ENVISIONING THE AGRICULTURAL CARRYING CAPACITY OF A WHOLE-DIET FOOD CLUSTER IN THE ATHENS METROPOLITAN STATISTICAL AREA

by

JULIEN PAUL DE ROCHER

(Under the Direction of Marianne Cramer)

ABSTRACT

The industrialized and centralized food system as it stands today has been implicated in a range of destabilizing trends in social, economic and ecologic dimensions. Smaller, decentralized food systems have been cited as potentially effective models that could mitigate the negative impacts of the industrial food supply. While the existing land base in the Athens area is capable of supporting a whole-diet production model, implementing a comprehensive, whole-diet local food system presents major challenges. Although the social virtues of local food systems are recognized and accepted by most Americans today, an understanding of how local food systems might feed entire populations merits further inquiry. How much land would be required to feed local residents if their diet were dependent on a strictly local food regimen? What are the social, ecological and economic implications of a whole-diet local food system? A lack of study in this area as it applies to geographically discrete food systems drives the research behind this thesis.

INDEX WORDS: landscape architecture, local food systems, foodsheds, agricultural carrying capacity, comprehensive planning, local food systems

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DEDICATION

I wish to dedicate this thesis to all of the hard working agriculturalists.

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I wish to thank Marianne Cramer for her guidance, unflagging patience and good humor. I also wish to thank my parents for their support of my continued study, as well as the faculty and staff of the College of Environment and Design at the University of Georgia.

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CHAPTER 1

INTRODUCTION

The origin of this thesis lies in a single idea expressed by Joel Salatin, a self-described "christian-conservative-libertarian-environmentalist-lunatic." Mr. Salatin is a cattle farmer, best known for his regionalist, anti-industrial farming philosophy. Asked how local farming systems might one day support large, statewide populations, Mr. Salatin came up with this:

> *What's the answer? I don't know, but what I've come up with is what I call food clusters. These require production, processing, marketing, accounting, distribution and customers - these six components make a whole. The cluster can be farmer-driven, customer-driven, even distribution-driven initially. But once these six components are in place, it can micro-duplicate the industrial on a bioregional or foodshed scale, which includes urban centers (Phelps 2008).*

Enter the *food cluster*. While the article highlights Mr. Salatin's frustrations with federal and state farm safety regulators (the so-called "food police"), his core farming philosophy remains one of unassailable conviction: food production ought to have a healing effect on soil and landscape, stabilize local farming economies and foment social and cultural well-being for regional populations (as well as animals). Mr. Salatin's food cluster vision, however, does not address whole-diet agricultural production scenarios capable of supporting area residents from a nutritional standpoint: Mr. Salatin's current farming model is geared toward meat production, and represents only one facet of the food supply in a whole-diet context. Humans, after all, require more than a steady diet of beef and poultry in order to survive. The food cluster, as envisioned by Mr. Salatin, remains a concept model, a model worthy of further exploration in social, ecological and economic terms. This thesis explores the vision of a complete-diet, local agricultural production system in the Athens area, posing the questions: What is a food cluster? How much land is required in order to meet the dietary demands of a regional population? What are the social, ecological and economic implications behind the local food cluster vision?

Research in this thesis shows that the Athens area is well capable of "feeding it-self" from a land resource perspective: every resident could be nutritionally supported using approximately 60% of existing pastureland in the study area. However, knowing that land resources are available does not answer larger questions: should local food production be balanced in order to meet the nutritional demands of local residents? Is existing pasture area an appropriate sector on which to impose a food cluster?

Recognizing and analyzing relationships between long-term societal needs and finite natural resources (land area, for example) is at the heart of the carrying capacity discussion. In a global context, swelling populations, diminishing natural resources and environmental degradation drive research into the long-term viability of global energy and food production systems once thought of as inexhaustible. At regional and local levels, however, the idea of quantifying agricultural carrying capacity appears to be a non-issue: the stunning productivity of the industrialized food system offers us not only cheap food but also a seemingly permanent escape from the prospect of backbreaking farm work. A post-agricultural society is by definition oblivious toward the intricacies of a farming world controlled by private interests.

Agricultural activity in the study area appears to be alive and well, evidenced by the pastoral scenes unfolding before us in the passenger seat, replete with wheels of winter hay and gently grazing livestock. What could possibly belie an image of such serenity and timelessness? Behind this pastoral scene, however, lies a world of agriculture driven by interests indifferent toward the long-term stability of small farmers and local agriculture. The question this thesis seeks to answer is: how can regional food systems serve as viable alternatives to the present industrialized food supply?

Prior Studies

A lack of peer-reviewed, published literature on geographically discrete agricultural systems drives the work behind this thesis. While the majority of existing research into carrying capacity appears to focus on national or global systems, several studies address discrete land areas at a regional or statewide level, specifically focusing on how populations with diet-driven preferences might impact land resources. Selected studies germane to this topic have been conducted by Christian J. Peters in Cornell University's Department of Crop and Soil Sciences.

Geographically discrete regional food systems appear to be under-researched particularly where smaller land areas are concerned (around 1000 square miles, for instance). Although a range of county and state-level foodshed studies have been released in recent years across America, few, if any, appear to draw an explicit connection between agricultural carrying capacity and diet (King 2001; Cozad 2002). The metropolitan areas of New York, Chicago and San Francisco, for example, have channeled resources into food cluster studies relating to carrying capacity, although the research projects reviewed by the author center around developing analysis tools and methodologies as a way of "making sense" of the array of information about how populations acquire foods rather than balancing local production capacity and food demand.

Additionally, the Earth Institute at Columbia University houses the Urban Design Laboratory (UDL), which in 2008 launched the New York City Regional Foodshed Initiative.[1] The core focus of the project examines the New York City metropolitan region as a systemic food production and distribution model, and will eventually serve as a to guide in long term management policy. The model seeks to compare current production and possible, future production in the region, though no reports have been published as yet.

Methodology

This thesis draws data from various government and university research centers including the USDA, Department of HHS, the University of Georgia and Cornell University's Department of Crop and Soil Sciences. In assessing existing food production within the study area, the thesis cites production-based metrics from the Center for Agribusiness and Economic Development, the Department of Agricultural and Applied Economics, and the Cooperative Extension Service, University of Georgia. This

[1] http://www.urbandesignlab.columbia.edu

assessment is performed using the *ton* as a metric in the human diet (versus the calorie or kcal), since crop data is typically published in acres, pounds, tons and bushels. Average weights per crop and processing losses were obtained from the USDA Economic Research Service (ERS). Following an inventory of current agricultural output in the study area, the thesis undertakes a subsequent exploration of dietary need as a way to compare existing food output and food demands. Data from Christian Peters' study is used in estimating land area requirements of whole-diet farming systems. An effort was made by the author to shield the reader from a cascade of dietary and crop data tables used in calculations.

Relevancy to the profession of Landscape Architecture

Prior research describes a void between landscape architects as practitioners and the food system.[2] How has this condition arisen? The fact remains that most of our food today is grown and processed in uniquely "non-farm" environments: feedlots, poultry barns and expansive mono-cultural tracts navigable only by diesel-fueled equipment. While the industrialized food system in America relies on everyday small farmers working in far away places, the consolidation of farm output and subsequent centralization of market power in American farming belies the bucolic imagery in the rural south where seeds are set to soil. Despite the enormity of industrial farming firms in North America, a smaller, more fragmented farming sector persists in rural northeast Georgia, perhaps only barely, visible along the undulating state roads once traveled by horse and cart.

[2] Walker, Jennifer 2009

How then, does the food system relate to the landscape architect? Within the context of farming in northeast Georgia, approaches to landscape management, natural resource conservation and social themes in farming are germane to the landscape architect, planner and preservationist. While around 12% of ideal farmland has been lost to development in the study area, this quantity may increase significantly in light of development pressures stemming from the Atlanta area coupled with increasing economic stresses that typify small farming in the region. These pressures encourage ageing farmers to sell their land to property investors rather than pass it along to a diminishing flock of up-and-coming agriculturalists.

No single authority is responsible for feeding Americans: is the food system driven by government agencies, private interests or everyday consumers? Who is "steering the ship?" This thesis stakes the claim that we are all "behind the wheel:" voters, journalists, farmers, geographers, gourmands, planners, ecologists, politicians and yes, landscape architects. To assert that the American food system is too nebulous, too economically productive or beyond the scope of training for the landscape architect is a bid for staying the course toward a highly tangible, and highly probable, social and environmental catastrophe. This thesis demonstrates that our food system is not only relevant within the field of landscape architecture, but also relevant to all people, in any discipline. It is the author's hope, too, that this thesis might serve as an informational resource in future research relating to agricultural policy.

Landscape architects are by vocation trained to synthesize solutions that blend with and enhance life within a greater social and environmental fabric. Cattlewomen, hay-bailers, small-time fishmongers, orchard keepers and worm-dealers, these are the people that continue to work the land, preserving via use, the landscape of farming in northeast Georgia. Given the omnipresence of our food system in economic, social and environmental terms, it remains a vital component within an array of disciplines. Planners must acknowledge and accept the importance of agriculture as a regionally based, contextual issue rather than one of peripheral and ephemeral influence in the realm of policy and landscape. A ten-minute drive into the peri-urban fringe reminds us all that our agrarian past is perhaps not so far behind us.

Limitations in the research

The remaining components of Salatin's food cluster (marketing, distribution, accounts and customers) are not specifically addressed in the research since they reflect an operational and management entity that does not influence carrying capacity. Connecting diet and landscape remains the core focus of study.

Although the subject area is typified by intermittent fluctuations in dietary needs throughout any given year, assumed reductions or increases in food energy demand will not be taken into account. University of Georgia administrative reports, for example, indicate a significant decline in enrollment during the summer months, potentially reducing the net energy demands of the subject area.[3] On the other hand, cultural events such as athletic competitions, conferences and general tourism throughout the year create occasional loads on the food demand continuum. Nevertheless, reliable indicators of

[3] UGA Fact Book 2005 reports 15,604 students enrolled for summer classes, compared to 33,000 students in the fall of 2005.

actual population transiency within the Athens-Clarke MSA are not available, and will therefore be excluded in the assessment.

Definitions

In this thesis, the terms *food cluster, area of interest, foodshed, the study area* and the *Athens MSA* are used, referring to the four-county area of interest containing both the resident population and the land resources required to feed them. Chapter 2 offers a more detailed exploration of these terms. In the context of diet, the terms calorie (cal), and kilocalorie (kcal) are used synonymously as "dietary calories," despite their differing quantities as measures of pure energy in the physical sciences. An additional unit, the *mega calorie* (Mcal), representing 1 million calories, is also used when quantifying food energy in greater amounts. In farming circles, "specialty crops" refer to fruit, nut and vegetable crops, and this term is used in the thesis as well. The term *agroecology* is used in the thesis, defined as follows (Wezel, 2009):

> *Agroecology:* At its most narrow, agroecology refers to the study of purely ecological phenomena within the crop field, such as predator/prey relations, or crop/weed competition. Broadly defined, agroecology often incorporates ideas about a more environmentally and socially sensitive approach to agriculture, one that focuses not only on production, but also on the ecological sustainability of the productive system (Hecht, 1990).

In this thesis, proposed production in the food cluster will adhere to the principles of sustainable agriculture as defined in U.S. Code Title 7, Section 3103 (SARE, NIFA):

<u>Sustainable agriculture</u> describes an integrated system of plant and animal production practices having site-specific applications that will, over the long term:

1. *satisfy human food and fiber needs;*
2. *enhance environmental quality and the natural resource base upon which the agricultural economy depends;*
3. *make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;*
4. *sustain the economic viability of farm operations; and*
5. *enhance the quality of life for farmers and society as a whole*.

This definition of sustainable agriculture resides within the greater Sustainable Agriculture Research and Education (SARE) program legislation (Title 7, Chapter 88, Subchapter I, Section 5801) whose governing purpose is to:

…encourage research designed to increase our knowledge concerning agricultural production systems that:

1. *maintain and enhance the quality and productivity of the soil;*
2. *conserve soil, water, energy, natural resources, and fish and wildlife habitat;*
3. *maintain and enhance the quality of surface and ground water;*
4. *protect the health and safety of persons involved in the food and farm system;*
5. *promote the well being of animals; and*
6. *increase employment opportunities in agriculture*.

A sustainable food cluster seeks to exploit the re-integration of waste energy and inter-species relationships as a means for reducing external energy requirements while at the same time hiving minimal negative impacts on land and atmosphere. While these methods are described by a range of terms in existing literature including *holistic management, integrated farming systems, natural farming* and *regenerative agriculture*, their respective aims converge in an effort to not only produce agricultural goods, but at the same time elevate the environmental conditions in which they were grown.

Research in Chapter 2 develops an understanding of local food systems in social, ecological and economic terms. Chapter 3 includes an inventory of current agricultural land area in the Athens MSA, basic demographic data and dietary requirements. Estimates of current agricultural production in the study area are collected in Chapter 4, drawing a relationship between locally supplied foods and dietary need. A brief historical overview of farming in the study area is undertaken here as well, in addition to the topic of local processing facilities. This data sets the stage for further analysis in the final chapters. Envisioning the carrying capacity of local food production is explored in Chapter 5, followed by the conclusion, Chapter 6.

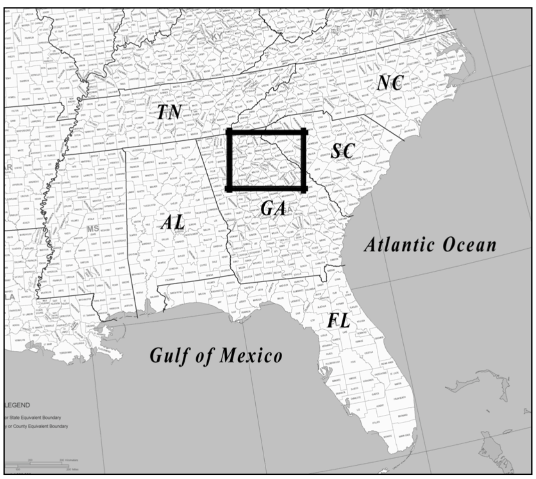
CHAPTER 2

THE FOOD CLUSTER

The food cluster context

The study area, comprised of four counties, is located in northeast Georgia, approximately 50 miles east of Atlanta. The four counties (Athens-Clarke, Madison, Oconee and Oglethorpe) make up the Athens-Clarke Metropolitan Statistical Area (MSA), a discrete boundary of one or many counties that exhibit social and economic interdependencies, primarily based on commuting patterns.[4] The study area is approximately 660,000 acres (1,000 square miles), with a resident population of 190,000 people (US Census, 2008). Demographically, the study boundary population is roughly 79 percent White, 10 percent Black, 7 percent Hispanic, 3 percent Asian and less than 1 percent Native populations[5].

Figure 1. Area of interest. Source: US Census



The purpose of this chapter is to develop an understanding of food clusters in social, ecological and economic terms. In large part, an effective way to define food cluster

[4] US Census Bureau
[5] American, Native Alaskan, Native Hawaiian or Pacific Islander.

models is by way of comparison: food clusters have the potential to mitigate the various societal and environmental degradations brought about by mass-scale agriculture. Food clusters represent a (re)fractured, distributed network of farming microsystems that do not necessarily, but could, feed into the dominant, concentrated food system today. A distinction between foodsheds and agricultural carrying capacity will also be made.

Semi-permeable membranes

The earliest use of the term foodshed was used as a means to convey the concept of a regionally contained economic entity as it related to the food system in America during the late 1920s (Hedden 1929). During this time it became apparent to citizens and government agencies that the food system was poorly understood and vulnerable to labor strikes, due in large part to a lack of information regarding food shipping driven by private enterprise (a condition that persists today). While the term foodshed was originally used in an economic context, later works adopted the term as a conceptual and methodological unit of analysis beyond economy, moving it into social and ecological frameworks (Getz).

As a conceptual model, foodsheds and food clusters are by no means geographically bound: while a foodshed can be imagined as basin similar to its cousin the watershed, participation in a food cluster is by no means an isolationist or secessionist enterprise. A consensus emerges in the literature that food clusters represent self-reliant systems rather than self-sufficient ones. Kloppenburg describes food clusters as proximal entities embedded not only geographically, but also socially, ethically and economically.

Carrying capacity

In light of consensus in the literature casting foodsheds as systems that transcend strict geographical boundaries, a question arises: why does the thesis limit the food cluster to a four county, 1,000 square mile land area? By limiting the study area to a four county tract, finite metrics may be gathered which support estimating carrying capacity (land area, for instance, and food energy needs). The administrative or "political" boundaries also offer social data germane to the food cluster (farm jobs, income, annual food expenditures). As defined earlier in this chapter, this block of counties represents a socio-economic and geographic microcosm, and as such serves as an appropriate land model for this thesis. While food clusters are highly dynamic in social and economic terms, they present advantages as a research topic given their relative regional immobility.

What is carrying capacity? Carrying capacity is an imagined state of balance between supply and demand within a discrete model. Some debate in the research surrounds methodology in calculating carrying capacity. For instance, a common question brought out in the carrying capacity discussion is "how many people can the earth support?" Naturally, there is no single answer, and fleeting agreement given the multi-scalar and multi-dimensional properties of such a question. It is difficult, for example, to forge a consensus on what any single person is entitled to consume, be it cattle, natural gas or wild salmon. A broad, longstanding research pool suggests, however, that we humans are most definitely "overdoing it," particularly in America when it comes to oil consumption and the dietary calorie.

Nonlocal foods, grown locally

Studies indicate that consumers consider any food grown within their state of residence to be a local food. Other surveys report that foods grown within a 100-mile radius of the buyer qualifies as a local food. Despite these perceptions, a locally grown food is not necessarily an available food: commercial crops in the study area are largely spoken for, grown for regional processors rather than for neighboring residents. This is a common scenario in the modern food system. Corn farmers in the Midwest, for example, are legally barred from selling their grain to everyday passersby. Envisioning a local food cluster requires a fracturing, or re-fracturing of existing local food production, unlocking land as a resource that may one day feed its neighbor rather than ignore it.

Food clusters as social systems

The purpose of this section is to develop an understanding of how local food systems and agricultural projects satisfy spiritual, emotional and educational needs, needs that have been obscured by the larger conventional food system, and that may be met in the food cluster scenario. Assessments of local food systems as social entities are often set before a backdrop of the expanded domestic and global food network.

Motivations behind food movements in America span the full range of human intellectual and spiritual resolve: research into why people grow food is longstanding and diverse, documenting myriad compulsions within humans that drive them toward agricultural cultivation as a means to not only prevent starvation but also as a way to manifest psychological control (Helphand 2002). Other published work cites a need for *opt-out* agricultural projects that foment local farming as means to withdraw and/or create alternatives to the dominant farming system (Berry 1995). Within the literature, agricultural and garden projects have been cast as sites of resistance, biophilic playgrounds, secessionist spaces, therapeutic sanctuaries and displays of pride, all socially minded pursuits (Pudup, Kloppenberg).

This thesis identifies several American garden and agriculture movements that document local food systems as vital social support systems, including Victory gardens, "defiant gardens", backyard gardens, community gardens, urban agricultural projects and CSA programs. Research in American food movements reveals projects self-driven and collectively supported, planned and unplanned, large and small, successful and otherwise. Given the diversity of social interests in agricultural movements, Thomas Bassett's unpublished 1979 master's thesis is helpful here for its clarifying effect on a seemingly tangled subject: a range of socially driven American garden movements in the 20th century are reassigned into a single category devised by Bassett, the Organized Garden Project (Pudup 2008). Each movement is catalyzed by its respective social upheaval, listed in the table below.

Table 1. Garden movements. Source: Pudup, M. B.

Garden Project	Era	Crisis / Emergency
Potato patches	1894-1917	Panic of 1893
School gardens	1900-1920	Childhood development
Garden city plots	1905-1920	Urban beautification
Liberty gardens	1917-1920	World War I
Relief gardens	1930-1939	Great Depression
Victory gardens	1941-1945	World War II
Community gardens	1970-present	Urban social movements

While Bassett's study predates the growth of community supported agriculture programs in America, it would today certainly include an 8th tier, shown below. The author proposes an additional 9th tier. The CSA program can safely be described as a socially minded garden movement: research indicates that CSA programs continue to grow in America. A study by the National Institute for Appropriate Technology reported 1,144 CSA programs were operating in 2005, up from 400 three years earlier. Estimates in early 2010 place the figure in excess of 1400 with a caveat that this number could be much larger (ERS Martinez). LocalHarvest, a national informational resource tracking local food systems listed 3,229 CSA active programs in January of 2010.[6] The food cluster movement, however, represents a more economically minded pursuit fomented by increasing domestic job losses and withering profits in the conventional farming sector.

Table 2. Bassett's 8th and the author's 9th tier (both proposed) Source: author

Garden Project	Era	Crisis / Emergency
CSA programs	1980-present	Market concentration
Food clusters	2010	Economic recession, 2008

Research into each specific garden movement is beyond the scope of this thesis. However, the underlying societal needs met within their respective histories is germane as it relates to the food cluster. Upon review of Bassett's selected food movements, key social conditions appear, unifying the various garden movements as coping mechanisms: food insecurity, chaos and social fragmentation. Perhaps the most predominant, unifying theme in all of these movements is a governing sense of uncertainty as it relates to food security: disruptions or shortfalls in the food supply foment skepticism regarding the

[6] http://www.localharvest.org/newsletter/20100128/

conventional food system and in turn stimulate interest in locally produced goods (Berry 1995). Salatin describes a “hiccup” effect within the conventional food supply that drives consumers toward the local farming sphere: food recalls, mad-cow disease and GM (genetically modified) products, for example, have the net impact of bolstering local food systems. Pride is a recurring social pursuit closely tied to agricultural activity, while other research cites an inherited sense of *biophilia* in humans, whereby the tending of plants serves as a means to manifest tangible, natural beauty originating solely in our imaginations (Kellert and Wilson 1993).

Local food movements in America have seldom occurred as federally or state sponsored endeavors, though it has occurred in the past: in 1917, American forester and conservationist Charles Lathrop Pack undertook a campaign to establish locally-based food production systems as a means to supplement strained food supplies in America and Europe during World War I. Pack envisioned the use of public and private lands, tended by everyday people, as a source of both food and a more intangible harvest: pride in the collective participation of a war-time effort. The USDA estimates that the Victory Garden campaign created around 20 million gardens during this time, and the National War Garden Commission concluded that this hodge-podge agriculturalist army, largely made up of women, matched the output of commercial domestic vegetable farms.[7] What remains important about the Victory Garden campaign is its singularity as a federally encouraged grass-roots agricultural movement occurring alongside the existing agricultural industry of the day.

[7] USDA 1920 Census of Agriculture

Diet education in the social sphere

Critics of current diet education programs describe an antiquated and politicized instructional model: the larger industrial food system is not discussed as an agroecological system, caloric intakes are recommended in minimums rather than maximums, suggesting that our food supply is an inexhaustible cornucopia (Pollan 2008). Excessive consumption of dairy, grain and meat, proven to be a contributing factor to long-term health conditions, is not explicitly discouraged in USDA diet guidelines (Peters 2003).

The distributed and integrated nature of food cluster systems as a new way of viewing food production make them suitable assets in coordinated educational programs involving area schools. Research indicates that long-term eating patterns crystallize during youth, and that Farm to School programs can offer a "living-lab" setting where students engage the full spectrum of the food system from farm to fork (Pudup). While these programs are by no means new, they have gained recent attention due to the pioneering work people like of Alice Waters (*Chez Panisse*, Berkeley) and Will Allen (*Growing Power*, Milwaukee), who guide and entrust young people in the caretaking and production of food. Currently, FarmtoSchool.org reports 2,256 active programs in 46 states across the U.S., with 9,715 participating schools.[8]

While the positive social impacts of Edible Schoolyard programs on society are difficult to measure in concrete, quantifiable terms, this condition may change in coming years as surveys and tracking methods develop. Farm to School programs involve more than simply growing food: connecting diet and specific discourses addressing the politics and ecological framework behind agriculture is at the heart of Farm to School programs.

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[8] www.farmtoschool.org, 2010

Social aspects of community supported agriculture (CSA) programs

What is community-supported agriculture? CSA programs are joint ventures between consumers and farmers to produce food. Most CSA projects involve shareholders investing a stake in the annual bounty of a farm, which the farmer is primarily responsible for producing. Other CSA models are more consumer-initiated, whereby a group of individuals may rent or purchase land and hire a farmer to grow desired crops. Some CSAs are church-oriented, some are committed to serving specific disadvantaged populations, and some are strictly dietary in focus (Kittredge 1996). Everyone involved shares in both the benefits and risks of farming. Some of the produce may not compare in size (or appearance) to what is available in stores, but the rewards of CSA programs usually are not measured by weight. People who participate in CSA programs often feel that they own the land on which they work, giving them a vested interest in how well the program performs (Donahue 1997).

Locally produced foods and their related marketing outlets stand as viable models for stimulating social and intellectual pursuits. While farmer's markets are important economic and nutritional vehicles, their use as social places should not be understated. Surveys indicate that "special on-farm events" represent a vital means for generating membership in CSA programs (Woods, Ernst and Wright),. Farm tours are almost universally accepted across demographic strata as highly enriching educational experiences. Harvest festivals are typified by a sense of accomplishment and shared, plentiful bounty. While it cannot be explicitly quantified, there is an uncontested sense of virtue gained though a "hard day's work."

Food cluster ecology

While incentives behind establishing local food systems address social and economic (re)stabilization, food clusters can also serve as mitigating forces in an agro-ecological setting. A local food system is perhaps best understood set against the backdrop of ruination that lies in the wake of the industrialized food supply: environmental degradation caused by mass-scale farming and lack of care (or understanding) within the American farming sector is longstanding and well documented. Agriculture is the largest single non-point source of water pollution in the US and consumes roughly 19% of the annual fuel supply (Pollan 2008). Agricultural pesticides from every chemical class have been detected not only in groundwater beneath farm fields, but are also widespread in the nation's surface waters (Gold and National Agricultural Library (U.S.) 1999). Industrial farming has contributed to tree canopy and wetland loss, strengthened resistance in pest and fungal pathogens, reduced genetic diversity in crops and fomented the growth of dead zones in marine ecologies hundreds of miles to the south in the Gulf of Mexico. Agriculture's link to global climate change is just beginning to be appreciated.

One challenge facing the local farming movement is a paucity of data documenting the benefits of smaller agricultural systems as ecologically restorative entities. For example, system-wide analyses in regional models, so called *life-cycle assessments*, were not found in the journals, suggesting that tracking data on how comprehensive, whole-diet local agricultural systems may improve regional ecologies is a nascent practice or perhaps vastly complicated. USDA reports suggest that the (re)localization of food systems may, but do not necessarily reduce energy use or greenhouse gas emissions (Martinez, ERS 997).

Another common argument supporting the energy-saving merits of local food systems cites shortened supply chains as a means for saving fuel; larger trucks and longer hauling routes must translate into greater energy needs during shipment and subsequent greenhouse gas emissions. While the scenario is plausible, data in this area of study is lacking. Working against the "short supply chain" assertion is the reality that larger trucks haul much more food that may in fact out-perform the local delivery systems in pounds per mile. Rail shipping, too, occurs regularly in the grain sector and represents a highly efficient means for relocating food long distances.

Despite the absence of comprehensive, regional measures of how local agricultural models might benefit regional, and ultimately, whole-earth ecologies, the net environmental benefits of implementing sustainable farming systems are beyond suspicion: farming systems which have a restorative impact on land and people in one region may be effectively reproduced in another. This cumulative effect of micro-duplicating site-based ecologically restorative systems can be safely accepted as a *raison d'être* for sustainable agriculture, despite the absence of hard metrics.

The Salatin approach

Because animal production dominates the agricultural and economic landscape in the study area, Mr. Salatin's experience in sustainable animal husbandry is relevant to the thesis. A successful and responsible farmer, in Mr. Salatin's view, is a catalyst, an orchestrator of process whose goal is to capitalize on energy and mineral relationships between organisms. A happy chicken is allowed to express its "chickeness" and by extension becomes a productive chicken (Salatin 1993). Despite his focus on beef, poultry and hog production, Mr. Salatin's management-intensive methods can be duplicated in other crop sectors: agricultural processes may be largely self-reliant from an energy and nutrient standpoint, foment social and economic stability and elevate soil fertility, be they grains, fish or fruits. Michael Pollan's research compares conventional methods with those of Mr. Salatin's farm, Polyface Farms, as follows (Pollan 2006):

Conventional models	Polyface Farms
Industrial	Pastoral
Annual species	Perennial species
Monoculture	Polyculture
Fossil energy	Solar energy
Global market	Local market
Specialized	Diversified
Mechanical	Biological
Imported fertility	Local fertility
Myriad inputs	Feed and fuel

Though Mr. Salatin casts himself as a simple "grass-farmer", his farming philosophy is driven by deep ideological convictions related to landscape stewardship and animal husbandry, and meet or exceed the tenets of sustainable agriculture as defined in this thesis. Steeped in agrarian self-reliance and a subsequent resentment for intrusion by externalities, Mr. Salatin describes his farming practice as *beyond organic*, dismissing the ubiquitous USDA label *organic* as an insufficient measure of agricultural process and integrity: the only way to keep farming systems from self-adulterating, Mr. Salatin argues, is to offer full transparency. Farm activity should not be concealed. Nevertheless, Mr. Salatin's farm does require external inputs, namely fuel and feed (though in minute quantities, compared to factory farm systems). Mr. Salatin is quick to point out that because his costs are minimally impacted by price fluctuations in fuel and feed, his farm is economically immune to price spikes, capable of “working-circles” around conventional beef production outfits (Salatin 1995).

While commercial agriculture’s history as an ecologically destructive presence in America is long and storied, the social and economic consequences of mass-scale agriculture are more insidious and difficult to quantify in concrete terms. Access to plentiful and low-cost foods, after all, reduces food insecurity while absolving Americans of back-breaking workdays in the sun. A return to regional farming in the food cluster scenario would require grave adjustments for consumers in terms of cost, food diversity and convenience. The following section explores the economic dimension of food clusters, from both the consumers’ and farmers’ perspective.

Food cluster economies

Despite the promise of food clusters as engines of economic democratization in a regional context, local food economies are difficult to measure, poorly understood and poorly documented, resulting in little hard data addressing discrete American food economies (Timmons and University of Vermont. Dept. of Community Development and Applied Economics. 2006). Research in this area describes a "distancing" effect: consumers and producers are effectively segregated by a processing/retail tier in the supply chain (Kloppenburg).

Wendell Berry, whose philosophical approach to local food economies can be safely described as anti-capitalist, characterizes small farmers as statistically insignificant from an economic standpoint. Industrialized farming interests, like the banking industry, have fueled a scenario whereby federally-backed market juggernauts consume the low-lying fruit offered by the small north-Georgian farmer in a dehumanizing theatre where people can be replaced by chemicals. Berry's message of economic empowerment is echoed in Salatin's view regarding small farm economies, and both appear optimistic regarding a cultural awakening by everyday people from the profit-driven food system nightmare into a realm of moral resolution that may guide us away from excessive consumption, landscape degradation and thoughtless care of animals.

This section explores the production and consumption of local food cluster products in an economic context. This economic setting will be examined from two primary perspectives: that of the consumer and that of the farmer.

The Consumer

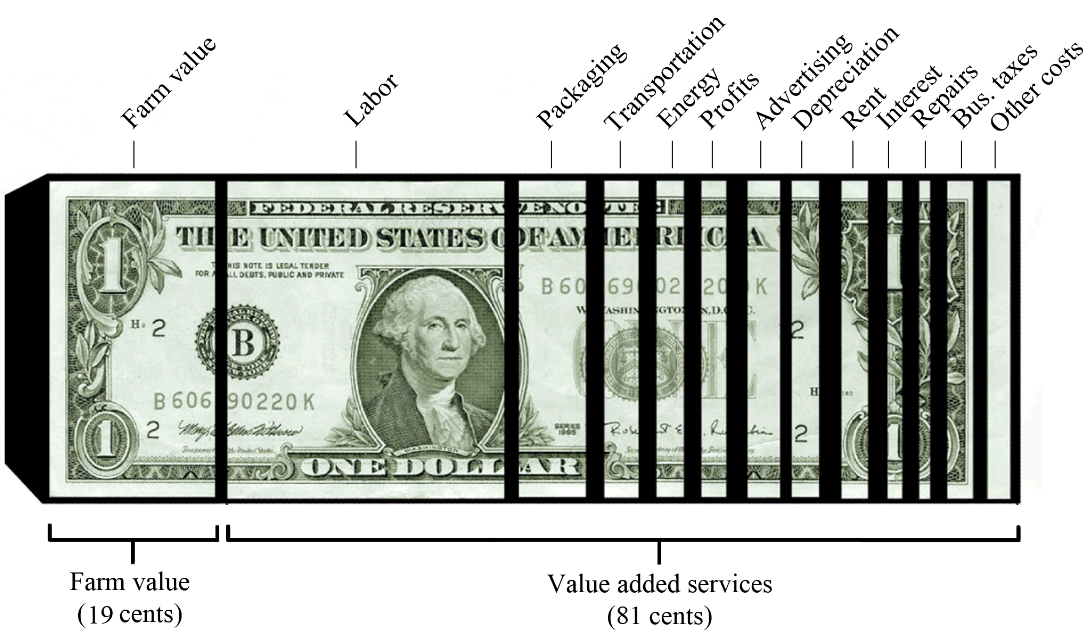
According to USDA data, direct-to-consumer sales in America of locally sourced foods accounted for 0.8 percent of total agricultural sales in 2007. In 2008, total food expenditures in the four-county area represented approximately $6,109 dollars per person, translating into a daily food allowance of $16.75 per person. This figure may be skewed, however, by the presence of federal food-assistance and school-lunch programs supporting food budgets. Local Harvest, a national local foods informational resource reports that roughly 390,000 farm shares are tracked within their purview, comprising around ½ percent (0.5%) of the U.S. population, suggesting that around 1,000 residents in the study area may acquire locally sourced farm products.

In a research context, measuring the economic impact of local foods and other alternative agricultural projects against other expenses is subject to a modicum of error. While anecdotal reports of increased participation in local food sourcing such as *cow-pooling*, CSA membership, pick-your own row crop plots and roadside vending are common, they represent an unknown quantity in this section. The vast majority of food expenditures in the study area support conventional food systems, and suggest that local food systems have an opportunity to recapture a greater percentage of food dollars.

The Farmer

The farming economy within the study area represents an agricultural sector that mirrors the national trend toward market consolidation: decreased earnings for small farmers, fewer farm operators and market isolation from the consumer base in which they operate. A comparison of past and present farm expenses in the study area confirms the pervasive nature of market consolidation in American farming in the past 70 years. The figure below illustrates that 19% of food dollars in 2006 went toward farmers, while the remaining 81% went toward the processing and marketing tiers.

Figure 2. Food dollar by economic sector. Source: USDA ERS, 2006



Figures 3 and 4, below, illustrate a restructuring of farm costs away from wage-driven, low-feed models toward concentrated poultry production. The marked difference in fertilizer expenditures suggests that commercial fertilizers were widely used in the study area around 1940. Phosphate ore, first discovered in South Carolina in 1837, began its journey into Georgia farms as a commercial product in 1867 (Beaton). The elevated fertilizer expenditures may be a symptom of increased production of specialty crops, which tend to perform well in energy-rich soils. The category “other” includes farm equipment, crop insurance and property expenses.

Figure 3. Study area farm expenses (relative), 1940. Source: US Agricultural Census, 1940

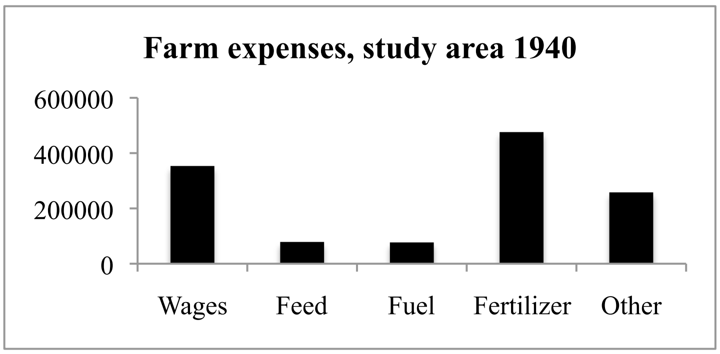
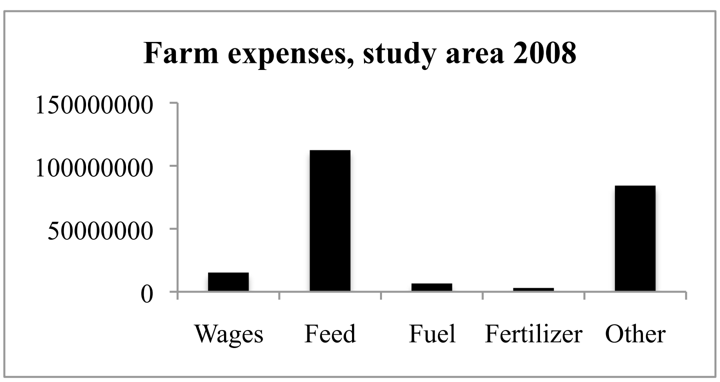


Figure 4. Study area farm expenses (relative), 2008. Source: GSS



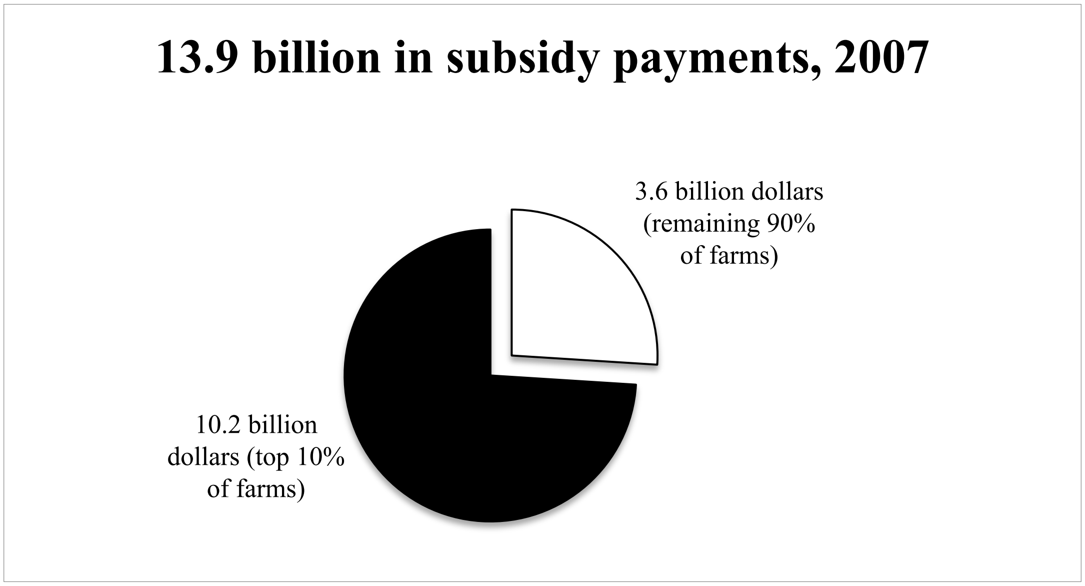
Long term, trends in farming profits display a transfer of financial gains away from the regional farmer toward a concentrated cluster of processing and retail firms. At the same time, farm labor expenses have declined in the relative sense, suggesting that farm workers may be in the same financial predicament as the farm operator. However, farm labor expenditures per county are offered in sum quantities rather than parsed according to individual crop sector or job: gaining a reasonable picture of local farm labor is impossible in this scenario, though it can be reasonably assumed that poultry production and processing accounts for the vast majority of farm and processing jobs.

The subsidy effect

Specific federal agriculture policies, originally devised as a means for stabilizing a precarious farming industry, have slowly transformed over several decades into antiquated, arguably destructive programs. The U.S. Farm Bill, in particular, has transformed the landscape of American farming in economic, environmental, political and social terms. While some programs funded by the U.S. Farm Bill expand natural resources conservation, others encourage overproduction, sole-resource dependency, market concentration and environmental/landscape degradation. Figure 5, below, illustrates the concentrated nature of allocated U.S. farming subsidies, which are disbursed in accordance with total annual sales (i.e. greater net sales per year translate into greater net subsidy payments) (Frydenlund 2007).

Within Georgia, data indicate that small farmers miss out on federal support typically granted to larger operations: In 2008, 70% of the farming operations in Georgia did not receive subsidy payments, and of those who did, the top 10% of recipients took and average payment of $33,515, compared to $450 received by the bottom 80% (the small farmers) (EWG). Within the study area, farm subsidies are slightly lower than the Georgia average, estimated at $343 per operator, according to CAED data.

Figure 5. Subsidy allocations, 2007. Source: EWG



Considerable rancor surrounds other federal farming policies, namely *direct payments*, which reward property owners who occupy land once "in farm." In 2007, for example, 5 billion federal dollars in direct payments were sent to so-called "farmers", whether they were farming or not. Studies report that public opinion in America regarding agricultural subsidies to large farming firms is well defined: 61 percent oppose such payments, while 36 percent are in favor of these subsidies. Opposition to subsidies for large farms was not substantively or statistically different among Republicans (62%), Democrats (60%), and independents (59%). Three out of four Americans, however, are in favor of providing subsidies to small farms (farms under 500 acres), and support is highest among Democrats (82%), followed by Republicans (73%) and then Independents (69%).

Redirection of subsidies

The prospect of redirecting farm subsidies away from corporate agriculture firms toward small farmers is an appealing one, though it presents a dilemma: critics of this position caution that subsidy money would be best redirected into the stewardship cause rather than the "farm welfare" cause. Just because a farm is small does not mean it is more ecologically or socially responsible than a larger one. Despite cautionary tones among analysts, radical agricultural policy shifts in New Zealand regarding subsidies illustrate the potential virtues of eliminating federal farm subsidies. Since the dissolution of farm subsidies in 1984, the Rodale Institute reports that New Zealand farmers and farm-related industries have become more efficient, diverse and responsive to market changes. The report continues, stating that this zero-subsidy framework grants farmers "more independence, and gains them more respect. It leaves more government money to pay for other types of social services, like education and health care."[9]

Local food systems offer potential employment for residents, despite social taboos describing farm labor as "slave's work" or otherwise antiquated. The fact remains that unemployment in the study area hovers around 8%, representing around 15,000 persons, some of whom might reasonably take up employment as a farm hand, with few misgivings as to the societal implications of long workdays in the sun. Assuming that local residents are willing to seek employ within a local food economy brings about larger questions: How will they be compensated? Will farm hands be without work during the winter months when production is greatly diminished? The USDA Economic Research Service reports that empirical studies suggest expanding local food systems in a community can

[9] http://newfarm.rodaleinstitute.org/features/0303/newzealand_subsidies.shtml

increase employment and income for area residents (ERS Martinez), but is not necessarily the case.

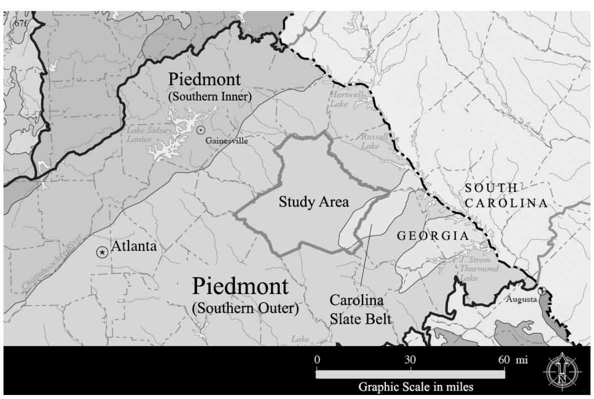
CHAPTER 3

INVENTORY OF STUDY AREA

Geography and land use

An assessment of the current land base in the Athens area reveals a predominately rural landscape dominated by forest and agricultural uses, with concentrated and sparsely distributed nodes of urbanized clusters. The study area lies within the Piedmont eco-region, a tract of land some 90 miles wide and 590 miles long, originating in Georgia to the south and terminating in middle Virginia to the north. The greater piedmont is considered a non-mountainous transitional mass between the steeper, more rugged Appalachian region to the north and the relatively flat coastal plains toward the south. The Piedmont is typified by lower elevations, diminished annual rainfall, increased frequency of pines and red, clayey sub-soils. Soil scientists describe the Piedmont as "a complex mosaic of metamorphic and igneous rocks with moderately

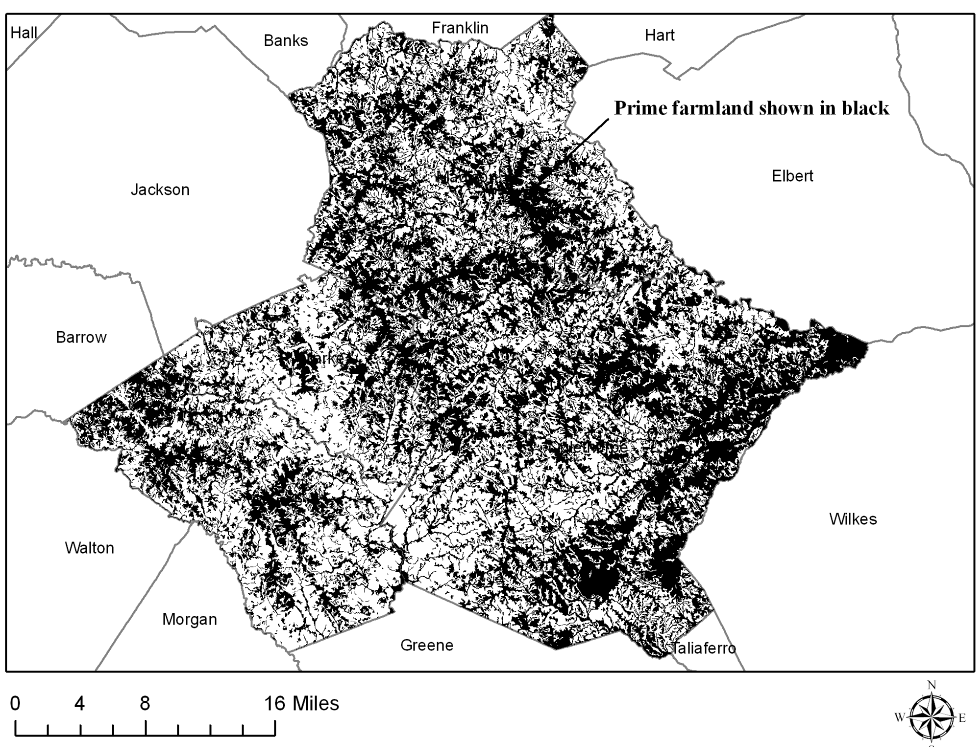
Figure 6. The study area, shown among Level IV ecoregions. Data Sources: U.S. Census and www.nationalatlas.gov. Map adjusted by author.



dissected irregular plains and some hills”. Common rock types in the Piedmont include schist, quartzite and granite.[10]

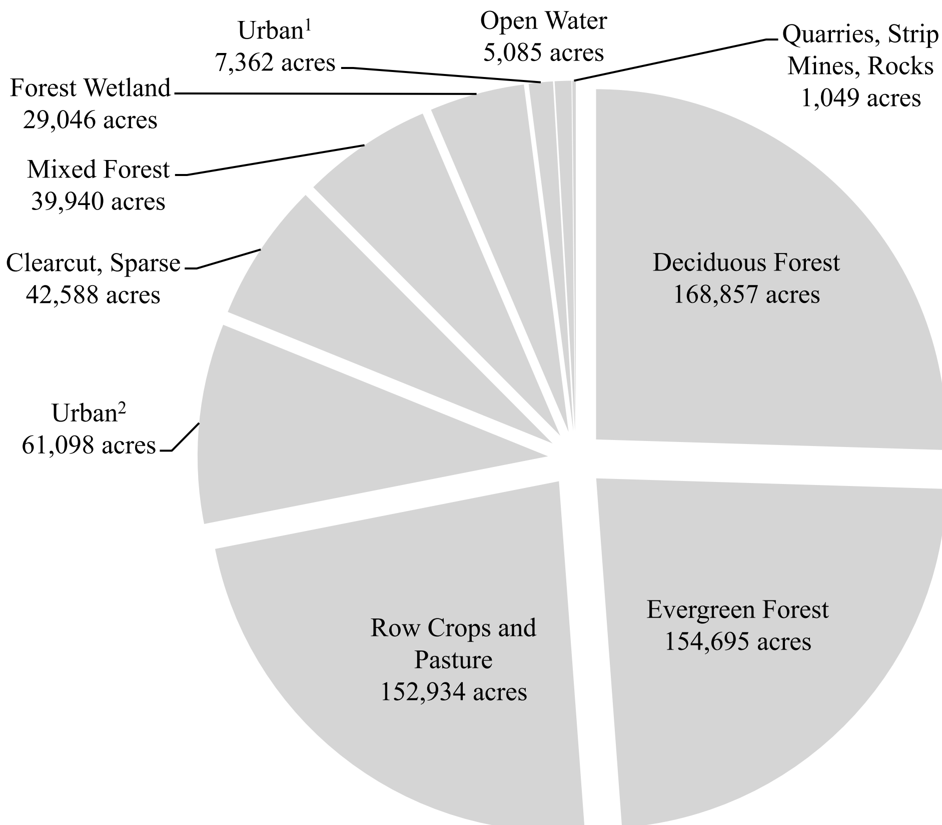
Across the entire study area, optimal farming areas appear to be a symptom of slope rather than soil composition. A direct spatial relationship between ideal farmland as defined by the Natural Resource Conservation Service (NRCS) and slopes of 5% steepness or less is extant. This data suggests that soil composition is of lesser importance than slope steepness when identifying land that is best suited for farming in this region. Primary limiting factors include steepness and/or proximity or inclusion within floodplains and water bodies. Distribution of ideal, arable farmland is irregular and well integrated across the area of study as shown in Figure 7.

Figure 7. Distribution of prime farmland in the study area.
Source: US SCS. Map by author.



[10] Source: USGS

Figure 8. Land use in the study area. Source: NARSAL, CAES, UGA, 2006[11]



[1] High Intensity Urban
[2] Low Intensity Urban

Land classifications according to area are shown above in Figure 8. Land use in the study area is dominated by agricultural use and forest canopy, which accounts for approximately 80% of the land base. Figure 8, above, represents land classifications drawn from satellite imagery. Additional information about agricultural activity is available via published "Farm Gate" reports, which document the sale of farm products on an annual basis. According to 2008 Farm Gate data, around 34% of the study area is actively farmed, and approximately 6% of the study area was harvested in 2008 (38,800 acres).

[11] www.narsal.uga.edu

Prime farmland, as defined by the NRCS, is abundant in the area, occupying around one half (48%) of the total land area and supports, primarily, forest canopy and open pasture/grassland.

Table 3. Prime farmland in the study area by use. Source: USGS and US SCS

42,266 acres	Prime farmland that has been developed	13%
145,607 acres	Prime farmland in forest	46%
91,806 acres	Prime farmland in pasture and hays	29%
27,550 acres	Prime farmland in herbaceous grassland	8%
12,728 acres	Prime farmland in wetland, shrub land and barren space	4%
318,224 acres	**Total acres of prime farmland**	**100%**

People in farming

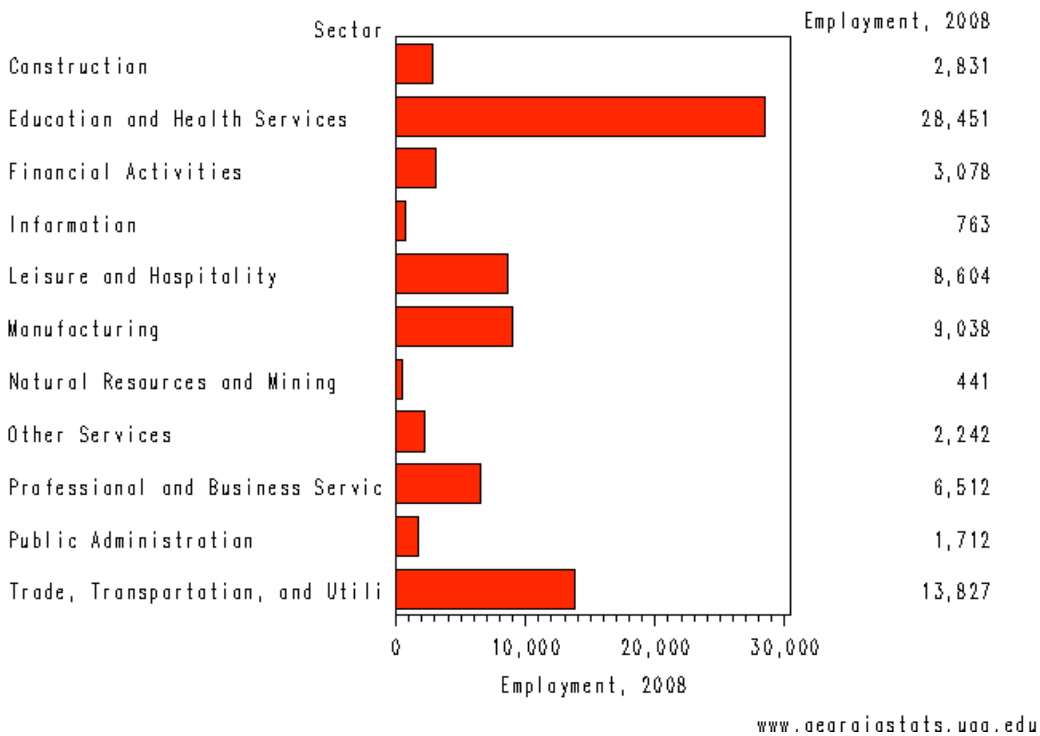
Within the study area, USDA and census data indicates that roughly 1 percent of the study area population participates in farming activity, with around 65 percent of these active farmers representing full-time operators (1,175 of the total 1,784). Farmers who worked in excess of 200 days "off-farm" qualify as part-time farmers (GSS). Of the entire group, the majority are white males, around 58 years old. While 19% of the active farmers in the food cluster are women, minorities represent less than 3 percent of the total (2% African American and less than 1 percent of Hispanic descent) (GSS).

Published information documenting the number of farm and processing laborers in the study area is not available. The Georgia Statistics System (GSS)[12] system reports that 1,784 farm operations are active in the study area, but assessing the quantity of la-

[12] www.georgiastats.uga.edu

borers per farm or processing facility is not possible given the opacity of private enterprise and migrant worker "invisibility", at least from an accounting perspective. A Bureau of Labor and Statistics (BLS)[13] report for the study area does not include farming as an industry within the data set, though farm laborers may be included in the "Other Services" tier:

Figure 9. Labor force in the study area, 2008. Source: BLS



Given an average unemployment rate of 7.9% throughout the study area, it is reasonable to assume that approximately 15,000 people in the study area are without long-term work. However, an accurate account of farm-related work in the employment sector was not found, given limited available data in this realm.

[13] www.bls.gov

Dietary needs

Because food energy requirements vary from person to person, key dimensions influencing food energy needs are taken into consideration: population size, age, gender and physical activity levels. According to U.S. Census estimates for 2008, the sample population within the Athens-Clarke MSA includes 189,264 individuals. The study area population will be assumed 50 percent male and 50 percent female, with females requiring slightly diminished calorie needs than males. In terms of physical activity, a recent Department of Health and Human Services (HHS) publication reports an average of 19% of the U.S. population qualifies as "active", while 25% qualify as "sedentary". The remaining 56% of the population therefore falls into the "moderately active" category. Caloric requirements according to activity level, age and gender are shown in the Appendix A: Calculating Food Energy Needs.

Published USDA data tracking food products in the U.S. is thorough and long-standing. *Food availability*, a metric for how much edible food is brought to market, represents one facet of the greater USDA food-mapping initiative. However, a discrepancy exists between what foods are available and what foods are actually consumed. Americans ultimately consume a portion of the domestic food supply as a *loss adjusted* quantity: foods spoil during shipment and in our refrigerators. Food products expire or become tainted, some are lost during preparation and some are thrown away as plate waste. The USDA Economic Research Service (ERS) reports that due to these losses, approximately 40 percent of the U.S. food supply is not eaten.

Although food availability data are offered in loss-adjusted quantities, the information does not adequately describe the needs of a discrete population as defined in this thesis. U.S. residents are, overall, eating too much: each American, on average, is consuming 16 percent more food than in 1970. USDA estimates of per-capita consumption exceed dietary recommendations for meats, processed grains and sweeteners. The estimated per-capita consumption of red meat and poultry during 2007, for example, is 47% higher than the recommended intake. Intake of fruits and vegetables, on the other hand, is deficient. Loss adjusted food consumption estimates do not accurately reflect a long-term, sustainable account of dietary requirements for the study area population. The study area, like the rest of America, is typified by both over-consumption and under-consumption of selected food groups.

In 1995, the USDA's Center for Nutrition Policy and Promotion (CNPP) unveiled the *MyPyramid* dietary recommendations system, a revised iteration of the "four food groups" model. The new model, as it stands today, reflects a shift away from calorie-based diet structures toward food-specific diets. In doing so, the *MyPyramid* diet scheme emerged as a useful tool in estimating agricultural carrying capacity, as any given food requires its respective land area allocation in production (Peters).

Critics of the MyPyramid plan, however, stress that recommendations have become politicized and do little to address chronic diseases associated with diet. The intake of dietary fat, some argue, has been demonized, while excessive consumption of grains and animal products is not discouraged in USDA recommendations. Other criticisms cite a lack of instruction geared toward exploring the relationship between the globalized industrial food system and dietary choices, particularly in K-12 programs. The most important shortfall of the MyPyramid model, at least within the context of this thesis, is a lack of distinction between the *meats* and *beans* food groups: though both are rich sources of protein, meats require far greater investments of land and energy (Peters 2003).

In this thesis, the required daily needs of the Athens-Clarke MSA population will be rounded to 400 million calories or 400 Mcal. The average energy needs per resident is 2,103 calories per person (according to a USDA-recommended diet). However, a standard two thousand calorie diet will be introduced here as a basic metric (rather than tracking the caloric needs of say, an elderly woman versus those of a high school cross-country trainer). Re-framing the data in this manner will facilitate subsequent estimates of carrying capacity, and have no effect on accuracy.

400 Mcal calories / 189,264 individuals = 2,103 calories per person, per day

OR

400 Mcal calories / 2000 kcal standard diet = 200,000 dietary units per day

The standard USDA 2000 calorie diet used in this study is based on the MyPyramid dietary guidelines model.[14] Table 4, below, reflects the dietary demands of the study area in a suitable metric (the US ton) for use in comparing how local production may or may not meet local demand. A subsequent analysis connecting food needs and land area will be addressed in chapter 5. The total required food weight estimate of 1,488 pounds per person is corroborated by other estimates: Michael Pollan's research estimates a total of "roughly 1,500 pounds per year." Pollan also suggests that food needs for any given person are relatively stable: our stomachs are only so big (Pollan).

---

[14] See Appendix A: Calculating Food Energy Needs

Table 4. Annual dietary needs, pounds per individual and tons for the entire study area (Source: Author, USDA data)

Food type	lbs / person	tons / study area	kcal/day	Mcal/year
Fruits	283	26,885	106	7738
Vegetables	336	31,920	370	27010
Grain	137	13,015	347	25331
Meat and Beans	125	11,875	329	24017
Milk or dairy products	546	51,870	413	30149
Oils	13	1,235	143	10439
Solid Fats	8	760	130	9490
Discretionary fats	14	1,330	130	9490
Discretionary sugars	26	2,470	97	7081
TOTAL	**1,488**	**141,360**	**2,065**	**150,745**

Within this thesis, food preferences or dietary regimens will not be addressed specifically in the design of the standard diet: individual food regimens like lactose-free models and strict vegetarianism represent a statistically insignificant quantity in the carrying capacity model. Given the finite amount of food intake, limited dairy intake may be reasonably offset by increased consumption of other foods in the model, such as oils and grains.

CHAPTER 4

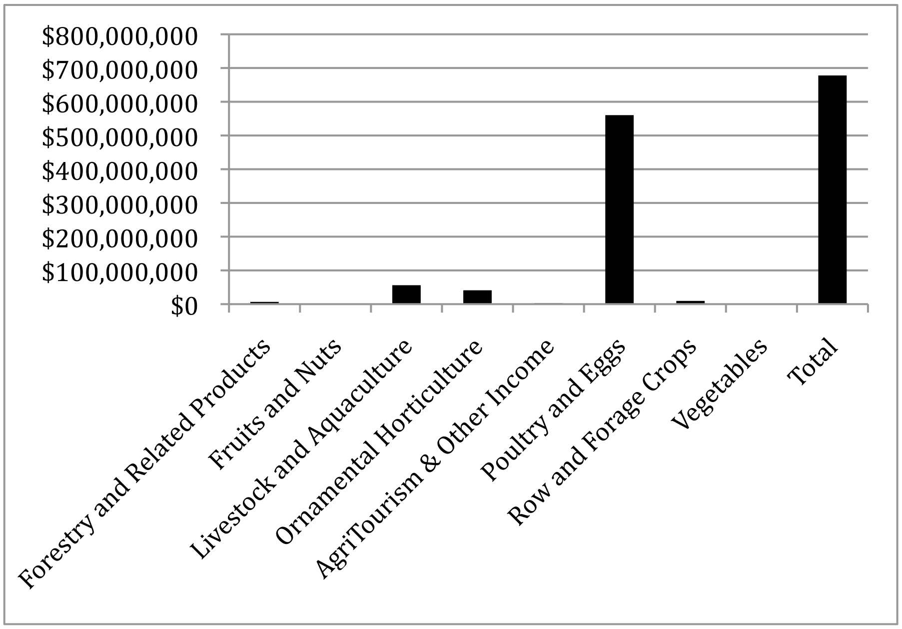
PRODUCTION and PROCESSING

Current production

Food production in the study area today is driven almost entirely by market-based demands outside of the food cluster rather than local demands, and is not balanced in such a way as to meet local dietary needs in a comprehensive way. Foods grown locally are not readily available to consumers, and reflect the agriculturally concentrated food system that dominates American agriculture. Chicken production is the economic hub of the farming industry within the study area: poultry production in 2008 approached one billion pounds, enough to offer each resident (including infants) over eleven pounds of chicken per day. Fruit and vegetable cultivation, by comparison, was deficient, accounting for less than 4% of the annual requirement. Data collected in this chapter reflects an imbalance between local agricultural use and dietary requirements in the food cluster in every sector, a scenario far removed from the farming world of the past in the Athens area.

Figure 10, below, illustrates the comparative sales volume of poultry with other farm enterprises in the Athens area. While poultry production is not an inherently ecologically degrading practice, conventional chicken farming represents a wholesale departure from the tenets of sustainable agriculture as defined in Chapter 2.

Figure 10. Study area farm sales by sector, 2008. Source: CAED *Farmgate* report.



While access to low cost poultry litter serves as fertilizer for cattle farmers in the area, this nitrogen-rich slurry can have negative environmental impacts on water quality if over-applied. Local agricultural codes now limit the application of poultry litter. Because chickens are confined, poultry production requires very limited land area in comparison to the volume of protein yields typical in beef production. However, poultry farmers depend heavily on feed from beyond the study area, and represent a zero-diversity, sole-resource dependent production system with significant market vulnerability (from a farmer's standpoint). This condition will be addressed in the final chapter, but nevertheless represents a compelling facet of the local farm economy within the study area.

Using data drawn from the University of Georgia's Center for Agribusiness and Economic Development (CAED), an assessment of 2008 food energy yield in the food cluster may be developed. A subsequent calculation accounting for processing loss is also included to better reflect the sum total of potentially available foods. Crop sectors include fruits and nuts, vegetables, animal products and row crops. It will be assumed that row crops fit for consumption by humans will be considered as an available food, despite their common use as industrial or commercial crops in animal production (forage crops are excluded, naturally). The sale of these edible crops into the commercial market suggests they are not integrated into the immediate farming sector, and represent "non-forage" foods. Available farm reports do not specify a particular crops' ultimate use, and therefore may potentially serve as foods fit for human consumption. Detailed charts with specific foods are shown in the Appendix. Total production in the study area by crop sector is shown below, along with crop deficits and surpluses shown in Table 6.

Summary Data: Caloric potential

Table 5. Total calorie production in the study area

Crop	Tons	Mcal	Annual Mcal (Edible)	Daily Mcal
Fruits and nuts	1,855	918	780	2.1
Vegetables	1,945	560	306	0.8
Animal products	526,731	605,867	495,710	1,358.1
Row and forage	9,890	160,042	94,784	259.7
TOTAL	**540,421**	**767,387**	**591,580**	**1,620.8**[15]

[15] Note that poultry production accounts for 90% of total animal food energy output

Figure 11. USDA recommended demand vs. current production, study area in tons. Source: GSS, CAED, USDA

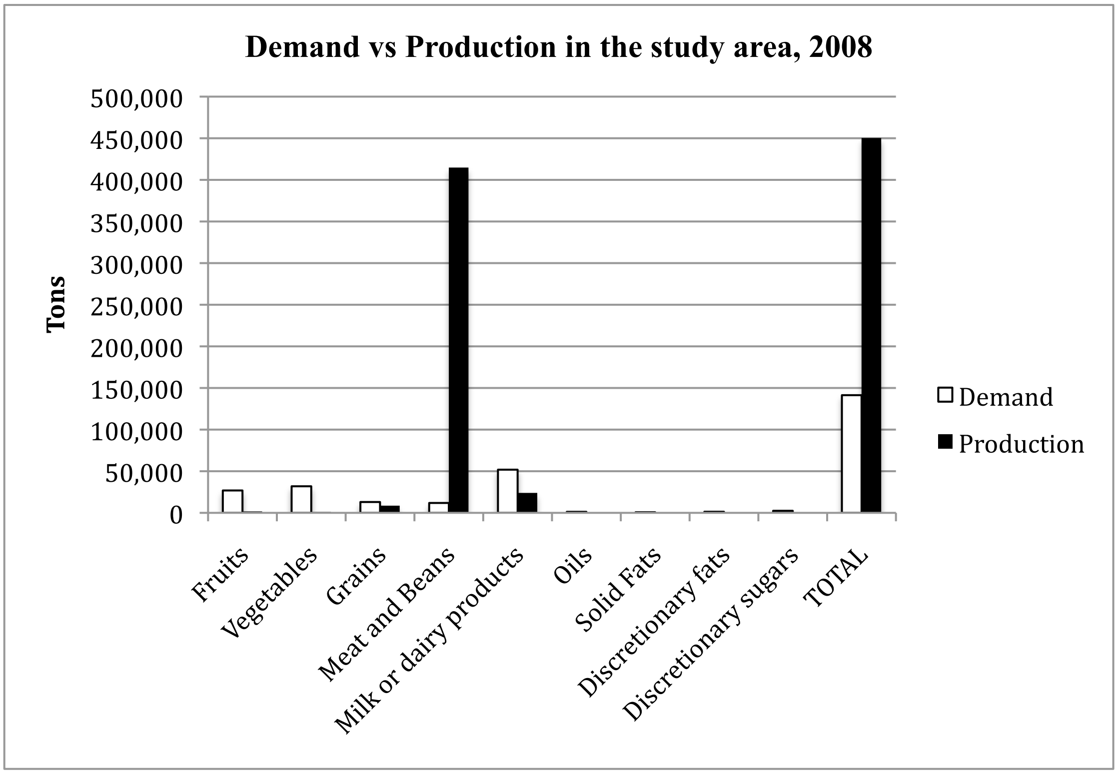


Table 6. Annual dietary needs and agricultural production in tons, study area (Source: USDA data)

Food type	Demand (tons)	Production (tons)	Difference (tons)	Mcal
Fruits	26,885	1,754	-25,131	-9,304
Vegetables	31,920	1,141	-30,779	-7,785
Grains	13,015	8,631	-4,384	-65,897
Meat and Beans	11,875	414,794	402,919	817,713
Milk or dairy products	51,870	23,958	-27,912	-12,660
Oils	1,235	0	-1,235	-9,924
Solid Fats	760	0	-760	-1,547
Discretionary fats	1,330	0	-1,330	-2,708
Discretionary sugars	2,470	0	-2,470	-8,689
TOTAL	**141,360**	**450,278**	**308,918**	**699,199**

Data in the above table illustrates production deficiencies in every sector, excluding meats. A diet-driven food cluster would require significant expansion in specialty crops (fruits, nuts and vegetables), grains and dairy output (oils and fats could be derived from grain and animal processing). While some research suggests that gaps in the U.S. food supply for specialty crops and dairy will be increasingly met with imported production (Abbot, 1999), research by the USDA ERS agency suggests that changes in cropland allocation on a national scale might better resolve this predicament (Peters, Fick). Research by Young and Kantor (1999) identifies the eastern states in America as a suitable region for expanded production in these crop sectors. In this way, deficiencies in fruit and vegetable production within the study area mirror those present domestically.

Farming in the study area, 1940

A review of agricultural production in 1940 within the study area reveals a highly diet-centric farming landscape in comparison to today's scenario. Crop diversity in 1940 was greater, reflecting a more sustainable approach to farming where dependency on external inputs is minimized and the processing and preservation of local goods are maximized. Farm products once tracked by the federal government in 1940 that are now agriculturally "extinct" in the study area (at least in terms of commercial production value) include turkeys, ducks, geese, guineas, rice, quinces, figs, pears, tung nuts, raspberries, persimmons, pomegranates, youngberries, boysenberries, walnuts, sugarcane and flaxseed. Despite a wider range of agricultural crops grown locally in 1940, the variety of specialty crops (fruits, nuts and vegetables) offered in modern supermarkets in comparison to modern standards eclipse food diversity typical of past local production.

Deficiencies in locally supplied crops typical today were absent in the 1940s farming landscape. For example, within the study during the 1940s, fruit and vegetable crops grown for personal consumption in farm gardens exceeded those grown for the commercial market (US Census of Agriculture, 1940). Grain production was comparatively elevated, as shown in the charts below (the high corn output may reflect its use as a livestock feed rather than for human consumption).

Figure 12. Grain supply and demand in tons (adjusted for population). Source: Author

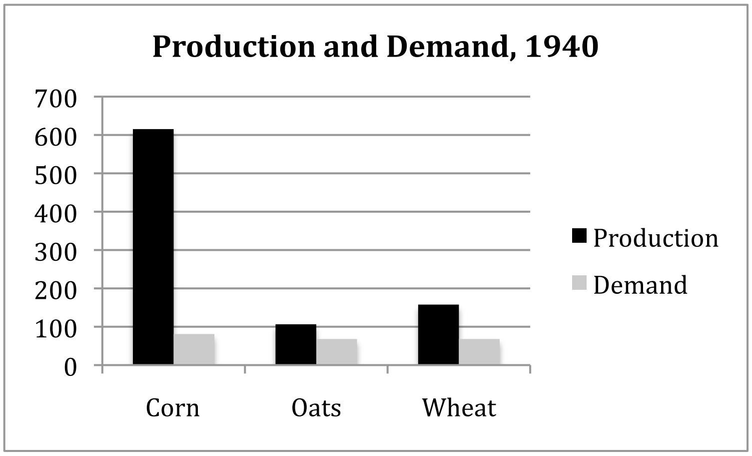
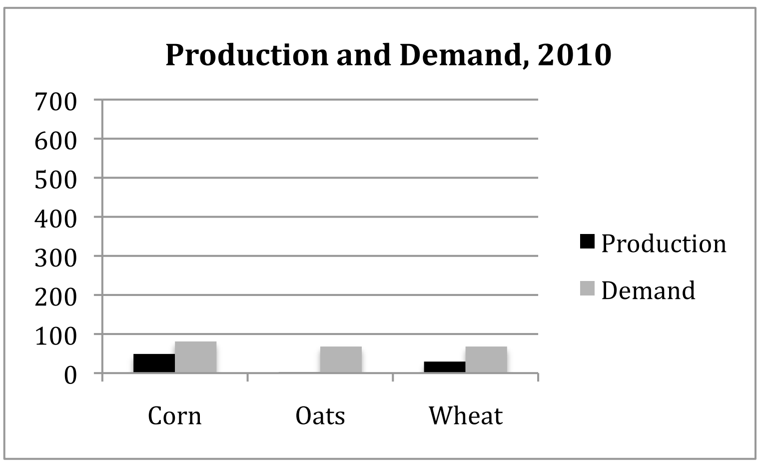


Figure 13. Grain supply and demand in tons (adjusted for population). Source: Author



In 1939, approximately 80% of the land in the study area was farmed, compared to approximately 34% in 2008[16]. Within the study area, farm jobs represented a similar quantity of the workforce, around 34%, compared to roughly 1% of the population today (BLS and US Census of Agriculture, 1940).

[16] CAED, CAES University of Georgia

Processing

A salient feature of a food cluster model is the absence of a corporate processing tier in the supply chain. In a food cluster, agricultural products are grown, processed, packaged and made available to consumers more directly, and do not pass through a conventional "middle-man" or "buyer" common in the conventional food system. Local processing and storage facilities within the food cluster are a vital component in the food supply chain, and stand to serve the food cluster in ecological and social ways: local processing facilities provide employment, marketing avenues, educational services and may also serve as waste processing facilities, transforming agricultural byproducts into nutrient-rich compost. This thesis assumes that processing and storage demands in the food cluster will be met locally. While research describing land area requirements for crop-specific processing facilities was not found, it is reasonable to assume that land area supporting these uses is available: processing and storage facilities can be retro-fitted into existing industrial areas formerly used in the manufacturing and industrial sector. Existing poultry processing plants in the study area, for example, shipped nearly 1 billion pounds of poultry in 2008, occupying only a handful of commercial parcels in the region. The literature indicates that primary limiting factors behind establishing local processing centers include high investment costs and storage capacity, particularly chillers and freezing equipment which are costly to maintain both in terms of energy use and technological complexity.

While local processing facilities can have restorative effects in purely social and ecological ways, they stand to offer regional farmers an avenue for (re)capturing value-added profits normally absorbed by large processing and retail firms (Goldkist and

Kroger, for example). In 2006, 19 cents for every dollar spent on food went to farmers, while the remaining 81 cents went toward supporting the costs of processing, marketing and other associated costs of doing business (energy, processing labor, rents, depreciation, transportation and repairs, for example) (Stewart, Elitzak, USDA ERS). On-farm processing facilities, coupled with direct sales to consumers, could assist farmers in reclaiming profits typically lost in conventional systems.

Mobile meat processing units

Significant market concentration in the meat packing industry has led to the decommission of local abattoirs across America, leaving local farmers with few alternatives to hauling their animals to the regional "farm-gate" where agricultural products are sold to processors. Though not a common feature in the agricultural processing sector as it stands today, mobile processing systems for poultry and ruminant animals are becoming more visible due to the increased interest in locally raised products, particularly meats (Martinez). With a viable marketing component in place, local farmers stand to see greater returns on their investments with mobile slaughter units: studies indicate that 60% of consumers are willing to spend 20% more on locally raised meats (Ostrom; Straw UK). Farmers point out, too, that transporting animals long distances elevates stress levels, a situation that could be avoided with mobile processing units.

Animal processing is more involved than non-meat processing, requiring a range of environmental conditions and inspection regimens geared toward ensuring proper sanitation and chilling standards are met. Treatments in a typical meat processing facility include stunning, bleeding, eviscerating, skinning, washing, butchering, weighing, ageing, storing and wrapping. Because animal processing creates large volumes of waste (viscera, tainted water, skins), particular care must be taken to ensure the offal and wastewater from these facilities are treated properly. If meat products are to bear a USDA-inspected label, the carcasses must be transported to a USDA certified "cut-and-wrap" facility. Carcasses may, however, also be sold to restaurants directly under a USDA retail exemption.

In a local food cluster model, value-added profits normally absorbed by processors could feasibly be transferred to support the operation of non-profit cooperative processing tiers in a food cluster, as well as support farmers and contribute to local economies. Food processing facilities with built-in retail counters can further serve the food cluster by offering residents access to freshly processed goods. Processing facilities could not only process farm products, but also serve as biomass conversion operations that could generate soil-building components out of agricultural by-products.

Conclusion

This chapter documents an agricultural sector dominated by poultry production, and to a limited extent, beef production. Agricultural production geared toward a whole-diet scenario is not in place. However, increased interest in locally sourced meats like grass-fed beef and the suggested expansion of specialty crop production into the eastern states make the study area a promising region. Regional abattoirs, once a mainstay of regional beef farmers in the region during the 20th century, have declined significantly in number. Research suggests that a cluster of 19 abattoirs could support the meat processing demands of the food cluster model (each abattoir would be 10,000 square feet and employ 45 persons).[17] A whole-diet approach to agricultural carrying capacity is explored in the next chapter, and goes beyond simple expansion of existing production in the Athens MSA.

[17] Stockman Grass Farmer Journal: http://www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=700

CHAPTER 5

ESTIMATING CARRYING CAPACITY

Summary

From a land area standpoint, the Athens area contains adequate pasture area to support a whole-diet food system capable of feeding residents within the food cluster. However, dietary intake of meat has a significant impact on land requirements in both conventional and sustainable models: conventional agricultural techniques out-performed sustainable systems in a non-meat diet scenario (0g fat). By comparison, sustainable farming techniques in meat production required less land area than conventional systems, but are far more management intensive (see Figures 15 and 16). Figure 14 reflects carrying capacity scenarios in this thesis.

Whole-diet land requirements in conventional agriculture

Christian J. Peters' study offers a means for connecting whole-diet requirements and land allocation as it relates to agricultural carrying capacity using conventional farming methods. Using a land area resource of 5,018,000 acres in concert with published agricultural output in New York State, Peters' study reported a nearly fivefold difference in per capita land requirements according to dietary choice: increased consumption of meats had the greatest impact on land area needs. Peters' results can be applied directly to this thesis: In the Peters' study, each resident requires between 0.8 and 2.1 acres of agricultural land (depending on meat intake) in order to support a whole-diet regimen meeting USDA standards (Peters 2007). Given the Athens MSA demand of 200,000 standard diets, this range translates into 36,000 acres (0g meat) for non-meat diets and 172,000 acres for high-meat diets (381g meat). The USDA recommended fat intake of 156g per day would require a net land area of 92,000 acres for the entire study area population (see Figure 14). As reported in Chapter 3, given a total pasture area of 152,934 acres in the proposed food cluster, it appears that the entire resident population could be supported with a whole-diet model using 60% of the available pasture area present in the food cluster using conventional means.

Sustainable farms

Research in this section includes a review of sustainable farming operations in America that may be duplicated into the food cluster as possible production nodes serving the study area. The examples were collected from a variety of sources, and represent an estimate of productivity per acre against which Peters' estimates may be compared. Estimates of production per acre were collected on a case-by-case basis rather than gathered from a single source. Table 25, in the Appendix, lists the examples of sustainable farms used to generate the data below. Each farming model meets the definition of sustainable farming as identified in the Introduction.

Table 7, below, estimates the land area requirements of the study area population in a sustainable farming scenario. The acreage estimate accounts for processing and marketing/consumer losses and reflects "consumable" quantities of food derived from the specified land area. According to this data, sustainable farming systems in this scenario would elevate the agricultural land base required to feed the study area by approximately 40,000 acres. While land area requirements for meat production are diminished in a sustainable farming model, this reduction reflects the management intensive nature of sustainable meat production typical of farmers like Joel Salatin. These systems require daily orchestration of farm equipment and considerable expertise.

Table 7. Estimated impact of sustainable farming systems in the study area. Source: Author

Food type	Required tons	Tons/ Acre[18]	Processing loss[19]	Required acres	Required acres (loss-adjusted)
Fruits and Vegetables	96,958	5.70	0.15	17,010	28,350
Grains	21,692	1.40	0.12	15,494	25,823
Meats	19,792	0.74	0.40	26,745	44,575
Pulses	9,895	1.50	0.25	6,597	10,995
Milk or dairy products	86,450	22.50	0.05	3,842	6,403
Oils	2,058	0.25	0.00	8,233	13,722
Solid Fats	1,267	n/a	0.00	n/a	
Discretionary fats	2,217	n/a	0.00	n/a	
Discretionary sugars	4,117	4.25	0.00	969	1,615
TOTAL	**141,360**			**78,891**	**131,483**

[18] Source: SARE New American Farmer, Pollan, M. (2006). The omnivore's dilemma : a natural history of four meals. New York, Penguin Press.
[19] Taken from USDA, Economic Research Service (ERS)

Figure 14. Available pasture area compared with land requirements per diet model.
Source: Author

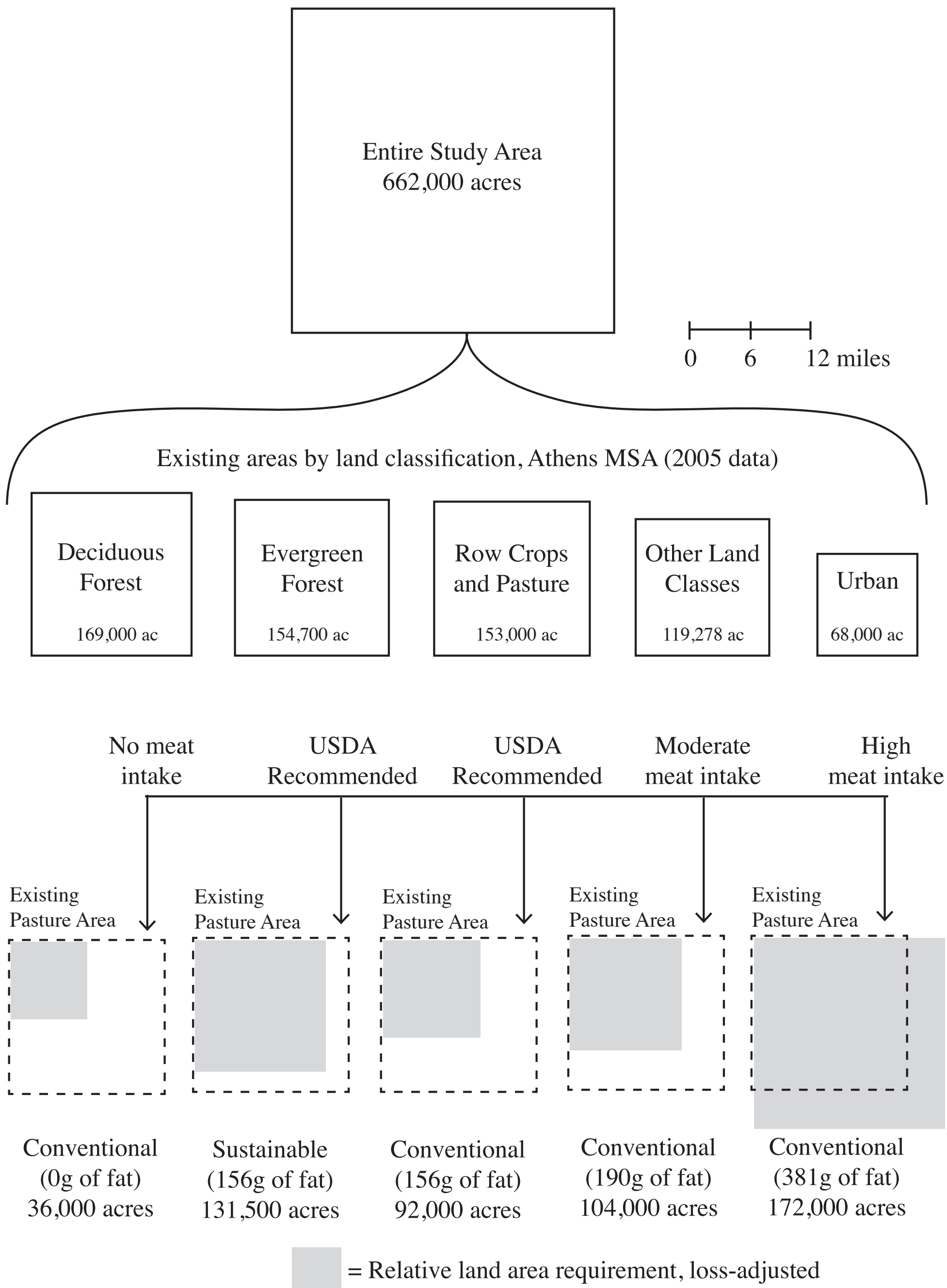


Figure 15. Required acres for non-meat production, study area (loss-adjusted). Source: Author

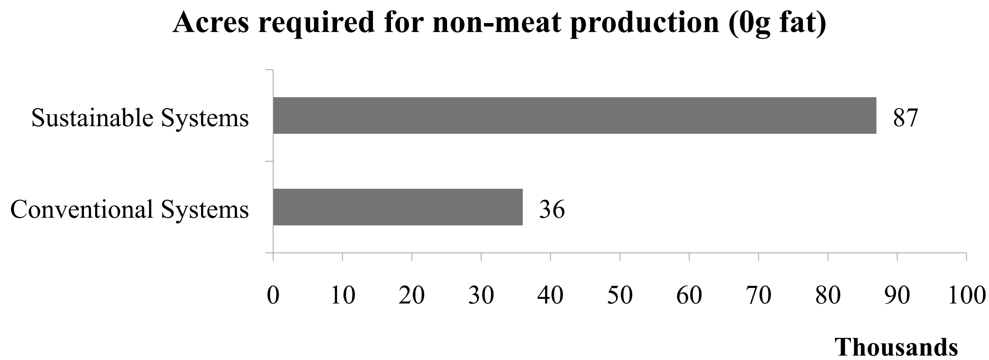
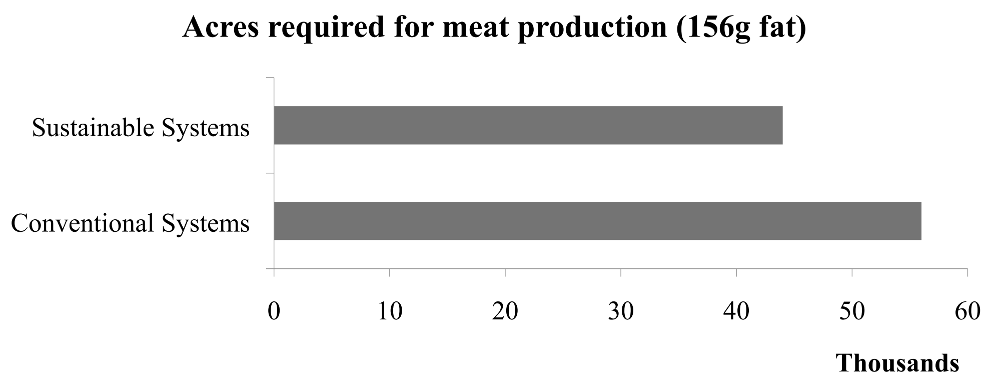


Figure 16. Required acres for meat production, study area (loss-adjusted). Source: Author



Forest displacement/replacement approach

While the study area contains vast tracts of pasture, these areas are important economic resources for local cattle farmers, and should not be disturbed. Leaving pasture area in place also does not remove the possibility of transitioning traditional beef production practices toward sustainable methods exploiting the inter-species relationship between ruminant animals (the cow) and birds (the chicken). The benefits of this production scenario are well documented and adhere closely to or surpass sustainable farming principles (Salatin 1995). In short, beef, dairy and poultry production could continue unabated, but not in the conventional sense. Dependency on external resources should be eliminated to the fullest possible extent in accordance with sustainable farming methods describes in the Introduction. Rising costs of fuel and feed may exert market pressures on conventional poultry production, and unforeseen viral pathogens could inflict catastrophic damage on conventional poultry production (though these diseases could feasibly spread to pastured birds). In such a scenario, Salatin proposes transforming existing chicken houses into storage bunkers for winter cattle forage (Salatin 1995). Dairy operations could be ramped up to meet regional demand within existing pasture areas.

The forest displacement/replacement approach assumes that necessary production of grains, specialty crops, pulses and sugars would take place on cleared forest land where soils are rich, and that meat production would continue on pasture tracts. Specific crops would be matched to their respective, preferred soil cultures. Assuming that meat and dairy production takes place on existing pasture means that a range of between 36,000 and 87,000 acres are needed to support non-meat agricultural production outside of pastureland, conceivably within the existing forested area of 363,492 acres (of which 145,607 acres are considered "ideal" farmland). As existing pasture tracts are transitioned toward sustainable methods, required pasture area diminishes, allowing for expanded reforestation of former pasturelands. Clearing forest is possible with minimal impacts on water quality provided that stream buffers are respected and "no-till" or conservation-tilling methods are used.

Conclusion

Research in this chapter reports local land requirements for whole-diet food systems that account for a 40 percent loss of foods typical in America today (expired foods, damaged foods and "plate-waste", for example). Studies indicate that food products in

America typically traverse 1,500 miles prior to being consumed, a distance that could conceivably be reduced greatly in a local food system. However, data supporting this argument is not available, and local land requirements in both conventional and sustainable models reflect current food loss estimates.

Data in this chapter illustrates that land resources exist which could support the Athens area population in a whole-diet context, and have minimal impacts on the existing agricultural sector. While this scenario limits available land to pasture area and existing forest, incursion of farming uses into other land classes may be possible and is worth exploring. Approximately 43,000 acres, for example, are classified as “Clearcut or Sparse”, and may be suitable for transition into farming uses. Urban land areas, which occupy 61,000 acres in the Athens area, should not be ruled out as potential farming zones. Knowing that a range of between 92,000 acres (conventional) and 131,500 acres (sustainable) is needed to support the Athens area is an important first step in envisioning a food cluster. However, growing food requires more than just land. The social and economic implications of the food cluster are explored in the following chapter.

CHAPTER 6

CONCLUSION

Research in this thesis makes clear that the Athens area possesses adequate land resources capable of supporting a sustainable (or conventional), whole-diet agricultural system. While conventional farming systems out-perform sustainably-minded agricultural production in a market environment, the negative social and ecological effects of mass-market food systems are evident, albeit difficult to measure. Likewise, the positive social and ecological benefits of local, sustainable food systems are difficult to quantify in concrete terms from a research perspective. However, success stories in small farming should not be dismissed as purely anecdotal, considering the aggregate effect of these projects which elevate soil fertility and offer increased economic stability for small farms. While the benefits of local, sustainable farming are indisputable, the implications of implementing a food cluster have considerable social, ecological and economic ramifications. Landscape architects should recognize the importance of advancing local food systems in an advocacy setting.

The management gap

Discrepancies between local dietary needs and local food availability illustrate a gap between the regional farming sector and long-term local land management. Should county governments, for example, have influence over what farmers are producing and how they are producing it, given the pitfalls of industrially driven agriculture which begin, ultimately, on small farms? What contingency plans are in place, for example, to protect small farmers from long-term market pressures, beyond federally supplied "disaster payments" which encourage business as usual in the short term? While some federal policies encourage transition toward sustainable farming, local government agencies appear content to maintain the agricultural status quo, leaving the Athens area without a comprehensive social, ecological and economic vision of changes in regional farming. In short, county governments, and their citizens, would be well served to offer incentives for local farmers to transition into more diversified, energy independent agricultural methods. Research in this thesis shows that doing so could improve local economies, offer intellectual enrichment, protect the farming sector from incursion by development interests and improve agroecological conditions in the long term. For these reasons, planning for long-term changes in regional agriculture is prudent.

In this pursuit, county governments could offer tax incentives for farmers to transition toward sustainable agricultural models. Farmers who implement ecologically restorative methods could effectively lower their property taxes in this scenario, with the net result of elevating their land tenure security against development pressures. This campaign is not without its obstacles. A farmer's transition toward more restorative agricultural practices involves risk and uncertainty. USDA field agents are hesitant to recommend techniques without concrete research histories, and these new systems require management expertise, infrastructural adaptation and financial investment. Initiating sustainable farming practices on rented land involves some trepidation as well: the rewards of restorative farming techniques are embodied in the soil, soil that may not be owned by those who work to improve it (Fazio 2003).

County governments have a vested interest in understanding local farming in a more direct, comprehensive way. Farmland preservation is a first step toward protecting a valuable source of both employment and food. The use of redirected federal farm subsidies away from corporate firms toward county governments could reasonably support local efforts at transitioning farmers toward sustainable practices, particularly in securing land tenure. It appears that established farmers in the study area are ageing, and that the trend of farm loss in the study area will continue.

The landscape architect

How might society best use land to make food? This is a question that landscape architects should ask themselves, and recognize that agricultural production is more than just an aesthetic facet of regional landscapes. Farms are ecological places with social and economic traits as well, attributes which feed directly into the social welfare sphere. Environmental designers and planners should look at farms as landscapes, and see landscapes as spaces with agroecological possibilities.

One powerful tool landscape architects possess is the authority to recommend plant species in public and private spaces. What makes, for example, *Miscanthus sinensis* a superior landscape plant over wheat (*Triticum spp*)? Why are flawlessly mown lawns held in such high regard, while fruit orchards wither? One could surmise, given the history of commercial landscapes in America, that the more ecologically irrelevant a landscape is, the more beautiful it is. Landscape architects must recommend more food plants without hesitation (fig, apple, filbert and persimmon trees, for example). While blueberry shrubs, for example, are familiar landscape plants in the Athens area, the use of grain crops as ornamental landscape plants is worthy of additional study. Landscape plants may be both beautiful and ecologically relevant.

Landscape architects must acknowledge that farms, first and foremost, must be economically solvent in order to persist. Agriculture is a competitive practice, and understanding why small farms in the region succeed or fail is vital. Success stories in farming are well received and can foment transition toward more sustainable methods as the public learns more about the values of conservation in the agricultural sphere. Information, however, remains the most powerful tool a landscape architect possesses. Consumers, for example, are willing to spend more for locally produced goods according to surveys. Joel Salatin's approach to agriculture, for instance, is remarkable in its effectiveness at preserving farmland, remaining profitable, offering high quality foods and elevating animal welfare. Landscape architects should familiarize themselves with the array of successful, specialized, market-adaptive farming outfits cropping up in America. While Earl Butz's agricultural mantra "get big or get out" is still reverberating in the farming world after forty years, small farmers today are discovering a new path: "get specialized and stay in."

Landscape architects stand to serve as advocates for the cause of local food systems in both public and private arenas. Within government offices, the issue of long range planning in local agriculture may be introduced and advanced by the landscape architect: farmers, processors, residents and regional development commissions all have a say in the future of local farms, and should have access to a forum that airs these concerns. Environmental designers and regional planners should seek educational resources for honing their understanding of how food and landscape are interdependent, becoming more conversant in successful, market-adaptive solutions pioneered by sustainably minded agriculturalists. In free-market settings, landscape architects can remind developers that today, many consumers prefer ecologically minded landscapes to conventional, commercial landscapes requiring year-round attention and elevated costs. In short, environmental designers can capitalize on this cause, educating themselves and others of the importance and relevancy of local food systems in everyday scenarios.

The future

Research suggests that secure water resources and mild winters make the southeast a promising farming region as water access pressures increase in the western part of North America and fuel costs rise, driving specialty crop production toward the east coast where large markets are close by. Recognizing and planning for this potential new market need not be orchestrated solely by the private sector.

County agencies can begin identifying ideal land areas within counties for future orchard plantings, which take years to begin bearing fruit. Aquaculture, according to some researchers, is the fastest growing agricultural sector in America, and demonstrates potential as a largely untapped protein resource and economic hub, though many existing aquatic farming operations are far from ecologically sustainable (McWilliams). A recent article published in Forbes magazine, widely recognized as a conservative voice in the American economic sphere, predicted that by 2018 (only eight years from now), 20 percent of the food eaten in major urban areas of the USA will be grown adjacent to or in the city itself. Envisioning a local food cluster is an initial call to action for us all, and demonstrates that engaging the world of farming is relevant to anyone who depends on it.

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APPENDIX A: CALCULATING FOOD ENERGY NEEDS

Table 8. Individuals per age group, male or female. Source: HSS

Age group	Individuals	Sedentary	Moderate	Active
		25%	56%	19%
0-18	20,611	5,153	11,542	3,916
18-24	18,787	4,697	10,521	3,570
24-44	26,503	6,626	14,842	5,036
44+	28,732	7,183	16,090	5,459

Table 9. Daily caloric requirements by activity level, per female. Source: USDA

Age group	Sedentary	Moderate	Active
0-18	1400	1625	1812
18-24	2000	2100	2400
24-44	1900	2000	2200
44+	1600	1800	2100

Table 10. Daily caloric requirements by activity level, per male. Source: USDA

Age group	Sedentary	Moderate	Active
0-18	1600	1825	2087
18-24	2400	2700	3000
24-44	2200	2500	2900
44+	2000	2300	2600

Table 11. Daily caloric requirements of activity level, females. Source: USDA, HHS

FEMALE	Sedentary	Moderate	Active	TOTAL
0-18	7,213,850	18,756,010	7,095,955	33,065,815
18-24	9,393,500	22,093,512	8,566,872	40,053,884
24-44	12,588,925	29,683,360	11,078,254	53,350,539
44+	11,492,800	28,961,856	11,464,068	51,918,724
				178,388,962

Table 12. Daily caloric requirements by activity level, males. Source: USDA, HHS

MALE	Sedentary	Moderate	Active	TOTAL
0-18	8,244,400	21,064,442	8,172,880	37,481,722
18-24	11,272,200	28,405,944	10,708,590	50,386,734
24-44	14,576,650	37,104,200	14,603,153	66,284,003
44+	14,366,000	37,006,816	14,193,608	65,566,424
				219,718,883

Table 13. Age Groups in the Athens MSA. Data Source: U.S. Census Bureau

Age Group	Range in Years	Individuals
A	0-18	41,222 (22% of total)
B	18-24	37,573 (20% of total)
C	24-44	53,005 (28% of total)
D	44 +	57,464 (30% of total)
		189,264 (Total)

Table 14. Recommended caloric intake. Source: USDA, HHS

Estimated Calorie Requirements (in kilocalories) for Each Gender and Age Group at Three Levels of Physical Activity.

Gender	Age (years)	Activity Level		
		Sedentary	Moderately Active	Active
Child	2-3	1,000	1,000 – 1,400	1,000 – 1,400
Female	4 – 8	1,200	1,400 – 1,600	1,400 – 1,800
Female	9-13	1,600	1,600 – 2,000	1,800 – 2,000
Female	14-18	1,800	2,000	2,400
Female	19-30	2,000	2,000 – 2,200	2,400
Female	31-50	1,800	2,000	2,200
Female	51+	1,600	1,800	2,000 – 2,200
Male	4-8	1,400	1,400 – 1,600	1,600 – 2,000
Male	9-13	1,800	1,800 – 2,200	2,000 – 2,600
Male	14-18	2,200	2,400 – 2,800	2,800 – 3,200
Male	19-30	2,400	2,600 – 2,800	3,000
Male	31-50	2,200	2,400 – 2,600	2,800 – 3,000
Male	51+	2,000	2,200 – 2,400	2,400 – 2,800

Source: HHS/USDA Dietary Guidelines for Americans: 2005

- ♦ These levels are based on Estimated Energy Requirements (EER) from the IOM Dietary Reference Intakes macronutrients report, 2002, calculated by gender, age, and activity level for reference-sized individuals. "Reference size," as determined by IOM, is based on median height and weight for ages up to age 18 years of age and median height and weight for that height to give a BMI of 21.5 for adult females and 22.5 for adult males.
- ♦ Sedentary means a lifestyle that includes only the light physical activity associated with typical day-to-day life.
- ♦ Moderately active means a lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life.
- ♦ Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life.
- ♦ The calorie ranges shown are to accommodate needs of different ages within the group. For children and adolescents, more calories are needed at older ages. For adults, fewer calories are needed at older ages.

Table 15. Standard diet per individual, 2000 kcal. Source: USDA

FOOD GROUP	DAILY INTAKE	WEEKLY INTAKE
Fruits	**2 cups**	**87 oz (cantaloupe)**
Vegetables	**2.5 cups**	**103.3 oz (mixed)**
Dark green vegetables	~0.4 cups	18.8 oz (collards)
Orange vegetables	~0.3 cups	9.5 oz (carrots)
Legumes (dry beans)	~0.4 cups	25.3 oz (soybeans)
Starchy vegetables	~0.4 cups	24.7 oz (sweet potato)
Other vegetables	~0.9 cups	25 oz (summer squash)
Grain	**6 ounce-equivalents**	**42 oz**
Whole grains	3 ounce-equivalents	21 oz
Other grains	3 ounce-equivalents	21 oz
Meat and Beans	**5.5 ounce-equivalents**	**38.5 oz**
Milk or dairy products	**3 cups**	**168 oz**
Oils	**16.2 grams**	**4.0 oz**
Solid Fats	**10.8 grams**	**2.7 oz**
Discretionary fats	**18 grams**	**4.4 oz**
Discretionary sugars	**32 grams**	**8.0 oz**

Figure 17. Daily caloric regimen of foods by percentage, 2000 kcal diet. Source: USDA

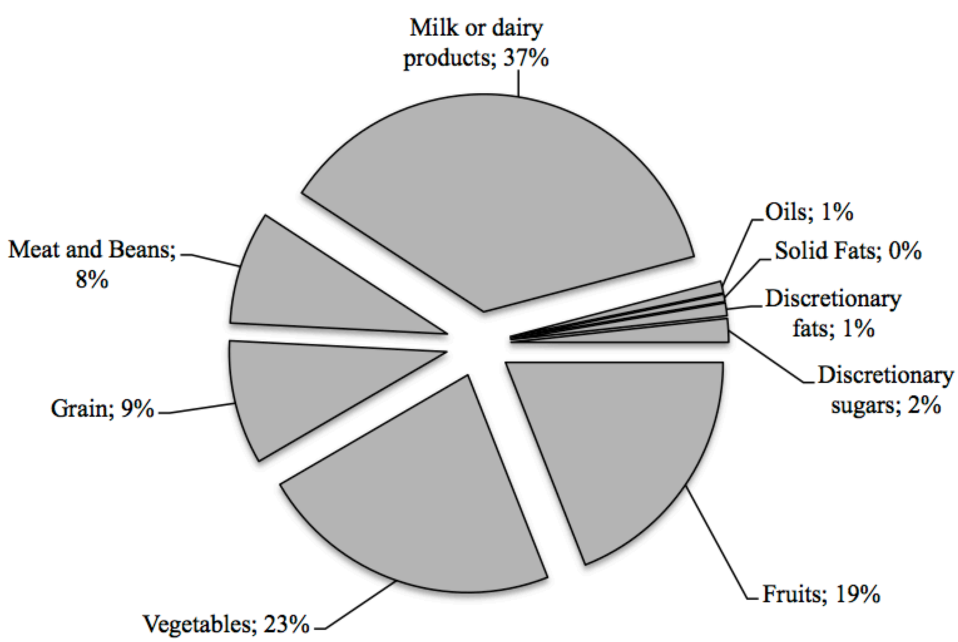


Table 16. Daily caloric needs, study area population.

Gender	Individuals	Required calories / day
Female	94,632	178,388,962
Male	94,632	219,718,883
TOTAL	**189,264**	**398,107,845**

APPENDIX B: STUDY AREA AGRICULTURAL PRODUCTION

Table 17. Fruit and nut production, study area 2008. Source: GSS

Crop	Yield per acre	Units	Acres
Apples	9.7	tons	6
Blackberries	2.4	tons	3
Blueberries	2	tons	27
Grapes	2.8	tons	22
Peaches	3	tons	133
Pecans	0.33	tons	65
Strawberries	7	tons	11
TOTAL			**267**

The acreage and yield values were taken from the CAED Farm Gate Value Report, and yield per acre are based on Georgia state totals (pounds/acre for individual crops). Pecan crop weights denote "in-shell" weight (not processed).

Vegetables

Table 18. Vegetable production, study area 2008. Source: GSS

Crop	Yield per acre	Unit	Acres
Cabbage*	17.5	tons	0
Cantaloupe	10	tons	8
Cucumbers*	7.2	tons	0
Eggplant*	9.8	tons	0
Greens	6	tons	143
Okra	5	tons	4
Onions*	12.4	tons	0
Peppers, Bell*	13.1	tons	0
Peppers, Other*	4	tons	0
Snap Beans*	2.3	tons	0
Southern Peas	1.7	tons	13
Squash	7.4	tons	4
Sweet Corn	7.2	tons	12
Tomatoes	15	tons	13
Watermelon	32	tons	20
Zucchini	7	tons	2
TOTAL			**219**

*Included for possible use in future calculations

The production estimates were taken from the Alabama Cooperative Extension System, Commercial Vegetable Production research unit, Auburn University. Yields per acre are based on bushels per acre numerical mean multiplied by pounds per bushel numerical mean, followed by conversion into tons. Production weights ranging from 1) irrigated, plastic-layered crops to 2) bare-ground, dry-land crops were numerically averaged.

Livestock

Table 19. Animal production, study area 2008. Source: GSS

Animal Products	Tons	Unit	Acres
Catfish	58	tons	45
Cattle[20]	8,734	tons	n/a
Eggs[21]	3,515	tons	n/a
Goats	75	tons	n/a
Lamb	38	tons	n/a
Milk	23,958	tons	n/a
Pork[22]	9,572	tons	n/a
Poultry	477,486	tons	n/a
TOTAL	**523,436**	tons	

Fruits and nuts

Table 20. Fruit and nut production, edible. Source: GSS

Crop	Tons	Refuse (%)	Tons (edible)
Apples	82	0.1	8.2
Blackberries	11	0.04	0.44
Blueberries	76	0.05	3.8
Grapes	167	0.04	6.68
Peaches	1224	0.04	48.96
Pecans	36	0.47	16.92
Strawberries	259	0.06	15.54
TOTAL			**100.54**

[20] Includes all production weight within study area (does not include weight gained at remote feedlot, for example).
[21] Egg weights based on 22.5oz dozens
[22] Includes farrow to finish, finishing only and feeder pigs

Vegetables

Table 21. Vegetable production, edible. Source: GSS

Crop	Tons	Refuse (%)	Tons (edible)
Cabbage	0	0.2	0
Cantaloupe	80	0.49	39.2
Cucumbers	0	0.27	0
Eggplant	0	0.19	0
Greens	858	0.43	368.94
Okra	20	0.14	2.8
Onions	0	0.1	0
Peppers, Bell	0	0.18	0
Peppers, Other	0	0.08	0
Snap Beans	0	0.12	0
Southern Peas	22.1	0.62	13.702
Squash	29.6	0.05	1.48
Sweet Corn	86.4	0.61	52.704
Tomatoes	195	0.09	17.55
Watermelon	640	0.48	307.2
Zucchini	14	0.05	0.7
TOTAL			**804.276**

Vegetables

Table 22. Vegetable production, edible Mcal. Source: GSS

Crop	Tons	Mcal/Ton	Mcal	Refuse (%)	Mcal (Edible)
Cabbage	0	0.23	0.00	20	0.00
Cantaloupe	80	0.31	24.67	49	12.58
Cucumbers	0	0.11	0.00	27	0.00
Eggplant	0	0.22	0.00	19	0.00
Greens	858	0.27	233.73	43	133.23
Okra	20	0.28	5.62	14	4.84
Onions	0	0.36	0.00	10	0.00
Peppers, Bell	0	0.18	0.00	18	0.00
Peppers, Other	0	0.27	0.00	8	0.00
Snap Beans	0	0.28	0.00	12	0.00
Southern Peas	22.1	0.73	16.23	62	6.17
Squash	29.6	0.13	3.82	5	3.63
Sweet Corn	86.4	0.78	67.39	64	24.26
Tomatoes	195	0.16	31.81	9	28.95
Watermelon	640	0.27	174.10	48	90.53
Zucchini	14	0.15	2.16	5	2.05
TOTAL					**306.23**

ANIMAL PRODUCTS

Table 23. Animal products, edible Mcal. Source: GSS

Category	Tons	Mcal/Ton	Mcal	Refuse (%)	Mcal (Edible)
Catfish	58	1.38	79.96	57	34.38
Cattle	8734	1.97	17190.17	50	8595.09
Eggs	6820	1.48	10082.76	11	8973.65
Goats	75	1.12	83.67	48	43.51
Lamb	28	2.19	61.20	28	44.07
Milk	23958	0.54	13037.94	0	13037.94
Pork	9572	3.41	32643.58	30	22850.51
Poultry	477486	1.12	532688.16	17	442131.17
TOTAL					**495710.32**

Row and Forage Crops (grown for livestock or fiber purposes only)

Table 24. Row and forage crop yields. Source: GSS

Crop	Yield per acre	Unit	Acres
Barley	56.5	bushels	100
Corn	112.2	bushels	1155
Cotton	1.7	bales	435
Hay	2.2[23]	tons	38700
Oats	52.2	bushels	303
Peanuts[24]	1.6	tons	0
Rye	1.8	tons	407
Silage	17.4	tons	948
Sorghum	51.2	bushels	400
Soy	32.6	bushels	1482
Straw	79	bales	3050
Wheat	45.8	bushels	2280
TOTAL			**49,260**

The estimates for yield per acre of row and forage crops were taken from the USDA National Agricultural Statistics Service (NASS) 2007 Census of Agriculture, Georgia state data. Acreage values were taken from the CAED 2008 Georgia Farm Gate Value Report.

[23] Numerical average of all hays listed (alfalfa, small grain, tame, wild, haylage, grass silage and greenchop)
[24] Value included for use in future calculations

Table 25. Sustainable farming examples by dietary tier. Source: Author

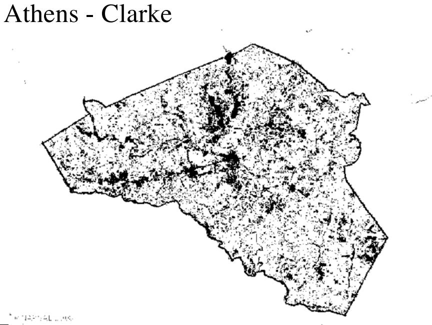
Food type	Farm	Location	Notes
Fruits and Vegetables	Roots farm	Watkinsville, Ga	Specialty crops
Grains	Max Carter	Douglas, Ga	Wheat or Soybeans
Meats	Polyface Farm	Swoope, Va	Beef, hogs, poultry
Pulses	Relinda Walker	Screven, Ga	Peanuts
Milk or dairy products	Johnston Farm	Newborn, Ga	Milk
Oils	n/a	n/a	Taken from grains
Solid Fats	n/a	n/a	Taken from processing
Discretionary fats	n/a	n/a	Taken from processing
Discretionary sugars	Northside Planting	Franklin, La	Sugar cane

APPENDIX C: GEOGRAPHIC AND DEMOGRAPHIC ESSENTIALS

(Chart appears on following page)

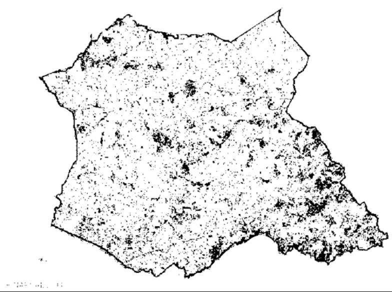
Table 26. Population and land area, study area. Source: NARSAL, UGA[25] and US Census[26]

Athens - Clarke



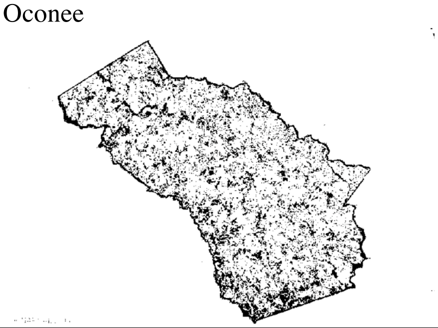
1990 Census	87,594
2000 Census	101,489
Acres	77,653
Hectares	31,425
Square Miles	121
Square Kilometers	314
County Seat	Athens
Density	948 ppsm

Madison



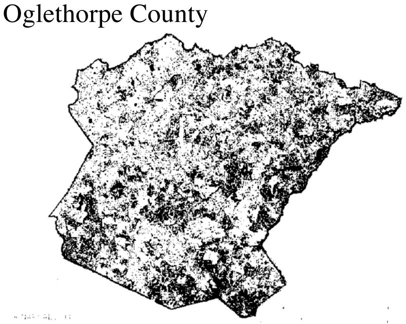
1990 Census	20,119
2000 Census	25,730
Acres	182,797
Hectares	73,976
Square Miles	286
Square Kilometers	740
County Seat	Danielsville
Density	99 ppsm

Oconee



1990 Census	17,618
2000 Census	26,225
Acres	119,183
Hectares	48,232
Square Miles	186
Square Kilometers	482
County Seat	Watkinsville
Density	173 ppsm

Oglethorpe County

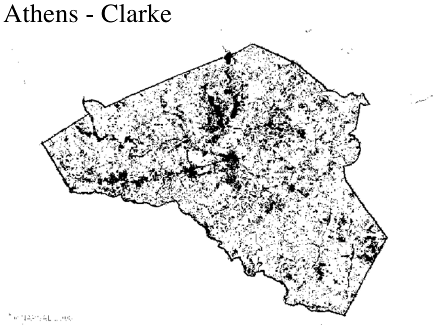


1990 Census	9,763
2000 Census	12,635
Acres	283,023
Hectares	114,536
Square Miles	442
Square Kilometers	1,145
County Seat	Lexington
Density	32 ppsm

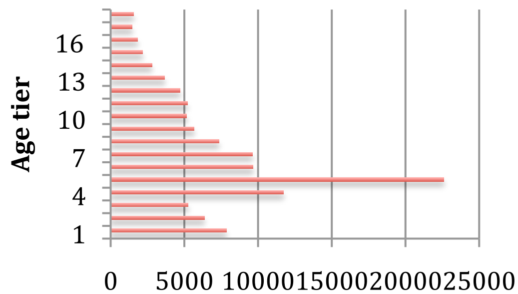
25 www.narsal.uga.edu
26 www.quickfacts.census.gov

Table 27. Age distribution, study area. Source: US Census Quickfacts[27] [28]

Athens - Clarke



Population: 114,737



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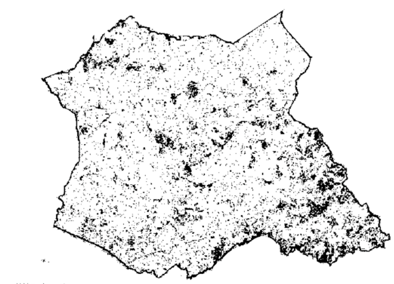
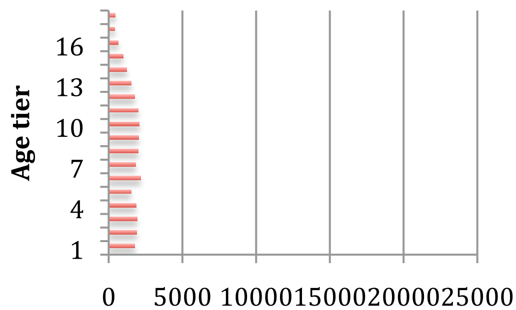


Population: 28,200



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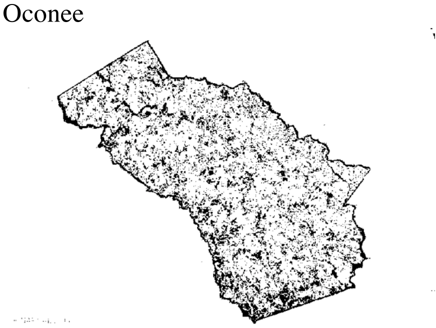
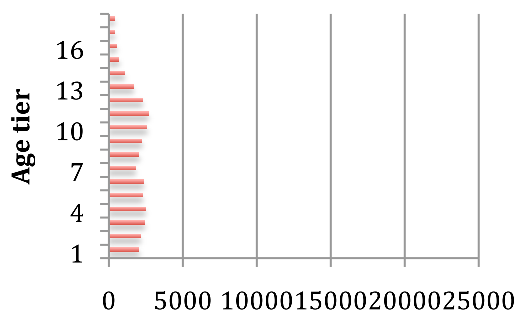
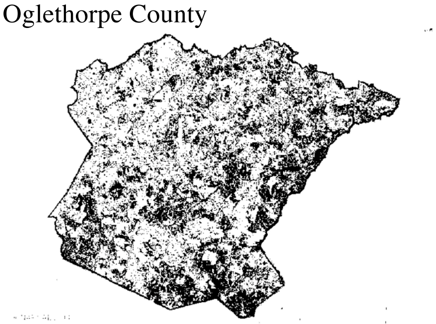


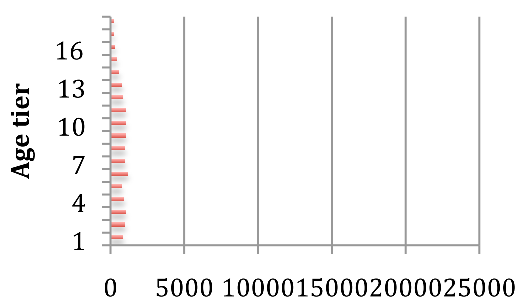
Population: 32,221



Oglethorpe County



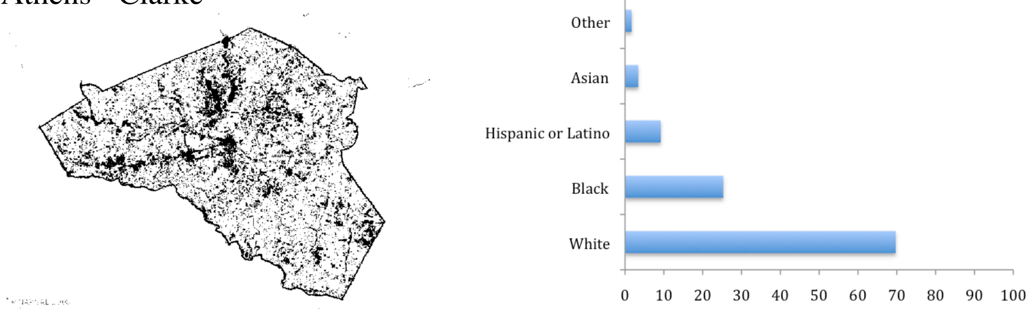
Population: 14,106



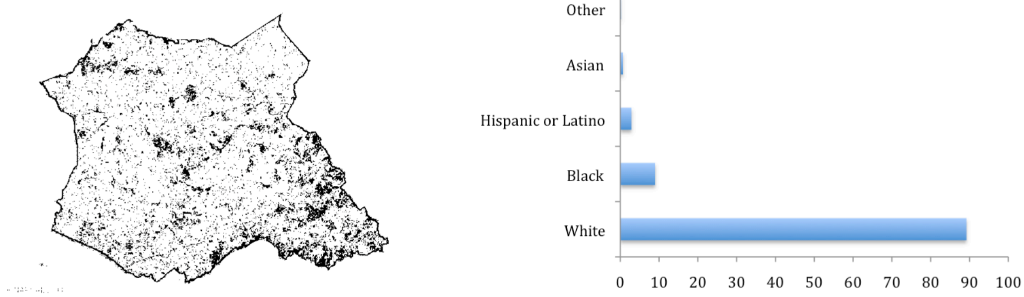
[27] www.quickfacts.census.gov
[28] Each age tier represents a 5-year interval (0 to 90+ years).

Table 28. Ethnic background by percent, study area. Source: US Census Quickfacts[29]

Athens - Clarke



Madison



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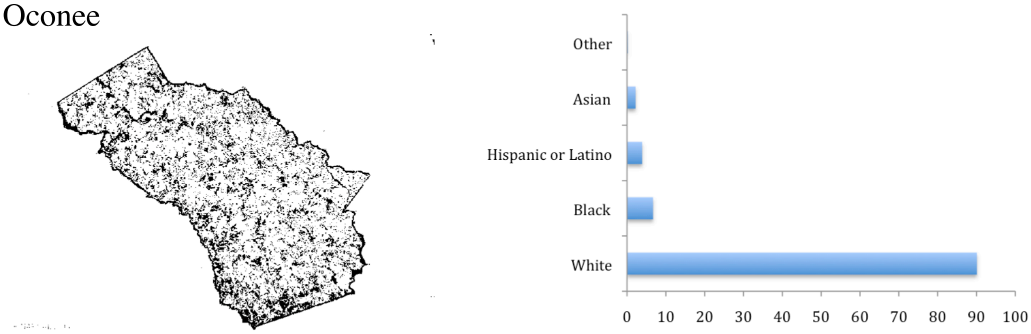
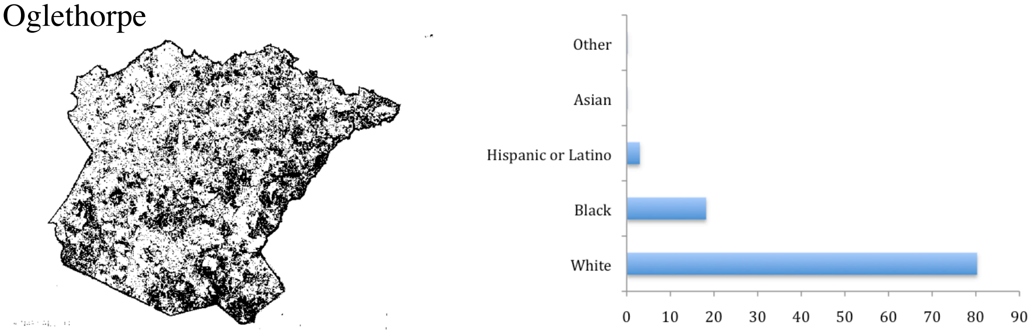


Oglethorpe



[29] www.quickfacts.census.gov