of our food from farms to consumers, have increased the chance that a single contamination incident could sicken a large number of people.

An example of an unnecessary target is a section of the audit that addresses risks posed by the presence of wildlife and other animals. It assumes that any and all animal presence poses a food safety risk. In most cases it would be a challenge for small farmers to totally prevent all animals, wildlife, livestock or pet, from entering any growing areas. On a small farm, fields are more likely to be near natural areas, perhaps used as buffers, which provide habitat to native wildlife.

Occasionally farm animals are used to provide services to the farm, such as providing manure for fertilization, which would result in an automatic audit failure.

In some circumstances, farmers attempting to sell to multiple buyers could be required to comply with multiple protocols and audits, potentially with differing criteria and focuses. In addition to the cost and burden placed on farmers, consumers might also be confused by such inconsistencies. Without a way to easily evaluate and compare claims from different certifications, they may be more hesitant to support a certain commodity or supplier.

There is potential for some food safety certification programs to have negative environmental effects in the immediate area surrounding farms. In some areas, farmers have lost interest in participating in some conservation programs because of concerns that it could jeopardize their ability to fulfill the requirements for food safety protocols (Starmer & Kulick, 2009). Additionally, although farmers cannot control their proximity to other farming operations, most auditing protocols penalize a farm for being near a facility such as a feedlot, where a concentration of feces heightens risk of the presence of pathogens.

All six sections of the USDA GAP audit include significant detail regarding the sorts of precautions and recording is necessary. All categories require the establishment of programs to follow in the case of certain accidents or incidents. Table 3.3 includes examples of some precautionary actions farmer must be able to prove they have taken. Information farmers must know to make decisions can be hard to track down, and is additionally hampered by differences between auditors. The cost of a GAP audit varies by individual auditor. A USDA audit costs \$92 per hour, in addition to \$1.32 per mile for the auditor's travel. An example of another audit price is Primus, which runs a flat \$600, also including additional travel expenses.

Table 3.3. Precautionary preparations (USDA, 2009)

Examples of necessary precautionary preparations:	
1	The operation has designated someone to implement and oversee an established food safety program.
2	A documented traceability program has been established.
3	The operation has performed a “mock recall” that was proven to be effective.
4	There is a policy describing procedures that specify handling/disposition of produce or food contact surfaces that have come into contact with blood or other body fluids.
5	A previous land use risk assessment has been performed.
6	Each production area is identified or coded to enable traceability in the event of a recall.
7	A response plan is in place for the event of a major spill or leak of field sanitation units or toilet facilities

It is important for farmers to check with third-party auditing companies about their policies, requirements, and pricing, to know exactly what an auditor will need to see (Ducharme, 2011). Although North Carolina Cooperative Extension hosts extensive training workshops, it would not be possible to share exhaustive information or answer 100% of questions accurately due to the differences between auditors and audits as well as the differences between farming operations. As the adage goes, circumstances alter cases.

3.4.3. GAP Audit: Water Quality

Because of the risk water poses as a vehicle of contamination, with the ability to carry pathogens including *E. coli*, *Salmonella spp.*, *Vibrio cholerae*, *Shigella spp.*, *Cryptosporidium parvum*,

Giardia lamblia, *Cyclospora cayetanensis*, *Toxoplasma gondii*, the Norwalk virus and Hepatitis A throughout an operation, it comprises a significant portion of the USDA GAP audit (Baldwin & Grabow, 2009). “Irrigation water and any foliar (leaf) applied water having contact to the developing or mature portions of fresh produce has long been recognized as one of the most plausible and probable sources of fresh produce contamination with pathogens of concern for human health.” (Suslow, 2010; Wheeler, et al., 2005; Hillborn, 1999). In addition to irrigation, water is used for a number of other purposes in the context of preharvest management. These include the application of pesticides, fertilizers, growth regulators, manure teas and compost teas (also used to fertilize), frost control, anti-transpirants (used to prevent plants from losing moisture) and dust control (Suslow, 2010).

The complexity of an on-farm irrigation water management system is determined by a number of factors, chief among them is the particular crop being grown. Irrigation water sources include wells, ponds, rivers, streams, municipal water sources, and reclaimed (treated wastewater) water. Methods of irrigation most commonly used in North Carolina include surface and subsurface drip and overhead (sprinkler) irrigation; other types include furrow, flood, and seep ditches (NC MarketReady, 2009).

The source of water used for irrigation is the first item on the USDA GAP audit. Irrigation water typically comes from a surface water body (pond, stream), a well, or a municipal source. Throughout North Carolina, most irrigation water comes from surface impoundments, typically ponds (NC MarketReady, 2009). Surface water is generally viewed as more susceptible to fecal contamination than is ground water, due to its constant exposure to sources of contamination such as wildlife, livestock, and field runoff. Irrigation with surface water is expected to pose a greater risk to human health than irrigation with water from deep aquifers drawn from properly constructed and protected wells. However, several studies reported a concern with wells based on well-water surveys and the prevalence of human illness associated with contaminated ground water, particularly enteric viruses (Suslow, 2010). The potential causes of such ground water contamination from surface events include flooding and storm-related runoff from areas of concentrated animal manure, manure lagoons, or sewage treatment plants. In addition, wells to

access groundwater can suffer from occasional surface water intrusion, or be exposed to contaminated groundwater resulting from an inoperative or abandoned wells (Suslow, 2010).

Because animal feces are the most likely source of contamination, the presence of livestock and wild animals must be monitored very closely to minimize the chance of contamination. North Carolina Cooperative Extension recommends fencing surface waters to keep livestock out of the water. They also recommend a minimum 25-foot buffer between fencing and water, to serve as both a biofilter to physically trap sediment and potential contaminants, and as a vegetative sink for nutrients contained in any runoff to the water (NC MarketReady, 2009). However, a balance must be found between minimizing the risk of contamination while not going to such extreme measures as to place undue hardship onto a small farmer – as an extreme example, to prevent any animal from ever entering the field or flying over the field to prevent fecal contamination.

3.4.4. Irrigation Water Sampling Challenges

In July 2009, the FDA released “Draft Commodity Specific Guidance” documents for leafy greens, melons, and tomatoes, providing the opportunity for public comment on the drafted guidance. [The document did not provide a time frame explaining when work on the final draft would begin.] This draft is essentially an elaboration of the guidelines it issued in 1998; it provide no specifics, critical limits or metrics based on indicators or pathogen prevalence in a standardized sample of any size. Producers are largely held to self-determination of the broadly applicable position that water should be “of appropriate quality for its intended use,” [and the producer will be] “obtaining water from an appropriate source, or treating and testing water on a regular basis and as needed to ensure appropriate quality” (FDA, 2009b; FDA, 2009a). While not directly part of the GAP audit, this example could be an indicator of the type of criteria that could eventually be part of federal GAP regulation if established in the future.

Currently, there is no universal ‘indicator organism’ used for water quality testing, specified by the EPA or by North Carolina Cooperative Extension. In North Carolina, tests for the presence of total coliform and fecal coliform bacteria are typically performed by water testing laboratories, though are acknowledged to be a poor indication of the quality or safety of water for production

of fruit and vegetable crops (NC MarketReady, 2009). Currently, the US EPA recreational water standards are used for most agricultural water uses, though there is ongoing debate about this issue as will be discussed below. The adoption of meaningful and predictive standards or criteria is significantly hampered by the apparent lack of correlation between the indicator coliforms or generic *E. coli* levels. Generalizing water quality based on the presence or absence of one particular bacteria species, which may not be an appropriate indicator of total water quality, could potentially miss the presence and abundance of another dangerous bacteria or pathogen. Winfield & Groisman (2004) conclude: “different rates of survival of *Salmonella* and *E. coli* in nonhost environments suggest that *E. coli* may not be an appropriate indicator of *Salmonella* contamination.”

In addition to the challenge of identifying specific, useful indicator organisms, water sampling frequency and timing can present major complications that are very difficult to anticipate deal with. An example is disturbance events related to storms or climatic changes, which could significantly, if only temporarily, hamper a grower’s ability to comply with a tightly structured food safety program for fresh produce. For example, an extremely dry season could alter the quality of water in their pond and threaten the result of a water quality test required for a GAP audit. In the audit, irrigation water is assumed to be a highly controllable farm input: question 1-5 under “Water Quality Risks” in the USDA audit form confirms that appropriate measures have been taken to protect irrigation sources from potential direct and non-point source contamination (USDA, 1998). Because small farms often rely on the most accessible source of water on their land, this requirement may be especially damaging to some. For example, surface water and naturally-moving sources (rivers, creeks) or delivered/conveyed water systems (irrigation district canals) can fluctuate in quality and quantity due to seasonal changes, adjacent land uses, wildlife activities or migration, hydrogeologic characteristics of aquifers, recreational activities and easements within agricultural settings, other forms of urban encroachment or urbanization storm events, or other unpredictable conditions, which may be entirely beyond the control of the grower (Suslow, 2010).

3.4.4.1. Suitability of Recreational Standards for Irrigation Water

The majority of GAP systems have adopted EPA recreational water quality criteria for establishing action thresholds, in the absence of actual risk-based data for irrigation water quality. Recreational water standards, based on *E. coli* population counts, shown in Table 3.4, were developed according to US EPA criteria from 1973 and 1996 ((Suslow, 2010). Most Probable Number (MPN) values, an indicator of contamination, were calculated from observed human health risk posed by full-body contact at swimming beaches contaminated with human sewage. Although the contamination sources, water type, and route of infection are dramatically different between swimming at beaches and irrigating produce, the recreational water criteria were easily accessible and anchored to a recognized federal agency rather than being a produce industry-sponsored safety scheme. For the USDA GAP audit, there are two categories of water quality, concerning whether it comes into contact with the edible portion of the crop or not, detailed in Table 3.4.

Table 3.4. General *E. coli* sampling parameters. MPN, an indicator of contamination, are given per 100ml (Ducharme, 2011).

Acceptance Criteria for:	Edible portions	Edible portions
	NOT contacted by water	ARE contacted by water
	MPN 100ml ⁻¹	
Any single sample	576	235
Geometric mean of 5 samples	126	126

The science behind the recreational water criteria was intended to maintain a risk of gastrointestinal illness lower than eight cases per 1,000 swimmers at freshwater beaches based on exposure to point-source, untreated human wastewater discharge or spill. Thus, the criteria may not be relevant to irrigation water (Suslow, 2010).

3.4.4.2. Water Quality Testing in Context of NC GAP Certification

A farmer must be able to provide a detailed and long-term record of water quality testing results of water used for irrigation, fertilization, and processing as part of a GAP audit. Obtaining these test results, however, is not always a simple process. The North Carolina Cooperative Extension Service website, ncmarketready.org, provides many resources for farmers, including information regarding food safety certification. One resource available through the website is a list of all certified water quality testing laboratories in the state. Within the 8-county region of SENCFS, there are 12 water-testing labs whose contact information and testing descriptions can be found on the list. Figure 11A shows the distribution of the 43 labs throughout the state, with the SENCFS region outlined in red. Figure 11B shows a close up of the SENCFS region; the orange line represents a distance of 110 miles, giving a scale of this distribution.

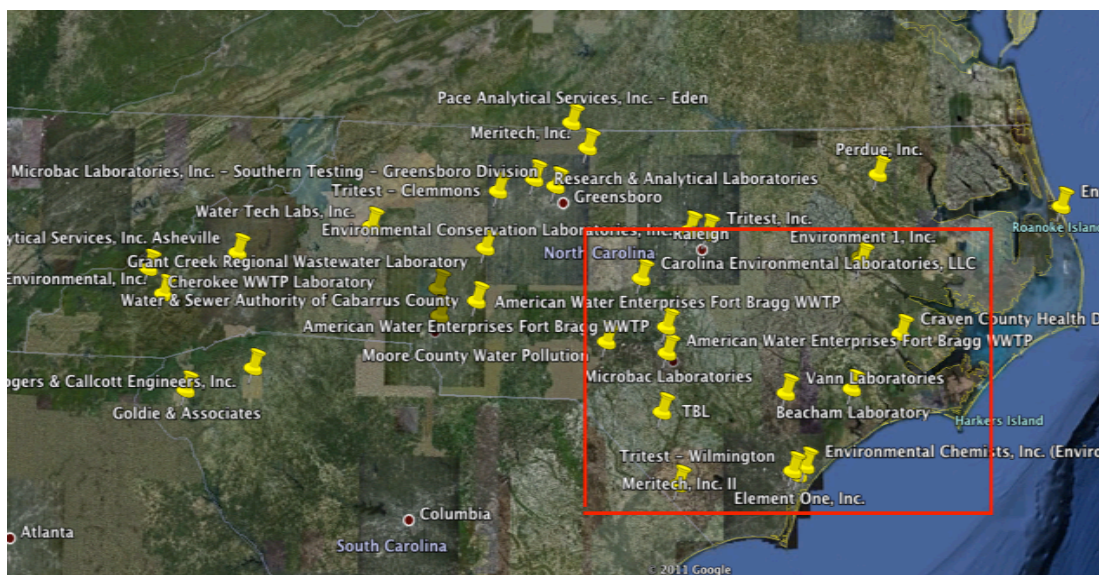


Figure 11A. All water testing labs in North Carolina.

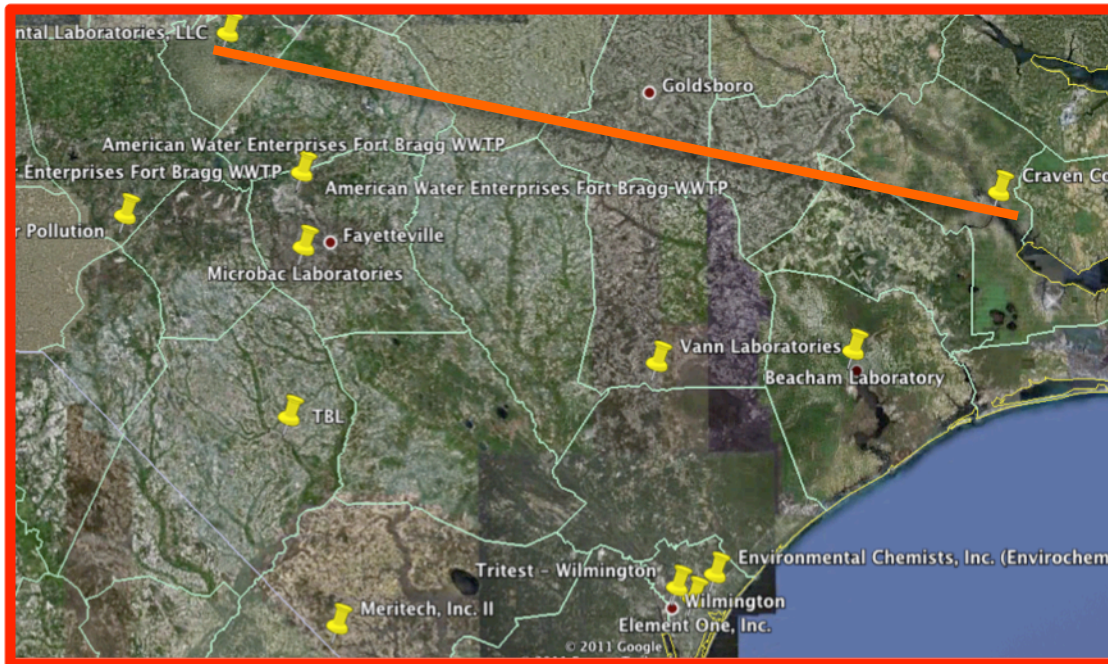


Figure 11B. The distribution of the 12 water-testing laboratories throughout the 8-county region served by SENCFS. The orange line represents a distance of 110 miles, giving a scale of this distribution

In addition to time and practical limitations posed by travel to and from a laboratory several times for a single test, to pick up materials and instructions, return to the farm to take the sample, and then return to the lab to deliver the sample within the required time frame, simply locating a laboratory that can perform the necessary tests can be challenging. Currently, guidance on finding water-testing laboratories is incomplete and outdated. Table 3.5 shows a comparison of information provided on ncmarketready.org, dated November 2009, with information gathered from a survey of the 12 laboratories in February 2011. Information for five of the 12 labs on the list was still accurate, while five had changed either pricing and/or the tests performed, and two were unable to provide data.

Table 3.5. Price information NC MarketReady website from November 2008 with updated information from a survey of the 12 laboratories in February 2011.

Laboratory	City	NC MarketReady prices:		Confirmed prices:		?
		Generic E. coli	Total Fecal Coliform	Generic E. coli	Total Fecal Coliform	Same?
Beacham Laboratory	Jacksonville	\$40.00	\$25.00	no	\$25.00	No
Microbac Laboratories, Inc.	Fayetteville	\$30.00	\$29.00	\$75 for both		No
Vann Laboratories	Wallace	\$25 for both		no	no	
TBL	Lumberton	\$35 for both		\$35 for both		Yes
Tritest - Wilmington	Wilmington	\$35 for both		\$50 for both		No
Environmental Chemists, Inc.	Wilmington	not available	\$35.00	not available	\$35.00	Yes
Moore Co. Water Pollution	Aberdeen	non-testing site	non-testing site	non-testing site	non-testing site	Yes
Carolina Environmental Laboratories, LLC	Sanford	\$30 for both		n/a	n/a	No
Craven Co. Health Dept. Environmental Health Laboratory	New Bern	\$25 for both		\$25 for both		Yes
Meritech, Inc. II	Tabor City	\$33.00	\$33.00		~\$30	No
Element One, Inc.	Wilmington	\$45 for both		no data	no data	
American Water Enterprises Fort Bragg WWTP	Spring Lake	non-testing site	non-testing site	non-testing site	non-testing site	Yes

A farmer typically selects a lab based on proximity, availability of the appropriate tests, and cost. Before selecting a lab to use, a farmer should learn the sampling protocol from the lab, as each lab might have a slightly different method in which they advise a sample be collected, some of which may be more appropriate for some farmers than others. Differences in where to sample based on different water sources, how to take the sample (such as at the edge of a surface water body or using a pole to get a sample several feet out from the edge), and how to process the sample once it is collected are some of the details a farmer must learn from the laboratory during the initial visit when s/he would also collect the supplies. Appendix 1 shows an example of instructions provided by the Craven County Health Department Environmental Health Laboratory in New Bern, North Carolina. There is the potential for conflicting information from different sources, which can be alleviated by guidance from an entity such as NC Cooperative Extension. The NC Cooperative Extension service provides a general overview of the basic practices in more advanced tiers of training (Baldwin & Grabow, 2009).

3.4.4.3. Is a Uniform Standard Possible?

As part of overall food safety regulations, standardized water quality metrics are currently a focus among policy-makers. The World Health Organization standard of <1,000 CFU (a measure of viable bacteria) fecal coliform 100 ml⁻¹ water is based on empirical epidemiological evidence not recognized as acceptable to US public health agencies (Suslow, 2010). Guidelines for health protection must be effective yet practical for the variation in methods of fresh produce production.

Commodity, crop management practices, regional climate, weather or other disturbance-related events are all factors that should be considered in setting microbiological limits (Suslow, 2010). In his article, Suslow (2010) explains that a single national standard for irrigation water quality would be unwise. Many differences exist in risk between different commodities, regions, and scales of production. Especially important for small farmers is the need for flexibility for an individual farm's specific conditions and capabilities. As science-based criteria are required for recreational waters, science should be applied to irrigation water as well. Minimizing the potential contamination that could reach consumers is the most important goal in all production operations. Rather than using the existing guidelines for recreational water, the EPA should set microbiological limits specific to agricultural irrigation water, accounting for a range of bacteria for different sources of irrigation water.

With so many variables and uncertainties, it becomes clear why regulatory agencies have had difficulty in creating regulatory water quality criteria that are detailed enough to be effective, but flexible enough to be applicable to a wide variety of production facilities. Returning to the subject of water quality, Suslow (2010) highlights some of these detailed and multi-level audit requirements that could present significant challenges to farmers monetarily: the adoption and enforcing of variable irrigation water quality standards, one of which being the cost of remediating contaminated water prior to use for irrigation. These two factors represent examples in just one subject area while similar changes will be necessary in the other five sections of the audit, such as animal control or providing sanitary facilities for all employees. They also allow for an explanation of the difficulty of creating uniform standards – source of water and financial resources of the farmer would make compliance very variable.

One solution for growers faced with the uncertainty of irrigation standards, or the repeated failure of the only available water source to meet the metrics for indicator bacteria, has been to treat their water, most often with calcium hypochlorite or chlorine dioxide injection (Suslow, 2010). The goal of the dosing system is to bring the indicator *E. coli* levels within a compliant range. It is unknown what the long-term effects of large-scale use could be on soil quality or the surrounding ecosystem could be impacted. Ozonation and UV treatment are two alternative water treatments with minimal concerns, though are too costly for most producers (Suslow, 2010).

3.4.5. Potential Significance of GAP Regulations to Small Farmers in Southeastern NC

One of the most problematic effects of the current food safety system is the threat it poses to jeopardizing efforts to build local and regional food systems. Historically, local food initiatives have grown and evolved organically, through concern for the land, and often through community action to support farmers in the area. Many farmers and other groups feel very strongly that federal regulations would likely not allow the flexibility necessary to ensure the ability to freely buy and sell directly, a relationship between grower and consumer built on trust. One of the biggest potential problems is simply the difficulty it can be to some small farmers to meet all criteria necessary to obtain certain safety regulations.

“Smaller, limited resource, and/or more diverse farms often cannot or will not comply with programs that require expensive testing, audits and electronic documentation and that mandate the removal of conservation practices. Because of the expense and the practices required by many food safety protocols, the system is biased in favor of larger, less-diverse farms and access to food produced locally, sustainably or on smaller-scale operations is limited” (Starmer & Kulick, 2009).

These concerns are supported by interviews with 17 small, limited resource, produce-growing farmers in southeastern North Carolina during July 2010. (For complete interview summary, see Appendix 2). These responses are summarized in Table 3.6. Out of 17 farmers, 14 were

questioned about their knowledge of GAP certification. All 14 farmers had at least heard of GAP, and two were already certified. Responses were equally divided between interested in learning more, maybe interested in learning more, and not interested at all. For uninterested farmers, the most frequently cited responses related to the cost in time and money.

Table 3.6. Summary of farmer interest in GAP, based on 2010 interviews.

GAP?	# of farmers
Yes, interested	4
Maybe	4
No	4
Already certified	2

Two examples of concerns and complaints about the GAP certification system follow.

“Our wholesaler wanted us to do it. It is a huge pain, and it cost a good chunk of money. But we've been encouraged to do it for years. [It's] a lot of work to get it, paperwork, lots of details. Very scary for the small farmers” (Newberry, 2010).

“[It] seems like a very extreme approach to take – No [I'm not interested]. Can't imagine how it would affect small farmers. [I] would probably find a way around it if it became required, like requiring customers to sign waivers or something” (Deener, 2010).

There seems to be a high level of trepidation and misconception surrounding GAP among small and limited-resource farmers in the SENCFS region, tending toward the side of negativity as is illustrated in the two quotations above. All 14 of the farmers interviewed had at least heard of GAP. Two of these farmers were certified already, five were interested in attending the workshops to learn more about the process, one stated that he must know there is a need for it before he would be interested, and three were not interested at all.

GAP certification is not yet universally required. It is currently up to an industry to determine whether or not to require certification, and if so, what type. Currently the NCDACS requires

GAP certification for all local growers that participate in the Farm-to-School Program. Similarly, the Agricultural and Marketing Service of the USDA requires GAP Certification for produce growers whose produce will ultimately be used in the school meals program. The intent is to be consistent with federal level agricultural authorities that have established GAP certification as a requirement for the purchase of fresh produce for service in the Child Nutrition Programs (Harvey, 2010; Ducharme, 2011).

Even without GAP certification, small farmers in southeastern North Carolina remain free to sell their products through CSAs, farmer's markets, roadside stands, and to local restaurants. The benefit of such a direct relationship between a farmer and a consumer benefits both sides equally, and keeps the economic benefit of the transaction entirely within the community.

Due to the challenges GAP certification poses to small, limited-resource farmers, SENCFS is working to provide assistance to farmers in the region. They are working with the NC Extension Service to facilitate an increase in the number of training workshops in the area. According to SENCFS director Renee Eli, she would eventually like to see the organization as a support leg for full farm certification (Eli, 2011). Renee is also hoping that in the near future, they will be able to support a handful of farmers to get certified with additional grants. In the early stages, she is especially interested in beginning by supporting farmers who would likely be able to get their produce into schools.

Through conversations Ms. Eli has had with several farmers in the region, she has gotten a sense of some of the reservations some farmers have toward looking seriously into becoming GAP certified. The most frequently stated reason is cost – besides the cost of certification, for many farmers there would be significant costs to prepare for the audit. One farmer stated that it would cost \$10,000 just to install sinks everywhere they audit would require them. Another high cost is in the time it would take to prepare, as well as the continuous time that would be required to maintain the necessary records required by the audit. Ms. Eli's findings of farmer concerns are consistent with those from the 2010 survey.

The North Carolina Department of Agriculture and Consumer Services offers two cost-share grant programs to assist farmers with the costs of water analysis and independent GAP certification. The Water Analysis Cost Share Grant Program reimburses farmers up to \$200 for certified laboratory analysis of irrigation and packing house wash water. The department also offers the Good Agricultural Practices Certification Assistance Program that covers up to \$600 toward a GAP audit (NCDA&CS).

3.5. Farmer Support: GAP Educational Process and NC Market Ready Program

The NC MarketReady program was started by North Carolina State University as a project of the College of Agriculture and Life Sciences and North Carolina Cooperative Extension. The goal of the multidisciplinary NC Market Ready team is “to build partnerships and educational resources to help North Carolina agriculture be more profitable.” To do so, the program has developed many educational programs and information resources on an array of topics from business and marketing to detailed information about growing certain crops, all with the aim to help North Carolina farmers be successful. As is stated on the North Carolina Market Ready website, www.ncmarketready.org, programs are designed to enhance and integrate farmers’ skills and knowledge in five key focus areas: agriculture enterprise development, business skills education, fresh produce safety, horticulture skills education, and strengthening markets.

The North Carolina Cooperative Extension Service presents training workshops periodically and in different regions in the state to introduce and educate farmers interested in learning about the GAP certification process. In the GAP training section there is an entire 2-hour module devoted to water quality. The training module stresses the importance of personal hygiene in preventing the spread of pathogens (NC MarketReady, 2009).

The GAP training program available through North Carolina Cooperative Extension is divided into three ‘tiers’, each of which is composed of several modules addressing particular aspects included in the audit. Farm to Family Tier 2 training session, an all day workshop event, is focused on risk identification and management. SENCFS as well as other organizations in the

state (based on direct communication with Diane Ducharme, the statewide GAP coordinator) are attempting to answer this ongoing question: why do so many farmers attend the first tier of training, but the not return for the second level? (Ducharme, 2011) A survey that directly targets a large and diverse sample of individuals known to have participated in an introductory level training will be essential to answering that question. Several hypotheses to this question are concern about cost, both in time and money, and uncertainty as to whether the certification is actually necessary and what the payoff will be worth it.

3.6. GAP Summary: Findings and Recommendations

In fulfilling its mission, SENCFS is in a position in the region to have a huge impact on the direction and extent to which a regional food economy develops. “Something in the [regional food] system has to switch a bit for farmers to want to take the step. We’re trying to figure out what that is.” (Eli, 2011) In order for small farms to be economically productive operations, they must have a consumer base to provide support. Being GAP certified opens large, previously unreachable segment of the market as potential consumers for small farms. There are a number of ways that SENCFS can work with both sides of the food supply chain to smooth acceptance and compliance with food safety regulations.

The results from the farmer survey described above suggest there is considerable interest within the farming community to learning more about the GAP certification process. Well over half the farmers in the survey were interested in GAP, at the very least in learning more about it. SENCFS is able to be a local, more specialized resource to support farmers.

We recommend that SENCFS target GAP as a major organizational focus in the following ways:

1. SENCFS should continue to work with North Carolina Cooperative Extension to ensure that ample educational resources are made available. Cooperative Extension regularly conducts GAP training workshops about GAP around the state. The workshops are organized in a series, and it has been recognized that often farmers attend the first session, but do not return for subsequent sessions. SENCFS could work with Cooperative

Extension in the area to create a streamlined introductory level course that thoroughly explains WHY GAP is relevant, and WHAT farmers can do to get started, before the established training workshops begin.

- a. Another very important task will be explaining to farmers why they should care about food safety regulations, and how they could be affected. This information will likely go a long way to encouraging further interest within the farming community about becoming GAP certified, which will boost the overall opportunity for small farms to enter the institutional markets. The processing and distribution center will be a additional catalyst in this movement.
2. SENCFS should continue to seek ways to assist farmers with bearing the financial burden of GAP certification. In addition to pursuing grants with which they could directly assist some farmers through at least parts of the process, they should also be able to share other financial resource with farmers.
 - a. Examples include cost-share grant programs that assist famers with the costs of water analysis and independent GAP certification offered by the North Carolina Department of Agriculture and Consumer Services. The Water Analysis Cost Share Grant Program reimburses farmers up to \$200 for certified laboratory analysis of irrigation and packinghouse wash water. The department also offers the Good Agricultural Practices Certification Assistance Program that covers up to \$600 toward a GAP audit (NCDA&CS).
3. SENCFS should develop and maintain relationships with all Cooperative Extension agents in the counties in which they work who will be able to work directly with farmers and provide farming-related information. The region has a wide diversity of farms and farmers, able to supply an exciting array of products to local markets, which will continue to grow with appropriate guidance and support. Because agents may specialize in different aspects of farming, building a support team that will be able to provide answers and help on any issue that a farmer in the region may need assistance with is another important resource that SENCFS should attempt to provide.
4. SENCFS should provide resources to assist farmers in gaining business and marketing skills, another necessary component to growing and strengthening their operations.

Community colleges or other community development organizations could be partners in creating educational workshops or counselors for these areas.

SENCFS is building its presence simultaneously with the local food movement itself. Statewide, local food represents a growing culture with the potential to have significant sway in the health of communities as well as economies. Ensuring that small farms are able to partake in all levels of this rapidly growing economic sector will help ensure their long term health.

Part 4. Farm to school

Schools are one institutional buyer to which farmers can sell. SENCFS has chosen to initially target schools and focus their efforts on implementing a farm to school program in the study region given the large number of meals served per day (over 150,000) and the consistent demand for food. This section explores how a farm to school program in southeastern North Carolina can be implemented in the context of the existing national food system structure, and the history and current state of school food programs across the nation. The scope is then narrowed and recommendations for implementation are based on successful farm to school programs in various states, the operational aspects of school food programs specific to southeastern North Carolina, and program participation barriers faced by Child Nutrition Directors in the 11-county study region.

4.1. Methods

An in-depth literature review was conducted for background information and identified 1) the structure of the current food system, within which poor and food insecure children exist; 2) the structure of school food programs, both in terms of nutrition standards and funding; 3) the ways in which farm to school programs can combat such a broken food system and work within the school food program framework; and 4) key elements of successful farm to school programs in North Carolina and case studies across the nation.

Specific barriers to the implementation of farm to school programs in southeastern North Carolina were identified via phone and email interviews with Child Nutrition Directors in the region. These interviews provided in-depth data on the individual issues they face in purchasing decisions, as well as their respective individual expression of how they could benefit from the assistance of a regional organization. Specific information obtained included Child Nutrition Directors' level of knowledge concerning local sourcing and the barriers to and existence of technical assistance for writing local bids. See Appendix 3 and 4 for a list of questions. The area

Child Nutrition Directors were split into two groups: Group A includes those who had not yet been surveyed by SENCFS personnel; Group B includes those Child Nutrition Directors previously surveyed by Raven Bruno, a graduate student at the University of North Carolina at Wilmington, of whom we asked additional follow-up questions.

Recommendations for SENCFS on how to successfully implement a farm to school program in the study region were crafted based on the interviews and literature review.

4.2. A Broken Food System: Food Insecure Children

Many children are tangled up in a broken food system. As children—and consumers in general—usually lack personal knowledge about the farms and farmers who grow their food, they have limited control over the quality and safety of it. Such a lack of consumer input in the quality of their food has allowed for our nation’s agricultural policy to counter consumer health. As a result of current policy, a conundrum known as the “cost-calorie paradox” exists where less calorically dense foods of higher nutritional quality are more expensive than more calorically dense foods of low nutrient content. This paradox exacerbates food access obstacles such as neighborhoods with few stores that sell fresh foods relative to unhealthy alternatives, and makes it difficult for many low-income children and families to obtain the fruits, vegetables and other wholesome foods they need to maintain a balanced diet. Consequentially, an abundance of highly processed, less healthy foods regularly make their way onto children’s plates and poor eating habits are instilled. Poor eating habits play a huge role in the rise of overweight and obese children in the United States (New Haven Food Policy Council, 2008; Dillon & Harris, 2007).

Children do not have to be relegated to such an unhealthy food system. Children can gain access to higher-quality, more healthful food when small farmers are able to sell their products to schools through a local food system. Additionally, farmers gain a new and reliable market, and more food dollars are invested in the local economy. Facilitators of a local food system can improve food access and food quality, thereby providing a major opportunity for reducing childhood obesity, and provide food education to children to improve eating habits.

4.3. Part of the Solution: Farm to School

Schools can play a large role in strengthening community food systems. They represent institutional buyers who serve hundreds of meals daily and have a consistent demand for food. Farm to school programs connect schools with local farms and contribute to the local food system. There are an estimated 2,352 farm to school programs across the country operating in 48 states, involving 9,756 schools and 2,255 school districts (National Farm to School Network, 2010). Because each community and region is unique, they shape each farm to school program, making a prescribed list of practices or products difficult. Benefits of farm to school include:

“strengthening children’s and communities’ knowledge about and attitudes toward agriculture, food, nutrition and the environment; increasing children’s participation in the school meals program and consumption of fruits and vegetables, thereby improving childhood nutrition, reducing hunger and preventing obesity and obesity-related diseases; supporting economic development across numerous sectors and promoting job creation; increasing market opportunities for farmers, fisher, ranchers, food processors and food manufacturers; and decreasing the distance between producers and consumers, thus promoting food security while reducing greenhouse gas emissions and reliance on oil” (National Farm to School Network, 2010).

A huge benefit lies in farm to school programs’ promotion of good health and nutrition. Children have the potential to benefit the most nutritionally from local food systems by way of farm to school programs. Students eat up to 40% of their meals at school, and over thirty million children receive low-cost or free lunches through the National School Lunch Program (NSLP) (USDA FNS, 2010). This program provides nutritionally balanced, low cost or free lunches to children in public and nonprofit private schools and residential child care institutions each school day. For many children, the meals received in school may be their only chance at a healthy meal all day. School meals, therefore, provide the major source of nutrition for America’s neediest children. Farm to school programs are a way in which school meals can be made even more nutritious for these children (New Haven Food Policy Council, 2008).

On the other end of the spectrum, school meals offer an important opportunity to introduce to healthy eating to those overweight/obese students who fall prey to the cost-calorie paradox. Schools are an ideal place to encourage increased consumption of fresh, nutritional produce. Farm to school programs seek to seize such an opportunity and foster healthy relationships with food by featuring locally grown produce on school menus and in classrooms, developing local foods-related curriculums, and providing experimental learning opportunities for children. These learning opportunities include school gardens, farm tours, farmers' market visits, classroom teachings from farmers and chefs, culinary education, and parental and community members' education (National Farm to School Network, 2010).

Additionally, healthier school meals make a vast difference in reducing behavior problems (Dillon & Harris, 2007)). For example, Pelsser et al. (2011) found that children's diets are often the cause of Attention Deficit Hyperactive Disorder (ADHD). Health intervention in childhood can set the stage for good health throughout a person's life.

4.4. School Food Programs

4.4.1. Legislative History

A brief history of school food programs is necessary to identify factors that inhibit the ability of school districts to provide fresh, healthy meals using local produce (see Table 4.1 for a comprehensive timeline of school food program legislation). After World War II, Congress instituted the National School Lunch Act to reduce "income-based inequalities in food access" and better nourish school children in the event of another world war. This program set nutritional standards, where lunch was designed to meet one-third to one-half of the minimum daily nutritional requirements of a child 10-12 years of age, and provided for meal subsidies (Gunderson, 2009). The Act worked with the Farm Bill to create the commodities program, through which schools receive free food distributed through the USDA and are eligible for bonus commodities that the Secretary of Agriculture deems overabundant. In 1966, Congress supplemented and expanded the National School Lunch Program (NSLP) with the Child Nutrition Act, which extended the Special Milk Program, and began a pilot breakfast program. Now a permanent program, the School Breakfast Program (SBP) provides cash assistance to

states to operate nonprofit breakfast programs in schools and residential childcare institutions. The Special Milk Program provides milk to children in schools and childcare institutions who do not participate in other Federal meal service programs. In 2002, a pilot Fresh Fruit and Vegetable Program provided free fresh fruits and vegetables in selected low-income elementary schools nationwide. In 2008, the program was made permanent with its inclusion in the Farm Bill (USDA FNS, 2010).

Currently, all these programs are housed under the title Child Nutrition Programs, which are a federally administered set of programs that “promote life-long healthful living while providing nutritious meals each day that prepare children for learning” (OPSI). Each program has eligibility requirements and school participation is voluntary. These programs are administered in participating school districts by Child Nutrition Directors, who conduct all purchasing, ordering, menu planning and program oversight. Child Nutrition Programs operate on a non-profits basis, and are partially funded by federal reimbursements for free, reduced and full price meals. Revenues for program supplies, equipment, indirect costs and salaries are generated via ‘à la carte’ offerings and full priced meals. Additional federal assistance is available through the Fresh Fruits and Vegetable Program Grant, which results in an extra \$50-\$75 per student per year for fresh fruits and vegetables for those elementary schools that operate a NSLP and have over 50% of students eligible for free and reduced lunch (Bruno R. H., 2009a). School systems participating in and receiving federal funds for Child Nutrition Programs were allowed to apply geographic preference to their produce purchasing with the Food, Conservation and Energy Act of 2008 (USDA, 2005).

Table 4.1. Legislation Pertinent to School Food Programs

Year	Legislation	Main Goal(s)
1946	The National School Lunch Act	Sets nutrition standards and provided for meal subsidies
1966	The Child Nutrition Act	Began the School Breakfast Program and extended the Special Milk Program

2002	Pilot Fresh Fruit and Vegetable Program	Provided free produce to low income schools
2008	Farm Bill	Made permanent The Fresh Fruit and Vegetable Program
2008	The Food, Conservation and Energy Act	Lifted the ban on geographic preference

The text of both the NSLP and the Child Nutrition Act outlines the framework for the school breakfast and lunch programs, and the Secretary of Agriculture prescribes the rules and guidelines (New Haven Food Policy Council, 2008). As you will see below, more processed foods in school meals are paradoxically favored by both federally mandated nutrition standards and low federal reimbursement rates, thereby working against the sourcing of local produce in schools.

4.4.2. Federally Mandated Nutrition Standards

Federal nutrition standards set the minimum nutritional requirements for federal reimbursement. All funds are distributed directly to the states for their further apportionment. Schools that participate in the NSLP or SBP must offer breakfasts and lunches that are consistent with goals of the most recent *Dietary Guidelines for Americans*. Current nutrition requirements for school meals are based on the 1995 *Dietary Guidelines for Americans* and 1989 Recommended Daily Allowances (RDAs), which require schools lunches to provide 1/3 of RDAs of protein, vitamins A and C, iron and calcium; school breakfasts must satisfy 1/4 of the RDAs for the same nutrients (USDA FNS, 2011). To comply with these nutrient standards, schools can plan meals according to two standards, nutrient- or traditional food-based. The nutrient-based standards require nutrient analysis of meals to determine the quality of each nutrient (i.e. carbohydrates, fat, saturated fat, protein, fiber, sodium, vitamin A, vitamin C, folate, calcium, iron and zinc). No more than 30% of calories can come from fat, and no more than 10% from saturated fat. Additionally, the USDA requires schools to create and use standardized recipes, to ensure standardization of nutrient content whenever that meal is produced. In contrast, traditional food-based standards require only that the school serve a certain number of ounces per class of food.

A school breakfast must consist of 8 oz. fluid milk, ½ cup vegetable/fruit or full-strength juice, two 1 oz. servings of bread/bread alternate or meat/meat alternate, or one serving of bread/bread alternate and one of meat/meat alternate. A school lunch must consist of 2 oz. meat/meat alternate, bread/bread alternate, ½ cup vegetable, ½ cup fruit, and 8 oz. milk. This food-based option allows for more latitude in meeting the guidelines and, thus, many school districts choose to plan their menus based on it (New Haven Food Policy Council, 2008; USDA FNS, 2011).

Implementation of these standards is problematic. The use of undesirable, processed foods is allowable under the traditional food-based option, with few “traditional” foods actually being “traditional.” For instance, “traditional” bread is not whole grain bread but highly processed, enriched white bread. Also, America’s childhood obesity epidemic is not addressed, and is perhaps exacerbated, by nutritional standards for all menu-planning options. These standards specify calorie minimums rather than maximums, and although providing enough calories was the goal of the program in 1946, we are now faced with an overabundance of calories from unhealthy sources. In addition to the aforementioned problems, the nutrition standards rest on a “faulty paradigm.” Food quality is measured by the metric of fat and calories, thereby blurring the distinction between food and “foodlike substances,” as Michael Pollan (2008) puts it in *In Defense of Food*. Under this paradigm, a “foodlike substance” such as enriched white bread might be favored, even though it is categorically less nutritious than whole grain bread, because it is lower in carbohydrates and higher in B vitamins (New Haven Food Policy Council, 2008).

In January 2011, the USDA Food and Nutrition Service proposed to revise USDA nutrition standards in the NSLP and SBP to align them with the 2005 *Dietary Guidelines for Americans*. This proposed rule would increase the amount and variety of fruits, vegetables, whole grains, and fat-free and low-fat fluid milk in school meals; set a minimum and maximum level of calories; and reduce the levels of sodium and saturated fat in meals. Specifically, this rule would double the number of fruit and vegetable servings offered at breakfast and substantively increase those servings offered at lunch; and disallow substitutions between fruits and vegetables, giving each its own requirement and ensuring that students are offered both fruits and vegetables every day. Also, this rule would require a minimum number of vegetable servings from each of four vegetable subgroups; require all grain products to be whole grain rich; and substitute low fat and

skim milk for higher fat milk (USDA FNS, 2011). These standards have yet to be federally mandated; however, such a mandate would significantly work to the benefit of farm to school programs.

4.4.3. Federal Reimbursement Rates

The major factor in preventing many school districts from serving healthy, fresh and unprocessed foods is low reimbursement rates. These low rates are part of the nation’s overall food policy, which contributes to the “cost-calorie paradox.” The Farm Bill creates strong incentives to grow a limited range of crops, the glut of which dramatically depresses prices once they flood the market; producers tend to shift toward the lower-priced input—most often corn—which is then substituted for other ingredients by food producers and manufacturers. Therefore, foods that contain more low-priced corn-based ingredients tend to be less expensive than their less processed counterparts (New Haven Food Policy Council, 2008).

Because of this cost-calorie paradox, schools faced with low reimbursements rates and minimal state and local financial support are forced to make difficult choices. Serving highly processed foods is often a tool used to combat financial burdens. Schools can attempt to keep costs within the federal reimbursement rates, which still may result in serving highly processed, less healthy foods; or schools can choose to provide healthier meals at costs that exceed the federal reimbursement rate and compensate for the shortfall by offering competitive foods. These foods may be a la carte offerings or food and drink in vending machines, and are often the least healthy foods served in the school. Child Nutrition Programs could not operate without the additional revenues provided by the sale of these items and, therefore, replacement with healthier items is typically cost-prohibitive (Andersen et al., 2004; New Haven Food Policy Council, 2008).

4.5. Demographics of Southeastern North Carolina Schools

The study area in Southeastern North Carolina is home to 14 school systems (which will be referred to as county 1 through 14 schools), over 250 schools and over 140,000 school children. Between 42% and 84% of students in the schools systems qualify for free and reduced lunch, as they live at or below the poverty line (The Annie E. Casey Foundation, 2009). Each school

system offers breakfast and lunch under the NSLP and SBP. These programs are operated either independently or by the food management company Aramark. School systems that are independently operated enable the Child Nutrition Director to choose the food vendors and set her own contract and bid regulations. In contrast, Child Nutrition Programs that are operated by Aramark require the Child Nutrition Director, an employee of Aramark, to purchase all school products through Aramark-approved vendors and contracts (Bruno R. H., 2009a). All elementary schools are required to plan meals according to North Carolina nutrition standards, which are stricter than current USDA standards and, therefore, take prevalence. However, state specified nutrition standards for secondary schools in North Carolina currently do not exist and meals are planned according to USDA standards.

4.5.1. Nutrition Standards in NC

The nutrition standards for North Carolina elementary schools are strikingly similar to the aforementioned improved USDA nutrition standards that have yet to be mandated. Within North Carolina standards, reimbursable meals must contain no more than 200mg cholesterol over the course of a week for breakfasts and lunches; food preparation methods for all foods must be limited to baking, roasting, broiling, and steaming; a minimum of 1 daily serving of whole grain products must be offered, and whole grain foods will be increased gradually to 8 servings per week as market availability permits. Additionally, four fruits and/or vegetables must be offered daily and may be canned, frozen, fresh, or dried with preparation methods limited to baking, roasting, broiling, and steaming; dark green, deep yellow or orange fruits must be offered 3 or more times per week; fresh fruits and vegetables must be offered at least 4 times weekly at breakfast and/or lunch; legumes must be offered at least 1 time per week; and all milk choices must be 1% or less fat. These standards were implemented in 2008, and while they remain unfunded, provide an encouraging atmosphere for farm to school programs (North Carolina State Board of Education, 2006). See Appendix 3 for county-specific breakfast, lunch, and a la carte menus in elementary and secondary schools.

4.5.2. Operations and Purchasing

The fruits and vegetables for meals planned in accordance with state and federal nutrition standards can be purchased with some form of federal funding in a variety of ways.

The first vehicle for purchasing local produce is through vendors. Each school system commonly purchases fresh fruits and vegetables through a vendor who has a pre-established contract via a formal bidding process. Food items purchased through competitive bidding undergo strict scrutiny to meet Child Nutrition Directors' specifications of description, quality, availability, and pricing. Usually the vendor with the lowest bid is accepted. Self-operating Child Nutrition Programs have multiple vendors that supply different products, with vendor contracts established on a semi-annual or annual basis (Bruno R. H., 2009a). For example, survey data indicates the 2010 annual bid for produce provision was awarded to US Foodservice in both County 1 and 8 schools. Alternatively, programs operated by Aramark, like those in County 9 schools, purchase produce only through Sysco, Aramark's contracted produce vendor in Southeastern North Carolina. Child Nutrition Directors were given the option to write local bids through the Food, Conservation and Energy Act of 2008 (previously mentioned). SENCFS hopes to utilize this pathway to local sourcing by becoming a competitively priced vendor of local fresh produce and frozen fruits and vegetables, representing a local farm cooperative. This cooperative is named SENC Foods and opened in Spring 2011.

Additionally, all school systems have the option to source produce elsewhere. Child Nutrition Directors can purchase produce for their school system using entitlement dollars through a North Carolina Department of Defense (DoD) contractor via the DoD Fresh Fruits and Vegetables program. And schools can purchase directly from farmers via the North Carolina Department of Agriculture and Consumer Services (NCDA & CS) Farm to School program. This program, however, comes with many stipulations—including NC Farm to School Cooperative membership, \$2 million liability insurance, GAP certification, and enrollment in the NCDA&CS agricultural marketing program, Goodness Grows in NC—that make it difficult and expensive for small and medium sized farms to participate (Bruno R. H., 2009a). SENCFS hopes to implement Farm to School programs in the Southeastern NC region that enable the participation of these small farmers.

4.6. Difficulties in Farm to School Program Implementation in Southeastern North Carolina

While ambitious and exciting, the aforementioned avenues to source locally in schools are not being utilized to the fullest given numerous barriers and challenges. Identification of these barriers is based on Child Nutrition Director interview data. Relevant components of farm to school programs reviewed in case studies are paired with the barriers they best address, and serve as the basis for recommendations to SENCFS.

4.6.1. Cost

The greatest barrier to sourcing locally in these school systems is cost, as federal assistance only goes so far. The USDA reimbursement is only a supplemental payment, and survey data indicates it covers only ~50% of Child Nutrition Programs' operating costs (i.e. food, supplies, equipment, indirect costs, and salaries). No additional state funding is provided for Child Nutrition Programs. The remaining portion of Child Nutrition Program operations are supported by a la carte food and drink sales, which are in all North Carolina public schools in addition to school meals and are typically of limited nutritional value (see Appendix 5 for a la carte offerings in County 8 schools). The Child Nutrition Director in County 2 admitted to feeling conflicted between purchasing certain things because she has to make money to cover the program and following restrictive nutrition standards, as more nutritious food is typically more expensive. Child Nutrition Directors must find creative ways to scrape up the money required to run successful Child Nutrition Programs.

Such financial distress restricts how much of the total food budget can be allocated to the purchasing of more expensive fruits and vegetables and how much per produce portion a school system can afford. Additionally, following unfunded mandated nutrition standards amidst operating balance deficits significantly restrict what and where food is sourced, and how it is prepared. See Tables 4.2 and 4.3 for county-specific examples of budget allocations and restrictions on sourcing and preparation. Most Child Nutrition Directors allocate a very small percentage of their food budgets to the purchase of fresh fruit and vegetables.

Table 4.2. County food budget allocations

County	Percentage of total food budget allocated to fruits and vegetables
County 1	Unknown, but 30% of total Child Nutrition Director budget allocated to <i>food</i> (fresh fruits and vegetables are not separated out in this percentage). No profits are made from lunches and there are no vending machines in these schools.
County 7	Less than 8%
County 8	A little over 1%. The average plate cost per meal exceeds \$3 when they only charge \$1.75 for a paid student meal.
County 9	20%. These schools use Aramark specified products, which are preferred choices in terms of the best nutrition, pricing, etc., and cannot afford fruits or vegetables above \$0.22 per portion. 2% is allocated to local produce purchasing.
County 10	A little over 2%. These schools must cover all of their own food and equipment costs, as well as some overhead like electric. Weekly bidding of vegetables is performed as a way to control the costs of meals.
County 14	A little over 1%. Commodities moneys cannot be spent elsewhere and there is a limited budget for kitchen labor hours.

Table 4.3. County restrictions on school food sourcing and preparation

County	Restriction on Sourcing/Preparation
County 2	Moving toward a convenience program, where meals come pre-cooked and will only require pre-heating. The elimination of raw beef is also being considered for cost reasons. The county’s entitlement dollars for USDA commodities will be spent on commodities, like frozen chicken pieces, and commodity processing, which turns cheese into macaroni and cheese for a fee that covers the cost of the product and its processing. Processed foods are, therefore, more cost effective
County 7	Cutting back on preparation and going to pre-sliced meats

Case Studies

Several states have prioritized healthy schools meals through increased funding, and improved nutrition standards and school wellness policies. For example, the state of California allocated \$18.2 million for produce purchases after it passed the most stringent nutrition guidelines in the nation in 2005. The state legislature of Oklahoma passed legislation establishing a statewide farm to school initiative in 2006 (Kloppenborg et al., 2007). And the state of Michigan incorporates farm to school into school wellness policies. See Appendix 6 for a sample of model language for incorporating farm to school into school wellness policies developed by the Community Food Security Coalition and the Center for Ecoliteracy (Izumi & Matts).

4.6.2. Regulation Restrictions

Federal and state food safety regulations for sourcing local produce in schools further compound farm to school programs. Listed produce vendors must follow Hazard Analysis and Critical Control Points (HACCP) standards in order for Child Nutrition Directors to buy from them. Additionally, the Agricultural Marketing service of USDA requires GAP certification for those produce growers whose produce will be used in school meals. Further standards set for the regulation of produce vendors are to be determined by the Child Nutrition Director of each school system and written into the produce bid (Harvey, 2010). For example, County 9 schools require an additional \$1 million insurance policy for produce vendors, which is implemented by Aramark to prevent purchases from a farmer selling produce out of the back of his truck without HACCP policies in place (Bruno R. H., 2009a).

Most school systems are not currently sourcing local produce due to lack of GAP certification on nearby small farms. This is the case even if Child Nutrition Directors are interested in sourcing locally and are unconcerned about small farm food safety issues. Given cost prohibitive nature of GAP and the difficulties in knowing the steps involved in actually becoming GAP certified, many farmers who are prime candidates for a farm to school program cannot legally participate. NC-mandated GAP certification has restricted uncertified small farmers from entering the farm to school market, but survey data indicates it has also increased produce prices in schools and, in some cases, produced a lesser quality product. For others, like County 9 schools, the GAP certification mandate has brought schools more possible vendors. As more local farmers meet

these regulations, these schools will be able to consider them as a possible vendor.

4.6.3. Child Nutrition Directors' Know-How

Additional challenges for farm to school programs lie in Child Nutrition Directors' general lack of knowledge about where and how to source local produce. Here, SENCFS can have the most direct impact. Many area Child Nutrition Directors have expressed interest in incorporating local food products into their Child Nutrition Programs, yet, lack the resources, both in terms of time and logistics, to contact farmers for various products. Generally, interviews indicated Child Nutrition Directors have concerns about establishing relationships with local farmers, the provision of enough product or variety to meet school district needs, time associated with writing local bids, costs associated with processing/delivery, and convenience of sourcing locally. See Table 4.4 for county-specific concerns of Child Nutrition Directors regarding sourcing local produce.

Table 4.4. Areas in which Child Nutrition Directors Lack Knowledge

County	Issues/Concerns
County 1	<ul style="list-style-type: none"> • Type of crops being grown in the county. • Quantity of produce that could be provided to the school system. • Attitude of farmers concerning collaboration and meeting federal requirements. • Tax burdens imposed on farmers by shifting from selling at roadside stands to schools. • Burdens on cafeteria staff from extra duties that may result via preparation of unprocessed, local produce (costs can only be controlled in this district via labor, which is 65% of the budget, and there is no additional money for extra staff, should the preparation of local produce require it).
County 8	<ul style="list-style-type: none"> • Capacity to produce enough product to fill a truck for delivery. • Convenience of local sourcing for larger districts.
County 7	<ul style="list-style-type: none"> • Contacting farmers for certain products.

	<ul style="list-style-type: none"> • Assistance in terms of resources (i.e. personnel, experience and money) for writing local bids. • Time constraints of writing local bids.
County 10	<ul style="list-style-type: none"> • Diversity of products grown in the county. • Complexity and cost of ordering/delivery process for local produce.
County 14	<ul style="list-style-type: none"> • Capacity of farmers to absorb some of the processing, storage and delivery costs. • Assistance in the publicity and education of the economic health benefits of the program.

Case Studies

Many successful farm to school programs have a point person that facilitates local produce sourcing and serves as a link between schools and farmers. Funding to hire such positions range from state provided funds to private endowments donations. For example, in California a state-wide project coordinator serves as the primary resource person providing information and assistance on how to initiate a program. Additionally, some California school districts hired their own coordinators. The Malibu School District has a coordinator who oversee the “Farmers Market Salad Bar” program, which features local produce in existing salad bars. With funding from the California Endowment, the Riverside School District originally hired a nutrition specialist/salad bar coordinator, who placed produce orders with the local farmers each week. This position eventually split into two people, a nutritional specialist and salad bar coordinator, and is now funded by the Nutrition Services Department. The salad bar coordinator is former kitchen manager, who now trains kitchen staff at new farm to school salad bar sites and serves as coordinator for all aspects of program. Within Oklahoma, the Hartford School District has a local food wholesaler who acts as middlemen between farmers and schools and helps facilitate the provision of produce in a desired form for food services staff (Oklahoma Food Policy Council, 2003).

4.6.4. Logistics of Local Food Purchasing

Logistics associated with demand, availability, delivery, processing and storage of local, seasonal foods present challenges for farm to school programs. Schools are accustomed to ordering most types of fresh produce year round and, therefore, do not have to worry about freezing and storing, say, blueberries from summer into winter. This has eliminated many storage needs and created purchasing patterns that typically enable schools to keep a limited amount of product on hand at any given time. School districts have their own ordering and delivery processes, in addition to their own product processing and packaging requests, all of which will need to be considered when offering them local produce sourcing. See Table 4.5 for existing ordering, processing, delivery and storage systems by county.

Table 4.5. County ordering, processing, delivery and storage systems

County	Ordering	Processing	Delivery	Storage
County 1	Orders placed 2 weeks in advance of delivery	N/A	Food is delivered once per week via vendor transportation.	N/A
County 2	N/A	N/A	Schools get delivered to individually. NCDA&CS delivers to the county warehouse. A county driver and truck then daily rotate through different parts of the county and deliver the produce to the schools.	The county warehouse has refrigeration and freezer storage.
County 7	N/A	N/A	Produce comes to one of the county's two warehouses and is then delivered individually to schools via the county's drivers and refrigerated trucks.	There are two county warehouses for storage purposes.
County 8	N/A	N/A	Food is delivered via major food service distributor.	N/A
County 9	Done through E-Sysco, an internet ordering system.	Some cutting, cooking, baking, etc on site. The schools currently get	The food comes from Sysco and is delivered once per week. This district prefers the	Only has enough freezer space to hold

	Each school places an order, the Child Nutrition Director reviews the order via email, and then the order is trimmed down or added to as needed	lettuce chopped in bags, and everything else comes whole and is processed on site. Meat that comes in 40lb cases bulk is sliced and all food is cooked on site	amount delivered to be usable within 1-2 weeks.	the quantity usable within 1-2 weeks.
County 10	Ordering is computerized. The computer looks to see if a commodity is on hand when it is needed, and if not, a Purchase Order is generated. Most items are ordered from the same vendor, which makes it less expensive and complicated because of bulk prices	All products in must arrive non-processed. Raw foods are processed and prepared on site by the cafeteria staff.	Produce is delivered every Wednesday. Either farmers delivery directly or the USDA goes to a central facility and the produce is shipped out to schools as needed by the school trucks. The county gets anywhere from a few deliveries per month from the USDA warehouse to a few per week.	Some schools have adequate storage and freezer space, albeit kitchen managers like to have only 5-7 days worth of food on hand; and the county has a central storage facility that contains dry storage and a large cooler with freezer storage.
County 12	N/A	All products in must be received non-processed. A second washing, cutting etc. is all done in school kitchens.	Get produce from several local farms, although only one at a time, within a 20-mile radius of the district. The Child Nutrition Director picks up the produce herself from the farm, and when she has a large order she sends the district truck to pick up the produce. This truck is not refrigerated but is	N/A

			not going very far and the products are picked and packed the morning of pick-up	
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Case Studies

Successful local produce suppliers streamline ordering processes and assume labor, equipment, transportation and distribution costs. This assists in alleviating the financial burden on school systems and making local produce purchasing more convenient. For example, New North Florida Cooperative assumes all labor, equipment, transportation and distribution costs. Farmers drop off products at cooperative where they are processed, then several refrigerated trucks are used for deliveries. The cooperative succeeds in the school market by offering value added products that are minimally processed so no further cutting or washing is needed by food service staff (Joshi et al., 2006).

Another example lies in Foothills Connect Business and Technology Center, a Rural Economic Development organization that seeks to develop entrepreneurship within Rutherford County, NC. This organization uses an online ordering system to bring buyers and seller together called Farmers Fresh Market. Farmers list their available products, and buyers browse the products and buy what they want. All transactions take place on this website, and payments are automatically withdrawn from customers and deposited into the farmers' bank accounts. Additionally, Foothills Connect orchestrates deliveries for participating farmers' products. Depending on the size of the order, orders will be shipped directly to the buyer's door or to a central drop off location that serves multiple customers. The farmers deliver produce to Foothills Connect on specified delivery days, where it is sorted by order number and then shipped directly to the specified drop off location. Produce is picked, packed, and shipped within 24 hours (Foothills Connect Project).

4.6.5. Lack of Consumer Education

The overarching food culture in the United States significantly constrains possibilities for connecting the land and the lunchroom. This is a food culture where less than 20% of children eat the recommended servings of vegetables, less than 15% eat the recommended servings of

fruit, and many do not get enough exercise and eat too much of the wrong kinds of foods (Oklahoma Food Policy Council, 2003). These poor food choices can in some ways be attributed to lack of education on where food comes from, what is and is not nutritional, and how school food programs even work.

Survey data indicated nutrition education is typically not a focus of Child Nutrition Directors in southeastern North Carolina and/or is not a concern of the student body. Child Nutrition Directors often lack the time and funding to promote nutrition within their school systems or orchestrate field trips to farms. Additionally, students tend to demand items of limited nutritional value and do not give valuable feedback on healthier meal options when experimentally offered. Often times, the less nutritious meals are preferred as they are familiar/served at home, and because their deleterious nutritional content is unknown. See Table 4.6 for county-specific nutrition education efforts.

Table 4.6. Nutrition education efforts by county

County	State of Nutrition Education
County 2	<ul style="list-style-type: none"> • Not much advertising and promotion of nutrition given lack of time. • Fieldtrips to farms are limited due to lack of funding and instructional time. Each class is only allocated one field trip per year and the trip has to be associated with instructional moment at that time.
County 8	<ul style="list-style-type: none"> • Students mostly demand items like chicken nuggets, pizza, burgers, nachos, and hot dogs. • Less conveniently prepared foods like macaroni and cheese, spaghetti, and lasagna are offered but often are “misses” with the students.
County 9	<ul style="list-style-type: none"> • Students demand fast food, cheeseburgers and pizza. • The district is open to more salads, etc. but there is not a lot of feedback from students. Suggestions that are made either do not fit cost constraints or cannot be done nutritionally.

Case Studies

Implementation of nutrition education is a common trend in many successful to school programs across the nation. For example, a vegetable garden was incorporated into nutrition lessons at a California elementary school and eventually increased students' willingness to taste vegetables. The school found children will eat a variety of fresh fruits and vegetables when they have learned about them, tasted them, and become accustomed to them (Kloppenburg et al., 2007). Similarly, the Riverside Farm to School Salad Bar Program eased children into the program by introducing them to the salad bar with a nutrition lesson, salad bar taste test, and etiquette training provided by the Riverside Department of Health. The school has maintained enthusiasm with the Harvest of the Month program. This nutrition education program was developed by California departments of health and education and provides schools with the tools they need to feature one seasonal, fresh fruit or vegetable item per month in classrooms and cafeterias. Promotional activities and supplemental nutrition education reinforce messages of good nutrition and encourage salad bar consumption throughout the year (Oklahoma Food Policy Council, 2003). The farm to school program in the Santa Monica-Malibu Unified School District took a different approach in its initiation by involving students and parents in initial program planning. Students' likes and dislikes of the existing salad bar were taken into account, volunteer parents helped prepare food and monitor student food choices, and farm tours, farmers market visits, and school gardens were used as tools to raise student food awareness (Oklahoma Food Policy Council, 2003).

All of these efforts are supported by the state of California. Resources to schools interested in incorporating nutrition and agriculture into the curriculum are provided by several California organizations. The California Nutrition Network program provides funds for schools to incorporate educational activities that promote locally grown products in existing nutrition education programming. Harvest of the Month (previously mentioned) is one such example, and through the "Harvest of the Month Toolkit," schools are provided with a structured and accessible curriculum that helps facilitate relationships with local farms. Similarly, the California Foundation for Agriculture in the Classroom (CFAITC) offers lesson plans, an agriculture resource book for teachers, and hands-on trainings and conferences for educators. The California School Garden Network (CSGN) came together in 2006 to create and sustain

school gardens and released a school garden sourcebook. The Community Alliance with Family Farmers (CAFF) created a farm tour guide for farmers can schools (Joshi & Beery, 2007). There is a lot of momentum within the state to support nutrition education in farm to school programs.

The state of Oklahoma is also active in this regard. The Hartford School System incorporated a pilot component of nutrition education that involved 67 classes and events for 600 students, including farm visits and cooking lessons. Results found a 50% increase in recalling names of local produce after class (Oklahoma Food Policy Council, 2003).

4.7. Recommendations

SENCFS has a great opportunity to facilitate local purchasing within Southeastern North Carolina schools, and bridge the information gap that exists between Child Nutrition Directors and farm to school programs. Recommendations to achieve these objectives are rooted in making local sourcing cost effective, providing regulatory assistance to farmers, providing informational guidance to Child Nutrition Directors, tackling logistics through the SENCFS distribution center, and implementing nutrition education.

4.7.1. Make Local Sourcing Cost Effective

Given that Child Nutrition Directors already have a limited budget for fruits and vegetables, local sourcing must be cost effective to even be considered an option. To make local sourcing affordable, SENCFS can invest their lobbying efforts in the following initiatives. First, SENCFS should campaign for increased federal reimbursements for school lunches and push for a direct tie of that increase to more fruit and vegetable use. Being that these low reimbursement rates are part of the nation's overall food policy, SENCFS will need to form allies in its lobbying campaign. Secondly, SENCFS should urge the USDA to eliminate the nutrient based menu planning, disqualify or limit certain foods and, ultimately, encourage a move toward less processed foods. Thirdly, SENCFS should lobby for the creation of statewide food policies that support farm to school activities. In addition to the strict nutrition guidelines North Carolina already has in place for elementary schools, the state should allocate more money for purchases

of fresh fruits and vegetables for school meals. Child Nutrition Directors in counties 1, 8 and 9 are ready to support such legislation should it come to fruition in North Carolina. Lastly, SENCFS should encourage schools to incorporate farm to school into school wellness policies.

Ultimately, more federal and state funding for fruit and vegetable use will give Child Nutrition Directors more leeway in their sourcing decisions and increase the likelihood of local sourcing.

4.7.2. Provide Regulatory Assistance through SENC Foods

In order to prevent the manual facilitation of matching farmers with the appropriate schools based on their individual regulatory standards, the cooperative SENC Foods should assist their members as a whole in meeting these standards. The cooperative should hold food liability insurance coverage and provide resources to farmers to acquire GAP certification (i.e. direct financial assistance to cover the certification costs, the provision of a SENC Foods GAP certifier, or educational how-to materials). Having the cooperative bear the regulatory burden to the greatest extent possible will enable all members to sell their products to institutions with stricter standards and, therefore, increase market access for everyone. Child Nutrition Directors from counties 7, 8 and 9 have already pledged their involvement in SENC Foods should it provide these services.

4.7.3. Issue Informational Guidance for Child Nutrition Directors

SENCFS can assist Child Nutrition Directors in gaining knowledge about farm to school programs and ensuring program success in a variety of ways. First, SENCFS should facilitate the hiring of a nutrition specialist or farm to school program coordinator to introduce local produce into existing meals and serve as a liaison between the district and the farmers' cooperative. If the resources do not exist to hire such a position, SENCFS should provide educational materials to Child Nutrition Directors about the types, quantity and prices of produce provided by SENC Foods. Additional materials include how to build flexibility into menus to take advantage of the local, seasonal food supply. Secondly, SENCFS should introduce local produce into existing lunch programs and menus (See Appendix 5 for school menus). As previously mentioned, schools are required to offer 4 produce items, either canned, frozen, fresh

or dried, daily. Local produce can be provided as a fresh option. Some districts also provide certain vegetable dishes everyday within which locally sourced produce can be a part. Table 4.7 contains county-specific information on existing produce offerings, the level of participation in the Fresh Fruit and Vegetable Program, and Child Nutrition Director familiarity with local sourcing. With this information, SENCFS can determine where within existing schools meals to initially introduce local produce, which schools may be more financially able to be initially involved, and how much initial information sharing with Child Nutrition Directors will be required to ensure their successful involvement.

Table 4.7. County-specific produce offerings, purchases and local sourcing familiarity

County	Existing Produce Offerings	Participation in Fresh Fruit and Vegetable Program?	Familiar with Local Sourcing?
County 1	N/A		Yes
County 2	A fresh garden salad is provided daily, in addition to a minimum of two vegetables and two fruits daily (one fresh, one canned/frozen). The minimum serving for fruits and vegetables is $\frac{3}{4}$ cup but these schools serve 1 cup. County 2 schools also serve soup in the wintertime on Fridays from October to April.	Yes	Yes
County 7	N/A		Yes
County 8	Offers a daily chef/tossed salad in addition to three or four fruit and vegetable selections.		
County 9	Provides a fresh veggie bar daily, which includes carrot and celery sticks. These schools also try to provide two salads daily: 1) a tossed salad that includes lettuce mix, tomato, cucumber, onion; and 2) an entree salad like chicken Caesar, chef salad, or chicken fajita		Yes

	salad. Eight different kinds of salads are run for a week at a time		
County 10	N/A	Yes	Yes
County 12	N/A		Yes
County 14	N/A	Yes	

4.7.4. Tackle Logistics Utilizing the SENCFS Distribution Center

The SENCFS distribution and processing center located at the center of the Southeastern North Carolina region is being established to serve processing and delivery purposes, and provide a storage facility for products harvested in the summer when school is not in session and a place where farmers can collectively sell their products to school systems. SENCFS will need to facilitate ordering, delivery and processing, and expand current storage in the following ways. First, SENCFS should create a streamlined, online ordering process. Most schools systems order online and within a week of desired delivery. Providing Child Nutrition Directors with the ability to place orders for a majority of produce with one central source will motivate more participation in buying from SENC Foods. Second, SENCFS should assume transportation and distribution costs. Many Child Nutrition Directors indicate they would participate in purchasing from SENC Foods if deliveries are made directly to the schools. Therefore, dependable delivery to a central warehouse or individual schools is absolutely necessary. This is their current delivery scheme and providing this option would get many schools on board as buyers early on. Then once farm to school programs become more institutionalized within regional school systems, alternative delivery systems could be determined. Third, SENCFS should process foods according to school preferences. Many schools prefer receiving non-processed foods and others prefer items to come chopped. These specifications will have to be made and could be detailed in orders. Lastly, SENCFS should continue to provide a flash freeze unit and storage space. County 9 Child Nutrition Director sees the flash freeze unit and storage as huge benefits to his schools. Blueberry and strawberry season come into play when school is out of session and by the time school is back in session it is apple season. The schools, therefore, miss out on a big portion of the prime growing season because they currently have no way to store produce. Storage is also limited in counties 1 and 10, so many schools could benefit from the SENCFS Distribution Center.

4.7.5. Implement Nutrition Education

In order for any farm to school program to be successful for an extended period of time, students need to be engaged. Innovative nutrition education, experiential education, and marketing programs are key to generating enthusiasm about farm to school programs and maintaining strong participating in school meal programs. Activities may include in-class education identifying health and nutrition as the focus, agricultural education, farmer in classroom presentations, or cooking demonstrations. Several Child Nutrition Directors are already implementing educational activities surrounding health and nutrition in their schools, but need assistance in doing more. See Table 4.8 for Child Nutrition Director’s attitudes toward and current involvement in nutrition education. SENCFS can use this information to initially target those Child Nutrition Directors who are already passionate about nutrition education.

Table 4.8. Child Nutrition Directors and Nutrition Education

County	Support for Nutrition Education
County 2	Realizes nutrition education really does something for the children: when one can let a children know what they are eating was grown in the soil in which they play and that we can live off the land, their ideas are expanded about choosing healthier foods. The Director contends if we can just make them open to receiving that sort of education then it might help them.
County 9	Currently pushes for fruits and vegetables in elementary schools. The schools have nutrition mascots and videos are sent into the classroom and show how to choose foods in the cafeteria. At elementary level, the Director tries to work with teachers and principals to educate them. Nutrition tends to get pushed by nurses in the school districts and not parents, so getting the support of both students and parents for a farm to school program will be necessary. The district’s biggest push this year is education and the substitution of fried chicken with oven-fried chicken—students have had to be educated and made to care.

County 12	Uses the fresh fruit and vegetable program money to take students on field trips to farms.
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Ultimately, farm-to-school programs in the southeastern North Carolina counties will aid in economic growth, student education about their food provenance and growth, and knowledge incentives for local consumption of fruits and vegetables. Additionally, farm-to-school programs have the potential to improve public health, reduce medical costs, reduce energy use, and reduce inequities. By applying the aforementioned recommendations, SENCFS can play a huge role in making these benefits a reality.

Part 5. Conclusions

The local food movement in southeastern North Carolina faces a plethora of challenges. Barriers to local sourcing are abundant and diverse, ranging from a lack of infrastructure to support small farms to a society accustomed to the convenience of year round, global food supply. Over time, SENCFS has the opportunity to improve the current system through work on several components of a regional food system. SENCFS, along with other organizations in North Carolina, is working to move the local food economy in their region towards a tipping point after which local food will be economically viable.

As production and marketing barriers for farmers decrease, and demand from consumers and institutions increases, a self-sustaining cycle of supply and demand will occur. This will serve to support existing farmers and encourage an increase in farming in the region. On the supply side, SENCFS should continue to address barriers that small, limited resource farmers face in selling their products locally by decreasing costs to farms and helping smooth logistical hurdles, such as those encountered in GAP certification and in distributing farm products in large volumes. SENCFS should also continue to build demand for local foods by working with schools to ease the feasibility burden of local sourcing and with food service companies to help justify purchasing decisions that include local farms using environmentally friendly agriculture techniques. Pairing environmental and economic goals will improve the health of the ecosystem while contributing to the economic rehabilitation of the area.

To accelerate movement towards this tipping point, we recommend that SENCFS consider the following points. First, SENCFS should focus a great deal of lobbying efforts on increased federal reimbursement for school meals. Secondly, SENCFS should continue to build and develop SENC Foods as a supportive farmer cooperative in the region. Successful development of such a cooperative will serve as a vehicle to reduce financial barriers for farmers to source to local institutions. Many barriers faced by farmers are cost prohibitive when faced individually and can be addressed through the resource sharing that a cooperative enables. Priorities for this cooperative should include maintenance of liability insurance on behalf of its members. Another priority for SENCFS should be to facilitate GAP certification in the following four ways: act as a

mechanism for financial support and knowledge sharing for farmers; provide resources to alleviate some of the confusion around GAP certification; target farmers that are good candidates to meet demand for local institutions for cooperative membership; and communicate with local farmers about demand and price projections in order to facilitate effective planning. Lastly, SENCFS should continue to focus its efforts on the distribution center. By increasing the capacity of the center, SENCFS will facilitate the connection between farm products and institutional buyers. Through these recommendations, we hope SENCFS will continue to develop opportunities through the supply chain in order to better contribute to both the economic revitalization and environmental protection of southeastern North Carolina.

Part 6: Appendices

Appendix 1: Sample water collection guidelines from Craven County Health Dept. Environmental Health Laboratory, New Bern, North Carolina

Instructions - BACTERIOLOGICAL ANALYSIS

SAMPLE COLLECTION

For Residual Disinfectant Concentrations: Before taking your bacteriological sample, if your system uses a disinfectant, fill a separate clean container with water to measure the residual disinfectant concentration. If chloramines are used as the disinfectant, measure “total chlorine.” If only chlorine is used, measure “free chlorine.”

For Bacteriological (Coliform) Sample: Use only the bottle supplied by the laboratory. The bottle contains sodium thiosulfate, a dechlorinating agent; do not rinse the bottle. If a white crystalline material or small amount of liquid is visible inside the bottle, it is the sodium thiosulfate and is a normal condition. If the bottle is damaged or the lid is loose, do not use the bottle; contact this laboratory for a replacement. The sample bottle mouth should never come in contact with the faucet. Never collect a sample from a hose or any other attachment fastened to a faucet. Do not lay the sample container lid down, splatter water on the lid or container. Never touch the inside of the container or lid. If anything other than water comes in contact with the inside of the lid or bottle, contact the lab for a replacement bottle.

- Distribution System Samples - must be collected from taps (preferably bathroom or kitchen taps) located within your distribution system. Samples should not be taken from drinking fountains or hydrants. Do not sample from taps that are leaking around the handle shaft. Do not collect distribution system samples from a well house or storage tank.
- Source Water Samples - must be collected from the sampling tap in the well house, prior to any treatment. If you do not have a sampling tap at the well and provide disinfection to the water you serve, you must install a tap to be able to collect a raw water source sample. If you do not have a sampling tap and do not disinfect, you are encouraged to install one or you may collect a source sample, when required, at the tap nearest to the well, mark it as “Source Water” on the form and indicate the State three-digit Facility ID of the well.

Before taking the sample, remove any strainers, aerators, washers and filtration devices from the tap and then disinfect the tap. You may disinfect the tap with rubbing alcohol, diluted bleach or by flaming the tap with a propane torch (after making sure the flaming will not damage the faucet). If flaming, flame until any water on the tap is driven off. The tap does not need to be heated until the metal changes color. After you disinfect the tap, let the water run from the tap for five (5) minutes. If the tap supplies hot and cold water, flush the hot side for two (2) minutes and then the cold side for three (3) or more minutes. Fill the sample collection bottle to the 100 mL mark, but do not fill the bottle completely; leave a required ½ to ¾ inch air space at the top of the bottle. This space allows the sample to be shaken properly at the lab. Place the samples and completed collection form in the shipping container. Forward all samples to the laboratory immediately after collection. Samples must be analyzed within 30 hours of collection, so it is important that they be sent by overnight mail or hand delivered so that this time limit is not exceeded.

After the samples are analyzed, regulations require that the laboratory submit the results of all compliance samples to the Public Water Supply Section (Attention: Data Entry), 1634 Mail Service Center, Raleigh, NC 27699-1634. The laboratory will send a copy of the results to the water system, and the water system shall retain the copy for at least five (5) years.

DIRECTIONS FOR COMPLETING THE TOP PORTION OF THE FORM

The water system is responsible for completing all information above the double line. Please print/type all information and ensure the information is legible. Complete all water system information such as the PWSID#, system name and county, etc. For System Type, indicate whether the system is a community (CWS), non-transient, non-community (NTNC), transient (TNC) or adjacent (ADJ) water system. For Water Source, indicate whether the system’s source is from ground water (GW) or surface water (SW). Complete sample collection date and time and provide contact information. Note the disinfectant used (chloramines, chlorine or none) and record residual disinfectant information in the appropriate locations. Then complete only one of the following sections:

- Distribution System - Total Coliform Rule (TCR): Sample Type selections for distribution system samples are "Routine", "Repeat", or "Special / Non-compliance". Choose only one type. (Note: "Special / Non-compliance" samples will not be entered into our database as they cannot be used to satisfy TCR compliance requirements. However, these samples can be used to help delineate bacteriological problem areas within the distribution system.) Also indicate the Location Code, Location Where Collected, and the Sample Point. Note that the Facility ID for all distribution system samples is "D01" and is already indicated on the form.
- Source Water - Ground Water Rule (GWR): The Sample Type for source water compliance samples must be one of the following:
 - (1) Triggered - must be collected at each well if the lab informs you that your most recent routine distribution TCR sample is positive for total or fecal coliform and your system does not provide State-approved 4-log treatment for viruses,
 - (2) Additional/Confirmation - five samples must be collected from well if the State directs you to do so when the triggered sample is fecal positive,
 - (3) Assessment - must be collected only if the State deems your water vulnerable to fecal contamination and directs you to conduct assessment source water monitoring or
 - (4) Triggered/Distribution Repeat (**Note: Only for water systems serving $\leq 1,000$ population**) - allows one sample collected at the source to count as compliance credit for both a GWR triggered and a TCR repeat sample. Also complete the Facility ID and Sample Point information for the source water sample.

When a **Repeat, Triggered or Additional/Confirmation** sample is required, complete the block of data for the Previous Positive sample (includes the Previous Positive Sample's Laboratory ID Number, Laboratory Log Number, Location Code and Collection Date). Note that under the Total Coliform Rule, a repeat sample set must have at least the following: one sample collected from the same location (Repeat-Original Tap) as the previous positive, one sample collected within five (5) service connections upstream (Repeat-Upstream) of the previous positive location, and one sample collected within five (5) service connections downstream (Repeat-Downstream) of the previous positive location. If 4 repeat samples are required, systems with $\leq 1,000$ population should collect the 4th repeat sample from the source. Repeats are to be collected within 24 hours of being notified of a positive routine sample.

Appendix 2: Perceptions of Small, Limited Resource Farmers in Southeastern NC: Challenges, Successes and New Directions

Perceptions of Small, Limited Resource Farmers in Southeastern North Carolina: Challenges, Successes, and New Directions

Pender, Duplin, Bladen, Brunswick, and New Hanover counties

Data collected for the
Southeastern North Carolina Food Systems Project

Laura Cloak
Nicholas School of the Environment
Master of Environmental Management Candidate '11
Duke University

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Introduction

In July 2010 a study was conducted for the Southeastern North Carolina Food Systems Program to gather data concerning the lives and work of small, limited resource farmers in southeastern North Carolina. Farmers from 16 small to medium-sized farms were interviewed on topics regarding background, characteristics of their farm, current output and challenges to farming in the region, as well as ideas they had that could benefit the local farming community. The goal was to document the lives of the farmers and their farms as well as to collect information about the challenges farmers in the region face and what could help them to achieve both greater profitability and more sustainable livelihoods.

The 16 farmers interviewed were from 5 counties in southeastern North Carolina: Pender, Duplin, Bladen, Columbus, Brunswick, and New Hanover counties. The semi-structured interviews were conducted at their farms between July 6 and July 31, 2010 by Laura Cloak, Nicholas School of the Environment, Duke University, and Josh Tuttle, University of North Carolina Wilmington.

Farmer Demographics and Background

Ages of the 16 farmers varied considerably, while race and geographical distribution were more constant. The farmers ranged in age from mid 30's to mid 80's, though the majority fell in the middle of this range. 7 of the 16 farmers were African American and 9 were white. 14 of the 16 farmers had at least some family background in farming, and 13 had been raised in the region. The majority of farmers and/or their spouse had attained at least a college education.

Seven farms were located in Pender County, three were in Duplin County, three were in Brunswick County, and one was in each of Bladen, New Hanover, and Columbus Counties.

Farms fell into four major types, though there was often crossover between categories. The four main types of farms were working farms which had been in the family for two or more generations and were the sole source of income for the family, farms started by the farmer that were the sole source of income for the family, farms started by the present generation where one family member was employed off the farm – either in the past, having retired, or currently, and lastly, farms that were started by the farmer(s) after retiring from another career. The majority of the farmers interviewed fell into the first two categories and were full time farmers at the time of the interview.

Farm characteristics

Characteristics of the 16 farms, such as size and output varied extensively. The sizes of farms ranged widely, from <2 acres to 550 acres (5 = <5; 4 = 6–50; 2 = 51 – 100; 3 = >100). Half of the 16 farms were not currently farming a significant portion of their acreage, sometimes as little as <10% of their land was in cultivation. In many of these cases, however, land was being used for other purposes, such as grazing or resting the land for future agricultural production.

For all but one of the 16 farms, produce was a significant portion of the output. All but two had a variety of products; these two exceptions grew blueberries exclusively. Four farms grew field crops in addition to produce (such as corn or soybeans), six raised animals, two raised shrubs, sod, trees and other plants for landscaping purposes, and one produced processed food in addition to produce.

Several of the medium-sized farms sold to wholesale markets, such as Winzeler Farm and Cottle Tip Top Farm where produce is sold throughout the state and country to several grocery

chains. Some medium-sized farms, such as Newberry's Blueberries also sell to wholesale distributors, but on a smaller scale. About half the farms were quite small, selling through outlets such as farmers markets in the Wilmington area, small CSAs, from a small roadside stand direct from their farm, or to family and friends. Three farmers sell at farmers markets every week, two at both the downtown Wilmington market and the Poplar Grove farmers market. One farm was able to sell to the local school district due to the recent acquisition of a greenhouse that enabled them to grow tomatoes throughout the winter.

7 of the 16 farms were organic; 3 of these were certified organic, the other 4 used organic practices but were not certified. Two more were headed toward using organic practices; one farmer was beginning to experiment with one field of organic produce, and another was organic in some capacities but not all. Both of these farmers as well as four others cited finances and manpower as the reason for not pursuing organic production.

Challenges of Farmers in the Region

The most frequently cited challenges by farmers were having adequate help and having sufficient demand for their products. While the larger farms depend on a number of employees, the smaller farms often rely solely on the farmers themselves, and sometimes drew on additional family members. Five farmers reported having full time farm help. The need for farm help is highly seasonal, which some farmers described as a major part of the larger challenge of finding good help.

Additional challenges included:

- Selling/marketing farm products
- Lack of equipment, such as cold storage, irrigation, affordable heating source for a greenhouse
- Finding new and committed buyers, especially in the avenue of chefs
- Recordkeeping
- Competition with new farmers entering the market
- Education of farmers and of the public
- Getting a fair price for products
- An awareness of the lack of younger farmers entering farming

Farmers' Thoughts Regarding SENCFS

All but two farmers had heard of SENCFS and were positive toward the organization. Many of these expressed a desire to learn more about the organization and how to get involved. Several farmers emphasized the general need for cooperation between small farmers, recognizing that SENCFS was attempting to facilitate such cooperation. Three farmers mentioned that something such as a farmer-run cooperative organization could serve a similar purpose to what SENCFS is doing that would be totally organized and run by the farmers who it was serving.

One farmer felt that SENCFS should shift its focus more strongly to the needs of the farmer, and reduce the amount of outreach to other sections of the local food community. Opinions of the farmer to chef idea were mixed. Many farmers were very excited about the potential new market it could provide to their farm. Some who had sold to restaurants in the past shared negative experiences, most often a result of poor communication between the two parties. One suggested developing some system of staggering the growing of certain crops between multiple farms and over a period of time so that chefs would have a steady supply of a particular vegetable to meet their needs.

Most farmers were positive toward the idea of the processing and distribution center, though there were many reservations as well. Several farmers reiterated a concern that such a center would be something that farmers themselves would have to feel a need for before it could be a successful operation. Some saw it as a potential outlet for a farm's extra produce as well as a way to utilize imperfect food that could not be sold to wholesalers.

Concerns about the processing and distribution center included:

- The logistics of aggregating necessary quantities of a variety of produce for sale to institutional buyers
- The need for a lot of “convincing and re-educating” potential buyers
- The distance to Warsaw from many of the farms
- Pooling produce from different farms to get a large enough quantity to supply an institutional buyer – How to track produce back to specific farm? How to control for the quality of different farms' goods?
- How to effectively manage products for which there is a very short season and potentially a very large supply

A more general concern was that farmers wouldn't necessarily be able to increase their production of a particular crop to provide to the processing and distribution center, even if the center represented a new market for them. Limitations in equipment, manpower, and the seasonal weather situation could factor in to a farmer's ability to participate. Several farmers emphasized how important it would be for the farmer to know well before planting time what products there would be a demand for, so that they would be certain there would be a market for their produce. One farmer described the concept as “a challenge”, in that it would be trying to help the small farmer while the large farms are able to produce larger quantities at lower prices. This farmer said that he would need more information about the center, especially in how it planned to attract institutional customers who would be able to purchase a huge variety of produce from wholesalers at the lowest possible cost.

Agricultural Resources, Organizations, and Grants

14 of the 16 farmers indicated awareness of the GAP certification system. Several of these farmers admitted not really knowing anything about it, while the majority expressed an interest in learning more about it and/or an intent to go to an upcoming workshop, and that it might be a good thing to consider in the future. One said they must know that there is a need for it first. The two blueberry farms were the only farms of the farmers interviewed who are already GAP certified, due to their main market being wholesalers. Both of these described the process negatively, as being a lot of paperwork and irritation. These two and five others expressed concern regarding the effect a certification requirement could have on small farmers.

The following list shows the replies given by farmers when asked about any organizations or associations they were involved in.

- CFSA (4)
- NC blueberry council (3)
- Willing Workers (2)
- CEFS (2)
- Twin Rivers (2) (mentioned as a potential partner for SENCFS)
- Slow Food
- ECO
- NC Farm Families and Rural Development
- Magnolia Outreach

- Farm Bureau
- ASCFG

Most farmers said they do use these organizations as resources, primarily for acquiring and sharing knowledge.

The following list shows the answers farmers gave when asked about any workshops they have attended or plan to attend in the future.

- CFSA conference (3)
- Class at NC state about bottling
- SENCFS workshops
- CEFS courses
- ASAP conference
- Acres conference
- SAWG conference

This final list shows farmer responses when asked where they get information on farming-related issues.

- Books (5)
- Extension (4)
- Universities (4)
- Other farmers (4)
- CEFS courses (2)
- Internet (2)
- Workshops
- Trial and error
- CFSA
- NC Blueberry Council
- Magazines (*Growing for Market, Acres*)

7 of the 16 farmers confirmed that they use the internet. Nine farmers mentioned having worked with extension agents in their county before; two of these farmers expressed dissatisfaction, saying that the agent was not familiar with helping small farmers, and that the agent wasn't knowledgeable about vegetables.

Eight farmers were interested in learning about the grant process and what grants are available. One was currently working on a grant with Twin Rivers, and one had secured a grant in the past to increase production capacity.

The Future

Five of the farmers interviewed expressed interest in expanding their operations. The 11 others were either satisfied with their current situation or did not feel they had the resources they would need to expand, most often manpower. Several explained their disinterest in expanding by describing their love of specializing in a large variety of produce types and varieties, which would not be possible with a larger operation.

All 16 farmers were in agreement about one thing, their love of farming and attachment to the land. The opportunity to educate their children, grandchildren, and the community about where their food comes from, the nutritional benefits of a diet high in fruits and vegetables as well as the importance of hard work and supporting a local economy was a joy shared by a number of farmers. The ability to be stewards of the land, sometimes land which had been in

their family for up to three generations, and manage it using sustainable practices was also very important to farmers.

The community of small farmers in southeastern North Carolina is a group of strong, committed individuals passionate about their work and their connection to the land. In conclusion is a list of insights, needs, and suggestions shared by these farmers in hopes of promoting the local food economy in southeastern North Carolina.

- Encourage more farmers to welcome the public to their farms as a way to educate people about local food as well as promote small, local farms.
- In addition to a processing and distribution center, consider building a central cold storage facility for each county.
- There is a huge need to educate consumers about both the reasons why locally and sustainably produce food costs more than conventionally produced food, and the value behind supporting local farms.
- One farmer is working on creating an email database of his customers so that he can communicate with them through the seasons and keep them up to date on what he has available throughout the year. A parallel project that would notify all consumers (such as through a listserv) throughout the SENCFS region of the location of farms and/or markets of particular products could benefit all farmers in the region.
- It can be extremely challenging to balance the demands of running a family farm and business with family demands, especially with the desire to expand the business.
- Communities in rural areas are divided into church congregations that are often the hub of activity as well as the means for much community communication. Churches have huge potential for a place to distribute information about events and opportunities for small farms as well as educating communities about the local food movement.
- CSAs that bring together multiple small farms can bring business for them all, rather than relying on the produce of one larger farm.
- Markets change over time as certain crops become ‘popular.’ New farmers will enter that market, making business harder for farms that have been in business for a while.
- Assistance with marketing could be helpful to many small farms.
- Variability in the weather is a major and constant concern of small farmers since it is impossible to anticipate or alter.
- There is a major need for public education to remove the stigma attached to ‘in the dirt farming’ which is unattractive to young people. People need to understand the difficulty of farming today, and a relationship needs to be built between the farmer and the consumer. “The literacy rate is directly connected to receptiveness of people to the local food movement.” (Lewis Dozier, when questioned about public receptiveness to buying locally.)
- There is need for a volunteer network to help with educating people about fresh, local food – perhaps with samples at farmers markets, or in involving churches.

Volunteers could also be a huge help to farmers (example: the crop mob - <http://cropmob.org/about>).

- It would be great to have a way for farmers to better connect with each other to share experiences and resources and to simply meet the other farmers in the region.
- Based on the past experiences of some farmers, it can be much better for farmers to have a direct experience with chefs to foster strong relationships built on the mutual understanding of each other's needs and abilities.
- A network to connect farmers with people looking for farm work would be extremely helpful since reliable help is one of the largest challenges faced by small farmers in the region.

Appendix 3: Semi-Structured Interview Questions for Group A

1. What nutrition programs are currently in place in your school district to encourage consumption of fresh fruits and vegetables?
2. What process do you use for receiving deliveries, food storage and food distribution to the schools in your district?
3. What are your demands on quantity and quality of food products?
4. Who is/are your food vendors? From where does the food they deliver come?
5. What is your food budget (Fruit and Vegetable budget, Fruit and Vegetable budget as a percentage of total budget, number of free and reduced lunch students, monies spent on school lunch per child)
6. To what extent do school cafeterias process and cook foods that are served for school lunches?
7. What equipment do school cafeterias currently use?
8. Do the schools in your district offer salad bars for students?
9. What is your role in deciding which foods to purchase? How are these decisions made?
10. To what extent are you currently involved in the North Carolina Farm to School program?
11. Are you aware of the benefits of participating in farm to school and/or purchasing local foods to incorporate into the school lunch program?
12. Would you be in support of legislation that encourages farm to school participation from public schools?
13. Are you aware of any school nutritionist buying products directly from farmers? Have you participated in such a program?
14. Would the schools in your district benefit from a flash freeze unit that could freeze and store local food products?
15. What barriers do you foresee in engaging in direct purchasing from local farmers? (staff, budget, food regulations, quantity, etc.)

Appendix 4: Semi-Structured Interview Questions for Group A and Group B

1. Are you willing to specify ‘a local produce bid within 100 miles or less’ of your district schools to include small farms?
2. If willing, do you have the resources to write those local bids? What is preventing you from writing a local bid that specifies geographic area?
3. Do you understand the Good Agricultural Practices (GAP) certification? Has the NC state mandate of purchasing from GAP certified sources limited your purchasing?
4. If SENCFS opened a GAP certified distribution center in Spring 2011, would you be willing to participate?
5. SENCFS plans to be a competitively priced vendor of fresh produce and frozen fruits and vegetables, representing a local farm cooperative. Who would SENCFS contact to be included on the “vendor bid list” for fresh produce and frozen fruits and vegetables?
6. Do you see the addition of SENCFS to your bid list as a good opportunity for you to connect with small farmers?
7. Are you willing to award a bid by ‘line item award’ (a bid per produce item) or ‘split the award’ amongst several vendors simultaneously, because SENCFS may not be able to meet the volume needed for all schools in your district? Why or why not?

Appendix 5. Sample Breakfast, Lunch and A La Carte Menus for Each County

	M	T	W	R	F
County 1					
Breakfast		Breakfast pizza	Super donut with cheese	Cheese toast	Sausage, grits/cheese and toast
Lunch		Chicken salad with saltines, cheeseburger lettuce and tomato, baked potato wedges, green beans, veggie dippers, diced peaches	Turkey taco, chicken nugget with whole wheat roll, tossed salad, seasoned corn, peas, chilled pears	Country style steak, whole wheat roll, turkey deli sandwich, ranch mashed potatoes, green lima beans, carrot sticks, applesauce	Cheese pizza, pepperoni pizza, baked French fries, tossed salad, green peas, mixed fruit
County 2					
Breakfast	Scrambled egg, grits and whole wheat toast, cinnamon French toast	Pancake and sausage on a stick, cinnamon French toast	Sausage biscuit, cinnamon French toast	Mystery pizza bagel, cinnamon French toast	Chicken biscuit, cinnamon French toast

Lunch	Pepperoni pizza, rib-b-que sandwich, baked potato wedges, green beans, diced pears	Grilled chicken sandwich, crunchy beef tacos, sausage	Chicken fillet sandwich, teryaki beef bites, whole wheat roll, mashed potatoes with gravy, broccoli with cheese sauce, pineapple tidbits	Chicken nuggets with sauce, corndog or puppies, garden peas, carrot coins, applesauce	Macaroni and cheese, chicken noodle soup with uncrustables PBJ, potato rounds, steamed cabbage, diced peaches
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County 3

Breakfast	Breakfast bagel, cereal with toast, juice, milk	Cheese biscuit, grits, cereal with toast, juice, milk	Sausage biscuit, cereal with toast, juice, milk	Breakfast on a stick, cereal w toast, juice, milk	Breakfast pizza, cereal w toast, juice, milk
Lunch	PB&J, string cheese, chicken nuggets, mac and cheese, seasoned green beans, peas and carrots, blueberry crisp, peaches, orange-pineapple juice, ketchup, milk	PB&J, string cheese, deli turkey sandwich, pickles, baked oven fries, steamed broccoli spears, chef's cheese sauce, apple, pears, orange-pineapple juice, milk	PB&J, string cheese, chicken fajita, taco salad, lettuce and tomato, spanish rice, winter blend vegetables, grapes, applesauce, juice, salsa, milk	PB&J, string cheese, BBQ pork, fish sandwich, cole slaw, tater tots, garden salad, ranch dressing, strawberry cup, jello, whipped topping, 100% grape juice, milk	PB&J, string cheese, hot dog/bun, chili dog, tater tots, baby carrots w dip, baked beans, grape sherbet, applesauce, grape juice, milk

County 4

Lunch	Nachos with beef and cheese, cheese pizza, baked potato rounds, garden salad, fresh apple, chilled peaches, milk	Roasted chicken, cheeseburger/bun, rice/gravy, mixed vegetables, fresh orange, fruit mix, milk	Breaded steak on bun, meatloaf, broccoli with cheese sauce, fresh banana, applesauce, roll, milk	Chicken wrap with dressing, baked ham, sweet potatoes (yams), fresh orange, spiced apples, roll, milk	Grilled cheese sandwich, chili with beans, garden salad, spicky baked fries, fresh apple, chilled peaches, milk
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County 5

Breakfast	Breakfast pizza	Whole grain fruit turnover, fresh orange wedges or juice	French toast sticks, peach cup or juice	Grilled cheese sandwich, apple wedges or juice	Sausage biscuit, banana or juice
Lunch	Grilled chicken sandwich with lettuce and tomato, steamed cabbage, cucumber and carrot cup, applesauce cup	Spaghetti with meat sauce and wheat roll, whole kernal corn, tossed side salad, fresh orange wedges	Popcorn chicken with biscuit, mashed potatoes, green peas, peach cup	BBQ pork sandwich, fish sandwich, cole slaw, apple wedges	Stuffed crust pizza, tossed side salad, pear cup, banana pudding

County 6

Breakfast (elementary)	Sausage Biscuit	Breakfast pizza	Chicken biscuit	Grits with toast	Eggs with toast
Lunch (elementary)	Chicken Fajita, carrots with dip, green peas, peaches	Turkey and gravy, sweet potatoes, mixed greens, rice, applesauce	Spaghetti, broccoli, green beans, apple, wheat rolle	Cheeseburger, garden salad, corn, pears	Chick fillet, winter blend veggies, oven fries, mandarin orange
Breakfast	Egg and cheese biscuit	Sausage biscuit	Eggs with toast	Chicken biscuit	Grits with toast

Lunch	Hamburger steak with gravy, sausage dog, green beans, mashed potatoes, peaches, corn muffin	Taco with cheese, chicken nuggets with dip, sweet potatoes, field peas, applesauce, wheat roll	Chick fillet, hot ham and cheese, broccoli, fries, orange	Hot dog with chili, cheeseburger, fries, green peas, pears	Pizza, broccoli, mandarin oranges
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County 7

Breakfast	Apple Churro	Scrambled eggs, grits	Chicken biscuit	Cheese toast	Bagelful
Lunch	Seafood combo, chicken tender fritter, lima beans, chilled fruit, pudding w/ topping	Rib-B-Q sandwich, nachos grande, baked potato, fresh fruit, all sports bites	Cheesy breadsticks w dipping sauce, spaghetti w breadstick, garden peas, strawberry cups, cookie	Roasted chicken w wheat biscuit, Texas BBQ sandwich, sweet potato souffle	Popcorn chicken, baked beans, peach crisp

County 8

Breakfast	Blueberry waffle, assorted cereals, cheesy grits, toast, grape juice, milk	Yogurt with crunchmania, assorted cereals, cheesy grits, toast, orange juice, milk	Apple turnover, cereal, toast, apple juice, milk	Breakfast scramble (eggs/grits/sausage), cereal, grits, toast, orange juice, milk	Sausage biscuit, cereal, cheesy grits, toast, grape juice, milk
Lunch	Pepperoni pizza, chicken fajita wrap, baked apples, carrot sticks, lima beans, milk	Hot dog/bun, port taco, pears, baked tater tots, broccoli, milk	Turkey and cheese sandwich, fresh red apple, orange juice, cheez-it crackers, milk	Chicken filet/bun, beef-a-roni/roll, applesauce, mixed veggies, collard greens, tossed salad, milk	Grilled cheese sandwich, hamburger/bun, cheeseburger/bun, peaches, pintos N cheese, corn, tossed salad, milk

A la cart

<i>Breakfast</i>	<i>Sunrise bites, poptart, muffin, nutrigrain bar, cinnamon roll high</i>	<i>Sunrise bites, poptart, muffin, nutrigrain bar, cinnamon roll high</i>	<i>Sunrise bites, poptart, muffin, nutrigrain bar, cinnamon roll high</i>	<i>Sunrise bites, poptart, muffin, nutrigrain bar, cinnamon roll high</i>	<i>Sunrise bites, poptart, muffin, nutrigrain bar, cinnamon roll high</i>
<i>Elementary</i>			<i>Nachos, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup, cheese sticks</i>		<i>Polish ice, cheese sticks</i>
<i>Middle School</i>	<i>Quesadilla chicken pizza whole wheat, cheese sticks and sauce, nachos, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup</i>	<i>Mini burgers, nacho chips, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup</i>	<i>Hot and spicy chicken filet, spicy french fries, nachos, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup</i>	<i>Beef fiestada pizza, nachos, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup</i>	<i>Pretzel whole wheat, cheese sticks and sauce, nachos, ultimate cheddar cheese cup, mucho queso jalapeno cheese cup</i>
<i>High school</i>	<i>Big daddy buffalo chicken pizza, hot and spicy chicken filet, hot and spicy fries, pretzel, cheese sauce</i>	<i>Mini burgers, nacho chips, spicy French fries, cheese sticks and sauce, pretzels and cheese sauce</i>	<i>Ranchero sausage pizza, hot and spicy chicken filet, spicy French fries, pretzel and cheese sauce</i>	<i>Spicy popcorn chicken, double cheeseburger, spicy French fries, pretzel with cheese, cheese sticks and sauce</i>	<i>Beef fiestada pizza, chicken dill sandwich, spicy French fries, pretzel and cheese sauce</i>
County 9					
<i>Breakfast</i>	<i>Cheese toast, grits, applesauce</i>	<i>Egg and cheese bagel, cinnamon apples</i>	<i>French toast sticks, grits, apple and orange juice</i>	<i>Scrambled eggs with cheese, cinnamon apples</i>	<i>Breakfast pizza, grits, applesauce</i>

Lunch (elementary)	Turkey corn dog, baked chicken patty sandwich, cheeseburger, corn, applesauce, bananas, fresh veggie bar	Baked chicken nuggets, turkey hot dog, baked chicken patty sandwich, green beans, peaches, oranges, fresh veggie bar	BBQ riblet sandwich, baked chicken patty sandwich, cheeseburger, carrots, fruit cocktail, apple, veggie bar	BBQ pork sandwich, turkey hot dog, baked chicken patty sandwich, baked beans, pears, orange, veggie bar	Chicken fried steak w gravy, baked chicken patty sandwich, cheeseburger, spinach, brown rice, pineapple, banana, veggie bar
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Lunch (middle and high school)	Turkey corn dog, corn, applesauce, bananas, french fries	Baked chicken nuggets, green beans, peaches, oranges, tater tots	BBQ riblet sandwich, carrots, fruit cocktail, apple, french fries	BBQ pork sandwich, baked beans, pears, oranges, baked tater tots	Chicken fried steak w gravy, spinach, brown rice, pineapple, banana, french fries
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County 10

Breakfast	Pillsbury mini cinnis, cereal, pop tart, juice, milk	Breakfast pizza or cereal, pop tart, juice, milk	Sausage biscuit or cereal, pop tart, juice, milk	Egg omlet w toast or cereal, pop tart, juice, milk	French toast sticks, cereal, muffin, juice, milk
Lunch	Teriyaki beef nuggets or chicken salad w crackers, oriental veggies, seasoned lima beans, peaches, milk	PB&J sandwich or grilled cheese sandwich, vegetable beef soup, carrot sticks with dip, fresh fruit, applesauce, milk	Pizza or grilled ham and cheese, tossed salad, seasoned corn, diced pears, milk	Chicken and noodles or pork chop sandwich, candied yams, green beans, baked apples, milk	Smoked sausage dog or fish fillet sandwich, macaroni and cheese, baked beans, cole slaw, peaches, milk

County 14

Breakfast	Cheese omlet with torilla shell and salsa, cheese toast	Cheerios cereal, cranberriers, cheese toast	Pancakes w blueberries, cheese toast	Sausage and biscuit, 1/2 banana, cheese toast	Scrambled eggs, sliced ham and cheese, seasoned corn grits, toasted bread with jelly
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Lunch	Sloppy joe/bun, chic filet/bun, side salad, pineapple tidbits	Beef-a-roni, corn dog nuggest, garden peas, dried cherries	BBQ/bun, fish/bun, cole slaw, baked beans, apple crips	Pork roast, baked chicken, macaroni and cheese, steamed broccoli, applesauce	Pizza, cheeseburger/bun, seasoned potato wedges, diced peaches
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County 13

Lunch	Chick filet/bun, hamburger steak w rice and gravy, blackeyed peas, peach cup, school baked roll, milk	Cheeseburger/bun, turkey and cheese hoagie, seasoned corn, sliced pears, milk	Fish filet/bun, spaghetti with meat sauce, garden peas, mixed fruit, whole wheat roll, milk	Grilled ham and cheese, teriyaki chicken/rice, oriental vegetables, baked apples, school baked roll, milk	Pepperoni pizza or cheese pizza, chicken fajita wrap, broccoli, applesticks, milk
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County 12

Breakfast	Breakfast bagel, chilled fruit cup, milk	Fruit yogurt, cinnamon toast, chilled pears, milk	French toast sticks, sausage patty, chilled applesauce, milk	Belgium waffle sticks, cereal, chilled peaches, milk	Assorted whole grain muffins, cereal, chilled juice, milk
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Lunch	Spaghetti with meat sauce and freshly baked garlic bread, hot cinnamon apples or seasoned CA vegetables or chilled peaches, milk	Chicken fried rice, steamed broccoli or mandarin fruit cup or fresh spinach and romaine salad w low fat dressing, frosty juice bar, milk	Hearty vegetable soup w toasted cheese sandwich, romaine and spinach salad w low fat dressing or crisp baby carrots or fresh NC apple slices, oatmeal cookie, milk	Nachos w rice and all trimming (cheese sauce, jalapenos, and non-fat sour cream), fiesta vegetables (broccoli, carrots, variety beans and sweet red pepper) or seasoned corn or hot cinnamon apples, milk	Chicken or fish fillet on bun w choice of condiments (lettuce, tomato, tartar sauce or low-fat mayo), oven roasted potatoes or seasoned baby lima beans or fresh orange wedges, milk
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Appendix 6. Sample of model language for incorporating farm to school into school wellness policies

Wellness Policy Requirement I: *Include goals for nutrition education, physical activity, and other schoolbased activities that promote student wellness*

- Staff is encouraged to utilize food from school gardens and local farms in kitchen classrooms and cafeterias based upon availability and acceptability.
- School food service, in partnership with other school departments and community organizations, will work to creatively market and promote locally-produced food to students, through activities such as:
 - Featuring food grown in the school garden in the cafeteria through sampling and inclusion in school meals based upon availability and acceptability.
 - Developing cafeteria themes and activities relating to local farmers and products grown in the region.
 - Developing school fundraisers based on healthy food items, integrating locally-grown produce where appropriate.
- Staff is encouraged to establish relationships with local farms so that farmers and farm workers will visit school classrooms and students will visit farms.
- Sampling and tasting in school gardens and kitchen classrooms shall be encouraged as part of nutrition education.
- Staff shall integrate experiential education activities, such as gardening, cooking demonstrations, farm and farmers' market tours, into existing curricula at all grade levels.

- Nutrition education messages from the classroom will be modeled in the cafeteria and across campus by offering locally-grown food whenever possible within the reimbursable federal meal program as well as a la carte sales, including vending machines.

Wellness Policy Requirement II: *Include nutrition guidelines for all foods available on the school campus (enhance broader nutrition guidelines to increase children's consumption of fruits and vegetables)*

- Meals served within the meal program will be designed to feature fruits and vegetables and other healthy foods from local sources to the greatest extent possible.
- Schools are encouraged to offer locally-grown food at every location on the school site where food is sold and in all school-sponsored events and activities.

Wellness Policy Requirement III: *Provide assurance that guidelines for school meals are not less restrictive than those set at the federal level by the Secretary of Agriculture regarding the Child Nutrition Act and National School Lunch Act*

- The School Food Service Authority ensures that the policies set here are not less restrictive than those set by the Secretary of Agriculture.

Wellness Policy Requirement IV: *Establish a plan for measuring implementation of the school wellness policy*

Evaluation of farm to school programs could include indicators or methods such as:

- the percentage of food purchased from local sources
- the budgetary impact of increasing local purchases
- the impact of local purchasing on participation in the school meal programs
- pre- and post-studies on what students have learned about healthy eating and local fruits and vegetables.

Wellness Policy Requirement V: *Involve parents, students, representatives of the school authority, the school board, school administrators, and the public in development of the local wellness policy*

- For the purposes of developing a school wellness policy, the wellness committee will involve parents, students, representatives of the school authority, the school board, school administrators, and representatives from the local agricultural community and food and nutrition professionals, like farmers, representatives from agricultural organizations, farmers' market managers, local public health professionals, chefs, nutritionists or health educators.
- A team of district and community representatives will be established to support the food service director and teachers in implementing local purchasing and other farm to school activities on an on-going basis (Izumi & Matts).

Part 7. References

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